

A Strategy for Growing The Ohio Aerospace & Defense Industry



**Prepared for:
The Ohio Aerospace and Defense Advisory Council
&
The Ohio Department of Development, Technology Division**

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Preface

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EXECUTIVE SUMMARY

This report provides a strategic framework to guide the activities of the Ohio Aerospace and Defense Advisory Council (OADCAC). The OADAC provides advice to the Governor. Although OADAC does not have operational authority, the OADAC plays an important role in shaping and aligning State policy toward the aerospace and defense industries.

This report reaches the following conclusions:

- Ohio's aerospace and defense cluster includes a wide array of private companies, two major federal labs, sophisticated intermediary organizations, and strong research and education programs at our colleges and universities.
- Over 60,000 Ohioans are employed in this industry cluster, and these jobs pay nearly twice the average wage in the State. Aerospace and defense businesses represent a "crown jewel" of our industrial economy.
- These businesses face sophisticated, relentless competitive attack. This pressure creates a stark choice for the State: Unless Ohio invests aggressively in aerospace and defense, it is likely to lose its competitive position.
- The challenges faced by our aerospace and defense cluster are balanced by extraordinary opportunities. Ohio's wide range of assets and capabilities opens the door to new business opportunities. These opportunities are likely to emerge through expanded information sharing, collaboration and networking. In addition, Ohio's aerospace and defense industry needs more effective and sophisticated advocacy with federal, State and local initiatives.
- OADAC should focus on developing strategic initiatives in four areas:
 - Strategic Thrust 1: Build a deeper, more comprehensive strategy for Ohio's aerospace and defense industry and all its components: federal laboratories, large prime contractors, smaller component manufacturers, universities, and non-profit intermediaries.
 - Strategic Thrust 2: Create an industry database and information system that can be used to develop new business opportunities and linkages among companies, the federal labs, and universities. We do not completely understand our assets, and our current knowledge is fragmented. We need a comprehensive database that covers all aerospace and defense related companies in the State. New and exciting business development opportunities will likely arise at the intersections among companies, federal labs, and universities.



- Strategic Thrust 3: Strengthen, focus and align the resources of the Ohio Department of Development to support aerospace and defense businesses. Strategies should integrate promotion, attraction, retention and expansion activities to deepen connections between State initiatives and the competitive challenges facing Ohio's aerospace and defense businesses.
- Strategic Thrust 4: Create and support more effective advocacy at the federal and State levels for all components of the State's aerospace and defense industry.



Purpose and Methodology of Study

The Ohio Department of Development, The Governor's Ohio Aerospace and Defense Advisory Council (OADAC) and Ohio Aerospace Institute (OAI) engaged Kleinhenz and Associates in alliance with Cleveland State University's Center for Economic Development and the Center for Regional Economic Issues at Case to complete a comprehensive analysis and survey of Ohio's Aerospace and Defense industry. The purpose of this study is to provide critical information that combines industry input on issues, needs and opportunities with an in-depth statistical analysis. The intent is to integrate this information into a framework for actions, programs or policies that the State, the Ohio Aerospace and Defense Advisory Council and nonprofit intermediaries can pursue.

The research team used a multi-faceted approach to analyze Ohio's aerospace and defense industry. The first step was to define and understand the State's aerospace and defense industry through a detailed statistical analysis. This analysis defined the size of the State's aerospace and defense industry, identified its key segments and compared its employment, and wages to other Ohio industries. The analysis also assessed the competitiveness of the State's aerospace and defense industry, analyzing variables including employment, output and wages as compared to 11 States considered leaders in the aerospace and defense industry. Appendices C and D present this quantitative analysis.

The second step validated this quantitative output and initiated a discussion on the requirements and priorities to strengthen the State's aerospace and defense industry. Over 40 industry representatives participated in either interviews or roundtable discussions providing their perspectives on the evolution and direction of Ohio's aerospace and defense industry. Four roundtables each were conducted in Dayton and in Cleveland, with executives in aircraft engine manufacturing, aircraft parts manufacturing, air transportation (scheduled and nonscheduled) and support activities and services for air transportation. The roundtables captured perspectives on the industry's near and long-term prospects, Ohio's distinctive advantages, and priorities for action. A summary of selected comments from roundtable discussions is provided in Appendix A, and a full list of the participants appears in Appendix B.



An Overview: The Challenges Ahead

Ohio competes in a high stakes, global market: aerospace and defense. These businesses – sophisticated and prized – sit at the top of the pyramid in advanced industrial economies.

Ohio has a strong competitive position in aerospace and defense, but the industry is under sustained pressure from sophisticated, determined competitors both here and abroad. To respond effectively, Ohio needs new strategies and a stronger, more focused priority on building aerospace and defense businesses. The risks of inaction are high: Over 60,000 high paying Ohio jobs are at stake. These jobs pay nearly twice the average wage. They represent the “crown jewels” of our State economy.

At the same time, the aerospace and defense industry opportunities match the risks. Ohio enjoys an extraordinary array of innovative companies, anchor investments in federal labs, highly respected university research programs and sophisticated intermediary organizations. Combining these assets in different ways can give rise to exciting business opportunities and new, high paying jobs. Unlike many states facing the pressures of global competition, Ohio has strong capabilities that can be quickly leveraged.

Equally certain: Our competitors – both companies and governments – are not waiting for Ohio to respond. They are moving aggressively to build their aerospace and defense businesses. In more simple terms, Ohio cannot afford the luxury of time. We need to move now.

These conclusions reflect both the statistical evidence and wide ranging consultations with members of Ohio’s aerospace and defense industry. This report provides a framework for the Ohio Aerospace and Defense Advisory Council (OADAC). The OADAC advises Governor Taft. While the OADAC has no operating authority, it can provide valuable guidance by framing the policy choices.



The U.S. Aerospace Industry: Major Driver of the 21st Century Economy

We begin this report with comments from the Commission on the Future of the United States Aerospace Industry. Reporting two years ago, the Commission noted,

Aerospace will be at the core of America's leadership and strength in the 21st century. The role of aerospace in establishing America's global leadership was incontrovertibly proved in the last century. This industry opened up new frontiers to the world, such as freedom of flight and access to space. It provided products that defended our nation, sustained our economic prosperity and safeguarded the very freedoms we commonly enjoy as Americans. It has helped forge new inroads in medicine and science, and fathered the development of commercial products that have improved our quality of life. ¹

The Commission went on to explain:

The Commission's urgent purpose is to call attention to how the critical underpinnings of this nation's aerospace industry are showing signs of faltering—and to raise the alarm. This Nation has generously reaped the benefits of prior innovations in aerospace, but we have not been attentive to its health or its future.²

Among the important forces and issues facing the United States aerospace industry leadership, the Commission found:

- We take the benefits of aerospace leadership for granted. Meanwhile, foreign nations clearly recognize the potential benefits from aerospace and are attempting to wrest global leadership away from us.
- The U.S. is losing global market share and our positive balance of trade in aerospace manufacturing is eroding. Jobs are going overseas.
- Around the world, foreign competitors are aggressively implementing policies to take global aerospace leadership away from the United States. The European Union has a stated

1 Final Report of the Commission on the Future of the United States Aerospace Industry, p. v.

2 *ibid.*



policy objective of being the world's leader in aerospace by 2020. Asian nations are aggressively trying to capture the U.S. systems engineering and integration expertise needed to develop state-of-the-art aerospace systems.

- The aerospace workforce and infrastructure are aging. The industry is confronted with a graying workforce in science, engineering and manufacturing,

Industry representatives throughout Ohio share these concerns about the future of Ohio's aerospace and defense businesses. The aerospace and defense industries represent among the most sophisticated and vital businesses in Ohio today. After nearly six months of research and conversations among industry representatives, this report finds both tremendous optimism and widespread "pragmatic realism" that the State faces many challenges about the future.

Ohio Aerospace and Defense Industry Assets: Critical for Future Growth

Ohio is well positioned as a keystone of industrial aerospace and defense enterprises – from research to business development. The State's core strengths in aerospace and defense are built around four major components:

1. Federal investments -- Ohio has major investments by the federal government in leading research-based enterprises. These installations include NASA Glenn Research Center, and the Air Force Research Laboratory.
2. Sophisticated companies -- Major aerospace companies provide sophisticated research, product development and manufacturing capabilities in defense and aerospace. Sophisticated smaller companies have evolved within the State to supply larger companies. For example, GE Engines has one hundred suppliers in the State. These companies combined generate a deep pool of management and engineering talent within the State.
3. University assets – Ohio has 10 leading universities with dedicated doctoral level research and education programs in aerospace related disciplines. These research and education activities provide continuous support to the aerospace and defense industry.
4. Important intermediaries – Ohio has two aerospace and defense focused intermediaries, OAI and the Wright Brothers Institute (WBI) who advance and facilitate technology collaborations and education and training among Ohio's aerospace labs, industry and



universities.

From this position of strength, Ohio needs to embrace the brisk turbulence and not turn away. The future needs to be seen in terms of the opportunities it presents. The industry voices we heard sent a strong message of entrepreneurial spirit, innovation and collaboration. Yet they also warned that Ohio's aerospace industry is in a stage of transition; the time for strategic change is now and not after the transformation.

How then can Ohio match its strengths to the opportunities and challenges ahead? One fact is clear: Standing still means falling behind. Frequently, recruiters from outside Ohio are visiting our aerospace and defense companies with healthy incentive deals targeted to specific companies. The reason is simple. Aerospace and defense companies provide good jobs. They stand at the apex of advanced industrial economies. By virtue of our past success in aerospace, Ohio stands in the middle of this global battle. International competition is growing. Ohio companies face a serious, complex world of greater global market competition. As the Aerospace Commission report points out, foreign governments actively help their companies to succeed in the global marketplace.

How can Ohio become better organized to compete globally? Throughout our discussions, industry representatives voiced an unmistakable sense of concern, while also identifying opportunities.

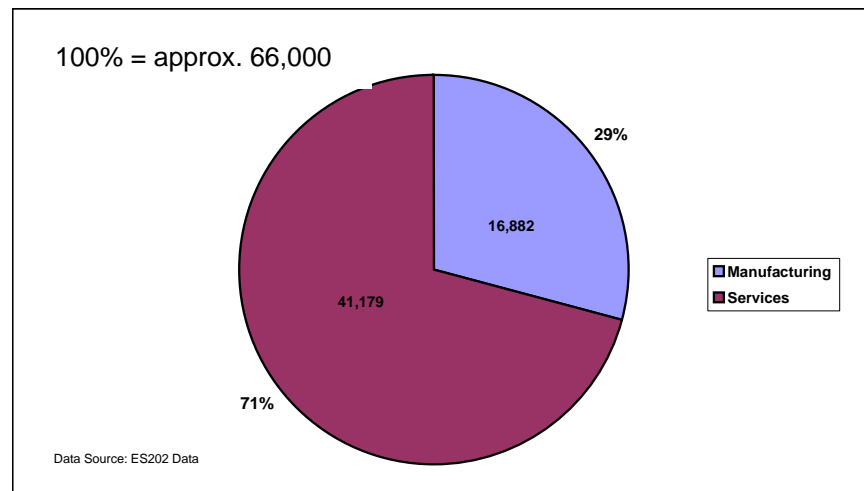
To explore these issues of Ohio's economic development, this report first provides an overview of Ohio's aerospace and defense businesses and the consequences in Ohio of the global restructuring occurring in aerospace. It next explores some of the core strengths of these businesses in Ohio. Finally, the report provides some specific recommendations that Ohio can take to strengthen our position in these global markets.

Where Ohio Stands

Ohio's aerospace and defense industry is categorized into two major groups: manufacturing and services. Within each broad category, Ohio companies compete in a range of segments.³

Over 60,000 Ohioans (excluding military personnel) work directly in aerospace and defense and it is likely that the number is larger.⁴ Seven out of ten of these jobs fall into services. About 41,000 people work in services, while 17,000 work in manufacturing. These jobs are spread across the State, primarily along the highway corridors linking Cleveland, Columbus, Dayton and Cincinnati.

Figure 2. Ohio's Aerospace and Defense Employment, 2003



Aerospace and defense in Ohio reported a net loss of employment between 2000 and 2003 of 1,500 workers or a 2.5 percent decrease. Competitive pressure falls disproportionately on our manufacturing sector. Between 2000 and 2003, Ohio lost about 11% of our manufacturing employment, a total of 2,100 jobs. In services, a slight gain of 600 jobs or about 1.4% was reported.

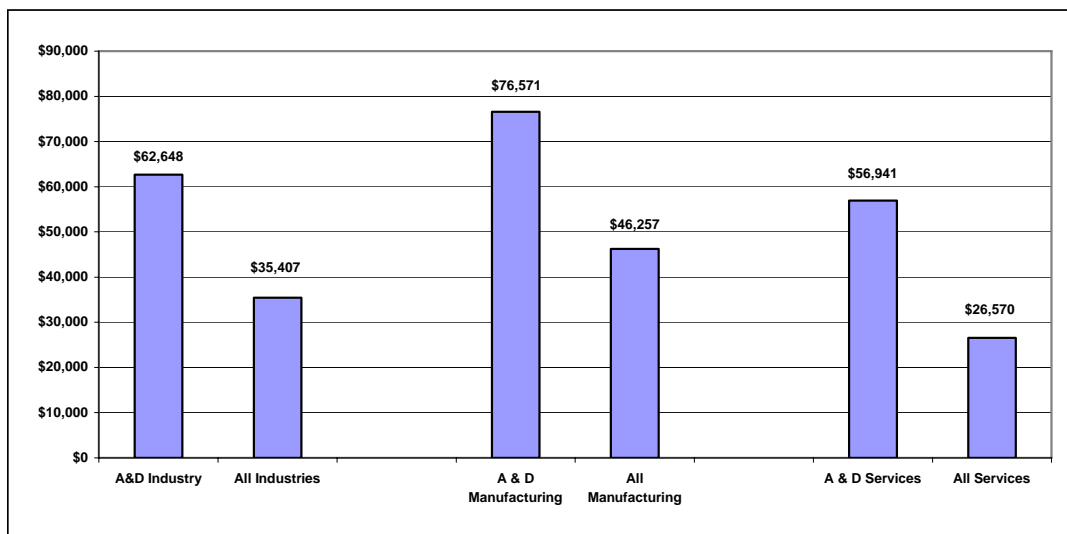
³ Additional background appears in Appendix C and Appendix D.

⁴ As noted in Appendix C footnote 13, there is a likelihood that Ohio's A&D industry actually had at least 66,000 workers in 2003. The three main reasons for this undercount are: 1) under-reporting the number of civilian personnel at national security facilities such as Wright Patterson Air Force Base 2) misclassified companies under NAICS codes, i.e., companies that should be classified under one of the A & D NAICS codes but were not, and 3) firms that create aerospace and aviation products but are not classified under aerospace and defense NAICS codes because aerospace and defense is not the firm's primary product or service. NAICS classification methods only permits a firm to assign an industry code based on its primary product produced or distributed, even though the firm may perform more than one activity. Therefore, there are many companies that produce aerospace and aviation goods and services but are not classified in the A & D industry because these are not the firm's primary activities. The primary product classification is determined by relative share of production costs or capital investment in the firm. Please see Appendix E for an explanation on the source data used in this report.



Aerospace and defense jobs sit on the top of the economic development pyramid. As shown in Figure 3, the average wage paid to all aerospace and defense workers across the State of Ohio in 2003 was significantly higher than the average wage paid to Ohio workers in all industries - \$62,600 vs. \$35,400. Wages paid to aerospace and defense manufacturing workers were 65 percent higher than the average wage paid to all manufacturing workers across Ohio—\$76,600 vs. \$46,300. Employees in aerospace and defense services reported more than twice the earnings as workers in all other service-related industries—\$56,900 vs. \$26,600. These high wage jobs have positive effects on the local and State economies. They increase purchasing power by households, which in turn helps create additional jobs, increase tax revenues for governmental entities including school districts, and increase levels of savings and investment

Figure 3. Ohio's Aerospace and Defense Wages in Comparison to Wages in All Ohio Industries, 2003



Aerospace and Defense: A 12 State Comparison

As the Aerospace Commission noted, global competition is placing enormous pressure on the U.S. aerospace and defense industries. This pressure is most evident when we focus on twelve key states, including Ohio, that are considered leaders in the aerospace and defense industry and account for almost two thirds of the total aerospace and defense workforce in the nation. The combined private sector aerospace and defense employment in the 12 comparative states

accounted for almost two-thirds of the total A&D workforce (excluding military personnel) across the U.S. in 2002. California and Texas reported the highest employment levels with 154,000 and 123,000 workers, respectively. Ohio ranked 12th with 35,000 A&D workers. In comparison, Ohio is ranked 7th nationally in total employment. Figure 4 shows private sector A&D employment in Ohio and other comparable states. (See discussion in Appendix C)

Figure 4. Private Sector A&D Employment in Ohio and Other Comparable States, 2002

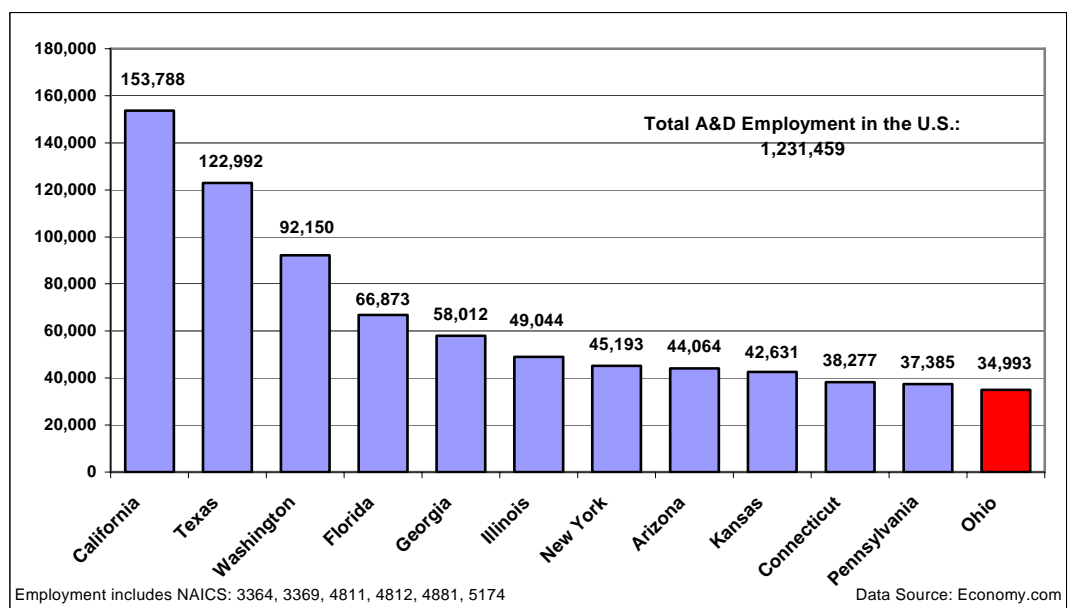


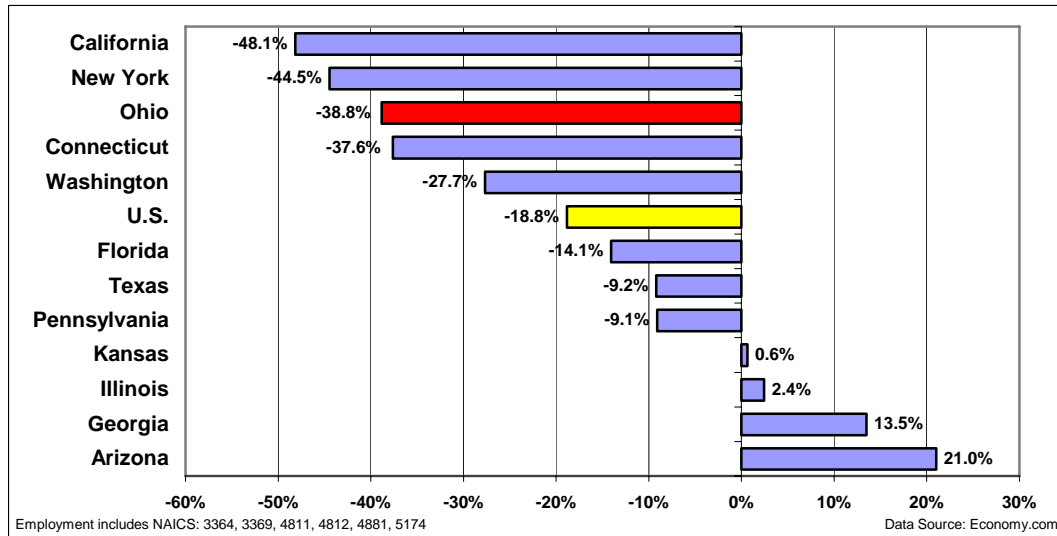
Figure 5 below summarizes A&D employment change within the U.S. and comparable states. Between 1990 and 2002, Ohio's aerospace and defense employment decreased by 38.8 percent. Ohio reported the third largest loss across the 12 comparable states and it was twice the national rate. This decline, while not shown, is due to a significant loss in manufacturing employment⁵ of 58 percent that was partially offset by a 42 percent gain in aerospace and defense services employment.⁶ (A more complete discussion is provided in Appendix C pages 49 and 50.)

⁵ The A&D manufacturing sector consists of NAICS 3364 and NAICS 3369.

⁶ The A&D services sector consists of NAICS 4811, NAICS 4812, NAICS 4881, and NAICS 5174.



Figure 5. A&D Private Sector Employment Change in Ohio and Comparable States, 1990-2002



Across these states, Ohio remains at a pivot point of the new era global aerospace competition. Although Ohio lost significant aerospace and defense employment during the 1990s, the State remains in the forefront of some highly sophisticated industry segments – jet engines, military armored vehicles and space research and technology. In 2002, Ohio ranked 1st among the 12 comparable states in private sector aerospace and defense manufacturing value-added at \$199,500 per employee, nearly double the national average of \$101,300. Ohio also reported significant employment concentrations in four aerospace and defense industries: aircraft engines and parts (3 times greater than found on average across the U.S.), nonscheduled chartered passenger air service (2.7 times greater than found on average across the U.S.), space research and technology (2.7 times greater than found on average across the U.S.), and military armored vehicles and tanks (2.3 times greater than found on average across the U.S.).

The combination of high value-added, high wages and significant employment concentrations gives Ohio a distinct competitive advantage that includes a business climate that can support globally competitive industries. Yet, Ohio needs substantial resources to respond to the heightened turbulence in the aerospace and defense markets. No market segment in aerospace and defense is sheltered from the strong winds of change.



Ohio's Advantages and Challenges in Aerospace and Defense

In our discussions with industry representatives, we learned that Ohio has several distinctive advantages:

- Ohio has an extraordinary federally funded asset base on which to build for future industry growth -- Wright Patterson Air Force Base with its Air Force Research Laboratory and the NASA Glenn Research Center.
- Ohio has a strong array of sophisticated aerospace companies, including larger companies such as General Electric Aircraft Engines, Goodrich, and Parker Hannifin as well as rapidly innovating smaller companies.
- One of Ohio's strengths in innovation comes from our strong collection of private and public universities. Higher education provides rich resources of brainpower and technical expertise for employment and support of these industries. If properly connected and invested with the State's strong concentration of aerospace and aerospace related industries, higher education can play a powerful role in determining the rate of innovation in the State.
- Ohio has two important intermediaries, the Ohio Aerospace Institute and the Wright Brothers Institute, that advance and facilitate technology collaborations and education and training among Ohio's Federal labs, companies and universities. These organizations also work closely with regional technology coalitions (e.g. Dayton Development Coalition, NorTech). In addition, the Ohio Edison Centers provide a critical infrastructure throughout the State that enhances the prosperity of the State as a whole and the aerospace and defense industry in particular.

Industry representatives pointed out that weak ties and an inadequate knowledge of our assets undercut Ohio's strengths. The State could do much more by expanding collaborations and leveraging its resources.

- The State lacks an integrated statewide strategy, which weakens Ohio's message in Washington and results in lost opportunities to build a more competitive aerospace and defense cluster. The State needs to strengthen, focus and align connections among the federal research labs, Ohio's universities and private sector companies to strengthen and grow the current industry base and to generate more spin-offs that extend our competitive



advantage into the future.

- Companies within Ohio's aerospace and defense industry cluster are generally unaware of other activities and initiatives within the cluster. For example, many of the companies who participated at the roundtable group discussions were meeting each other for the first time. Additional efforts that link companies and identify business opportunities are needed.
- Finding key information and locating resources within state government is seen as difficult. So too, accessible information on our university-based research and training is viewed as a shortcoming. Ohio needs improved communications, a menu of offerings and user-friendly access points so that companies can find out what is available.

At the same time we also learned that Ohio is missing potential business opportunities because of relatively weak collaborations across the aerospace and defense sector. While it is impossible to gauge the extent of these opportunities, two different dimensions were apparent:

- Business development opportunities can arise from closer coordination between larger companies and supplier companies. One large company representative pointed to the opportunity to have smaller companies work collaboratively to solve sophisticated product problems. These collaborations among smaller, entrepreneurial companies can then lead to new business opportunities.
- Business opportunities can also arise between aerospace and defense companies and companies in unrelated areas, such as health care. Firms noted that air delivery services, when combined with sophisticated health care technology, can lead to the development of entirely new business segments.



Industry and Market Sector Trends

Strong winds of change are sweeping through the aerospace and defense industries. As cost pressures increase, businesses are merging and shifting alliances. Foreign companies, often supported by direct government intervention, are moving into market segments long dominated by U.S. firms. Sophisticated technology is migrating to new low-cost production bases in Eastern Europe and Asia. Sophisticated logistics integration expands the opportunities for companies to find production partners in foreign countries. The competitive pressure felt by large, integrated companies ripples through the entire supply chain. No company, however small, can escape the turbulence.

Equally serious, a number of U.S. states and Canada are working aggressively to build their aerospace and defense industrial base. Economic development officials from these states are launching frequent recruiting initiatives to lure Ohio-based companies. In our discussions, the executive at one small company related the story of a recent visit from an industrial recruiter from a neighboring state. The Ohio CEO was surprised by the sophistication of the proposal he received. It was clear to him that the recruiters had "done their homework". At the same time, the CEO said that he was unaware as to what Ohio programs might be of assistance to his firm.

Intense competition is healthy. It drives innovation and efficiencies. At the same time, we need to recognize that some level of competition in aerospace and defense markets is distorted by direct government intervention. Ohio needs to respond to these pressures with tighter collaborations, more effective networks of innovation and state and regional assistance.

Large companies such as General Electric and Goodrich have extensive supplier networks throughout the State. Several industry representatives suggested that expanded networks among the suppliers could accelerate innovation. These executives expressed interest in participating in expanded business networks.

Finally, a number of industry representatives pointed to the valuable contribution that Ohio's colleges and universities make to the competitiveness of our aerospace and defense industry. These contributions range from providing technical training to conducting advanced research. Several industry representatives pointed to the importance of expanding these collaborations. These partnerships enhance the productivity and flexibility of Ohio's companies.



Ohio needs substantial resources to respond to heightened turbulence in the aerospace and defense markets. No market segment in aerospace and defense is sheltered from the strong winds of change. A brief overview of the changes sweeping these markets follows.

Commercial Aviation

- The commercial aviation market has experienced significant uncertainty -- consolidation, globalization, 9/11, and slow growth. This continuing uncertainty is pushing off aircraft purchases.
- Major commercial airlines are facing relentless competition from low cost business models: Southwest and Jet Blue, but these new low cost carriers are not spurring major new demands for aircraft. At the same time, these new carriers are placing competitive pressure on parts suppliers to lower costs while maintaining extraordinarily high service levels. They are effectively shifting maintenance costs back on to their suppliers.
- Persistent speculation that one of the major hub-and-spoke carriers will be forced to liquidate which would weaken Ohio's air transportation services.

General Aviation

- Steady growth, pushed by business demand, makes this market increasingly attractive. Business jets offer increased convenience to business travelers by circumventing screening at major airports.
- There is an emerging potential for an air taxi market, and other states are aggressively moving on this market. For example, Indiana is moving to develop businesses around on-demand, point-to-point, and affordable jet travel.⁷

Air Cargo

- Ohio's competitive position is strengthened by DHL's decision to keep Wilmington as its principal hub for overnight letter and package deliveries to North America. DHL plans to invest \$350 million to upgrade the existing Wilmington airport as the base for sorting operations and nightly delivery flights.
- At the same time, new business models of integrated logistics, inventory management and manufacturing may create new opportunities for Ohio in air freight. For example, through its

⁷ See Indiana's Small Aircraft Transportation Systems web site at <http://www.insats.org/>



facility at the Louisville airport, UPS Logistics Group offers customers a “total systems solution” that includes “pick, pack and ship” capability for business and generates additional jobs.⁸

- Other markets are also emerging, for example, “point-to-point”, time sensitive deliveries of medical isotopes, and cell therapies that create the potential to integrate medical production facilities near airports.

Aircraft Parts for Defense

- Tremendous uncertainty exists in military aircraft manufacturing.⁹ Defense budgets are significantly constrained with funding going to operations and not modernization. Thus, new platform development and procurement is not fully funded and has been deferred. There is a need to fully fund or restructure the investments. Major uncertainty is arising from acquisition schedules. This uncertainty ripples through the entire industry from the large prime contractors to the small business suppliers.
- At the same time, the repair and maintenance market for existing aircraft platforms remains strong because of the military’s need to maintain high levels of operational readiness. Older platforms are being stretched to meet the increased demands. Increased research investment is occurring in extending the life of aging aircraft

Aircraft Parts for Commercial Markets

- The outlook in commercial markets is also subject to uncertainty with two very different views of future aircraft development. Boeing is pushing the 787 Dreamliner with 289 passengers, while Airbus A380 has developed the Super jumbo, carrying 555 passengers.
- Original equipment manufacturers (OEM’s) are looking for increased supplier integration of parts into subsystems and systems. This pressure forces smaller parts firms to partner to provide systems solutions.
- Pressure from low cost production bases in China and Eastern Europe will be relentless. Major component suppliers are accelerating the trend by transferring sophisticated technologies and equipment to these low cost markets.

⁸ See “UPS Logistics provides variety of services at local center “, Business First, April 19, 2002, available at <http://louisville.bizjournals.com/louisville/stories/2002/04/22/story5.html>

⁹ For an overview, see “Aerospace: Preparing For A Descent” Business Week, January 10, 2005 available at http://www.businessweek.com/magazine/content/05_02/b3915413.htm



- Due to the pressures to integrate and the increased competition from low cost production facilities in Eastern Europe and China, businesses in Ohio face tremendous cost competition requiring them to transfer some operations abroad.
- Some parts suppliers are concerned that foreign competition supported by foreign government policies are undercutting their competitive position. In effect, they are echoing the concerns raised by the Commission on the Future of the United States Aerospace Industry.¹⁰

Jet Engines for Commercial Markets

- GE is in a strong position as a supplier to Boeing's 787 project. GE is also a supplier to the Airbus super jumbo through an alliance with Pratt & Whitney. At the same time, Rolls Royce has made aggressive moves in the US and World markets.
- Aggressive research and development investment drives this market. Industry observers believe that commercial market share is directly connected to a company's R&D investments. Ohio can support US engine manufacturing maintaining a leadership position by reinforcing the importance of research and development at both the state and federal levels.
- GE is committed to Ohio, but not complacent about the future. Its primary competitor, Rolls Royce, is a sophisticated company and a tough competitor. A Rolls Royce division -- Allison Advanced Development Co. -- works on advanced propulsion systems from offices in Indianapolis. Rolls Royce is funding a university technology center at Purdue University. Rolls Royce has 19 university technology centers in the United Kingdom and one in Sweden.
- At the same time, there is concern about complacency at the federal level. Some federal officials believe that turbine engine technology is "mature" with relatively little returns for increased R&D investment. Most industry executives and university researchers strongly dispute this view. In GE's case, corporate leadership has made strong commitments to expanding investment in turbine engines.
- GE understands that its competitive position in this market is driven by R&D investment. Failure to aggressively invest in R&D translates directly into market share erosion. GE sees a new frontier in "green engine" technology to reduce noise and emissions from

¹⁰ As the Commission noted, "We also must work bilaterally and multilaterally to get foreign governments out of the business of commercial 'product launch.'" Aerospace Commission, op.cit., p. 15.



commercial jet aircraft. This market is already emerging in Europe, and GE expects this pressure to build in the U.S.

Meeting these challenges requires a high level of collaboration. Alongside creating a competitive cost environment for all businesses, industry representatives believe that collectively we can encourage a business climate of more effective collaboration. Success in the aerospace and defense businesses increasingly requires partnerships to drive quality through the supply chain; to form joint ventures with partners who have complementary skills and technologies; to work with universities; and to learn from others by benchmarking.

State government can act as a catalyst to encourage the collaboration to compete. Connecticut's Aerospace Components Manufacturers (ACM) provides a good example. Part of the State's cluster development initiatives, ACM is a non-profit partnership in which companies work together as a network. According to the ACM, "Member companies collectively offer broader capabilities than they could as individuals. ACM helps capture new business opportunities for Connecticut's aerospace industry".¹¹

¹¹ See ACM information available at <http://www.aerospacecomponents.org/about.html>



Recommendations to Strengthen Ohio's Position

One fact is clear: in the turbulent markets of aerospace and defense, standing still means falling behind. Ohio faces a number of significant challenges ahead:

- Ohio's smaller aerospace companies are the targets of sophisticated recruitment efforts by other states. If we neglect the growing needs of these smaller firms, they will be increasingly vulnerable to recruitment drives. Smaller firms need help innovating and identifying new business opportunities, and Ohio has significant resources in place to help these firms. Yet, we learned that we could make these linkages stronger and more responsive.
- The emergence of increasingly sophisticated low cost production bases in China and Eastern Europe place relentless cost pressures on Ohio firms. To survive, Ohio firms must move "up the ladder" to increasingly sophisticated design, production, and systems integration. Moving away from "pieces and parts" manufacturing and toward more sophisticated product development and systems integration requires tighter networks of collaboration and access to more advanced technical resources, people, and programs.
- Innovation will arise from much closer coordination among firms, state government and colleges and universities. Other states are moving to integrate and focus their aerospace and defense resources. For example, Indiana is moving aggressively to build its university-based research activities at Purdue. Led by Ohio State, the Ohio Center for Advanced Propulsion and Power (OCAPP) is a newly created research center that focuses on military and commercial aero propulsion. While this new center brings together Ohio's significant aerospace resources, it is not the complete solution to innovation.
- Demographics are working against the aerospace and defense sector. If ignored, an aging workforce will weaken Ohio's position as retirements accelerate in skilled production and design occupations. Ohio has the college and university base we need to respond, but we need to market career pathways, especially in manufacturing, to young people.

Working together, the Department of Development, industry, intermediary organizations, and our colleges and universities can build tighter collaboration and focus assistance toward Ohio's aerospace and defense cluster. We recommend focusing on the following four strategic thrusts:



Strategic Thrust 1: Build a deeper, more comprehensive strategy for Ohio’s aerospace and defense industry and all its components: federal laboratories, large prime contractors, smaller component manufacturers, universities, and non-profit intermediaries.

This strategy translates into activities by the State such as:

1. Engaging all components of Ohio's aerospace and defense industry to develop and implement an “Ohio Strategy for Aerospace and Defense”. The State should develop a process that focuses resources on practical initiatives to build competitiveness and to define actions that the State should take to strengthen and grow the aerospace and defense industry in Ohio. By updating the strategy regularly, Ohio's aerospace and defense partners can build collaborations across the State.
2. Establishing benchmarks. Benchmarking provides a valuable tool to assess where we stand relative to best practices. A benchmarking report on what other states are doing to promote aerospace and defense will help us define and evaluate our new statewide strategy. This report can serve as a practical “bridging document” to identify effective initiatives underway elsewhere that could be implemented in Ohio.
3. Creating stronger public awareness of the opportunities in aerospace and defense, especially among young people. The future of aerospace and defense in Ohio will depend on continuing to attract the best young minds into all phases of research, business development, operations, marketing and service.
4. Educating government officials at all levels on the importance of Ohio’s aerospace and defense industry, on what the State can do for industry and on the need for government and private sector support of a comprehensive strategy.



Strategic Thrust 2: Create an industry database and information system that can be used to develop new business opportunities and linkages among companies, the federal labs, and universities. We do not completely understand our assets; and our current knowledge is fragmented. We need a comprehensive database that covers all aerospace and defense related companies in the State. New and exciting business development opportunities will likely arise at the intersections among companies, federal labs, and universities.

This strategy translates into activities such as:

1. Building, maintaining and marketing a database of Ohio aerospace and defense companies. During the course of our research, we learned that no one has a complete list of companies engaged in aerospace and defense markets. Additionally, existing databases do not always have current contact information or accurate descriptions of products and capabilities. To assist in developing this database, several companies have expressed a willingness to share their supplier information. It is recognized that creating and maintaining a comprehensive, user-friendly database would require dedicated resources and investment.
2. Developing new mechanisms to share information on capabilities and best practices that can help Ohio companies become more productive and innovative. OAI and the Air Force Research Laboratory have developed a collaborative software platform, *The Collaborator*, that could be customized to meet the needs of our aerospace companies. In addition, Ohio could follow Connecticut's lead by developing an aggressive program for implementing lean enterprise practices and conducting ongoing workforce training and development. OAI is launching a small business network for aerospace companies in the State and could be well positioned to assist in this need.
3. Expanding interaction among firms. We can provide significant business development opportunities arising at the intersections of firm capabilities. During the course of the business roundtables conducted, we were impressed 1) by how few industry representatives in Ohio knew each other; and 2) how quickly ideas arose for combining capabilities to create new opportunities. In combination with a comprehensive database, networking events can provide a low cost way to build connections among firms. Major companies in the State have offered to help facilitate these networking events by sharing their list of Ohio-based suppliers.



Strategic Thrust 3: Strengthen, focus and align the resources of the Ohio Department of Development to support aerospace and defense businesses. Strategies should integrate promotion, attraction, retention and expansion activities to deepen connections between State initiatives and the competitive challenges facing Ohio’s aerospace and defense businesses.

This strategy translates into activities such as:

1. Making ODOD’s economic development services on its website more “user friendly” by building a customized “front-end” to ODOD’s web site for key industries such as aerospace and defense. Ohio already has a wide array of services to support aerospace and defense businesses. Through our focus groups, however, we found that smaller companies especially have trouble navigating State programs. ODOD should develop leading edge, customer friendly sites to guide aerospace companies. Wisconsin and Kentucky are experimenting with front-end sites that could be a guide.¹²
2. Increasing ODOD’s awareness of the aerospace and defense industry by conducting regular interviews and surveys with company executives to understand the competitive challenges they face and surface ideas on how the State might help. For example, following up on the ideas expressed by industry representatives in the focus groups. These ideas are outlined in more detail in Appendix B.
3. Marketing and promotion by ODOD that emphasizes the State’s strengths in aerospace and defense such that the industry’s reputation is co-equal to the State’s capabilities and assets. Telling the story of Ohio’s Aerospace Industry. Implement strategic communications that focus on attracting firms and talent to the State, and also on bringing business to existing companies. Integrate ODOD’s marketing and promotion activities with regional intermediaries such as the Dayton Development Coalition or Team NEO to leverage local attraction, retention and expansion activities.

¹² See, for example Kentucky’s Entrepreneur Resource Navigator available at <http://www.ced.ky.gov/smbd/ern.asp> and the Wisconsin Business Wizard available at <http://www.wisconsin.gov/state/app/wizard/LoadIntro>



Strategic Thrust 4: Create and support more effective advocacy at the federal and state levels for all components of the State's aerospace and defense industry.

This strategy translates into activities such as:

1. Effective advocacy at the federal level begins with clear priorities and alignment. As such, Ohio needs a convening function, e.g. OADAC, to bring together all components of our aerospace and defense cluster to identify the most productive Federal investments and actions for the State. This convening and coordinating process can itself be valuable in terms of responding with an effective advocacy program to address the areas of interest. We are not suggesting that this effort replace local advocacy efforts. Rather, we believe that there is significant support for moving this advocacy to the next level by more effective coordination.
2. Effective advocacy at the State level first requires creation and adoption of a comprehensive State strategy as recommended above in strategic thrust one. Advocacy activities should then focus on educating and informing the State of Ohio's policy makers on specific programs, projects and investment required to achieve a successful statewide Aerospace and Defense strategy. Organizing various Aerospace and Defense firms to help shape the statewide strategy and to be directly involved with state advocacy activities should also be a primary objective of state advocacy efforts.



Appendix A: Industry Observations and Suggested Actions

We have assembled the following comments from roundtable discussions with industry representatives in Cleveland and Dayton. A full list of the participants appears in Appendix B.

Ohio's Industry Environment:

- Ohio needs a menu of offerings and entry points so that companies can find what is available. Companies are likely to face more turbulence ahead. e.g. A small company that lost 35% of its business when Honeywell moved its business to supplier in Czech Republic
- We need to communicate to the workers that the underlying markets in commercial aircraft are sick. The major carriers are under tremendous cost pressure. They are putting their suppliers under tremendous cost pressure and opening up new networks for global sourcing. In Eastern Europe – e.g., Czech Republic – assembly hourly wage is \$4 and engineer hourly wage is \$8. These workforces are being trained in the latest production techniques. Compare US workers getting from \$13.00 - \$14.00 to \$17.00 - \$18.00 per hour. The answer is not to lower wages but to increase productivity. To do that, you need more flexible work rules to implement lean manufacturing.
- Large suppliers are dumping the latest equipment into these low labor cost markets.
- Currently, Ohio companies are isolated from one another. We are not using the network that is available to us. This network is vast: GE, Goodrich, Wright Pat.
- We need leadership to provide education about the challenges ahead and leadership to build the networks we need. Innovation should be the organizing principle:
 - Company leaders need help in communicating the importance of innovation and productivity
 - We need to over communicate by a factor of 10



- There is a big disconnect between what is happening in the marketplace and what workers understand on the plant floor.
- Our training needs are relentless.
- We also might benefit from having a big goal. e.g., can we pull Ohio's resources together to build an engine that is competitive to Honda's new engine?

Ohio has major assets on which to build:

- Work ethic is strong in Ohio. This translates into low turnover rates
- Central location helps
- Established supplier base helps
- Major legacy investments creates major anchors in the State
- State has one of the best run manufacturing programs. A strong infrastructure of support. Example: TechSolve provides access to high power engineering and technical help.
 - Note however, the programs are not flexible, well advertised and may be too bureaucratic. Example: Skilled trades a problem. We need welders. State can help with establishing an apprentice program, but we have to fill out a fifty-page application. What is the sense of that?
- Skilled pools of labor
- Strong support in colleges and universities. Experts are located who can give answers to specific technical problems
- OAI with Air Force Research Lab has developed a computer program called *The Collaborator* to make connections between the Air Force and external researchers. This program is designed for the Air Force, but it could be applied in other situations.

Ohio's Constraints:

- Complex environmental regulations place burden on small, innovative companies. Example: We are trying to move into titanium brackets. The environmental expertise that we have to have to move into this area – just to answer the threshold question of “Is there a business here?” – is prohibitive. We need some help here. We need



expertise of people who know how to navigate the system. There are consultants who do this, but they are expensive.

- We need in-house training
- Canadian companies are moving aggressively. They have subsidies and have moved aggressively into landing gear production. (They are targeting key subsystems.)

Some recommended steps:

- Define the universe of companies
 - Skeptical that the universe we have defined from government data is complete. There may be 3X to 4X as many companies.
 - Get these companies through SBA's Pro-net database
 - Appeal to companies to share their list of certified suppliers based in Ohio.
- Conduct an Internet-based survey to test hypotheses
 - Are companies aware of the services available?
 - Do services in Ohio compare favorably to other states? (Ask companies with location in other states)
 - Is there interest in establishing a state-based association like Connecticut and Washington State?
- Define a clear value proposition for Ohio
 - Focus on geographic issues
 - Assist small firms unite their voice in Columbus
 - Offer education on what firms are doing to become more competitive. Learn across industries
- Conduct 4 meetings a year. Sample agenda:
 - Legislative issues
 - Industry trends
 - DOD, Wright Pat, NASA issues
 - Services available from the State
 - Executive level workshops around specific topics, e.g., export controls



- Tell the story of Ohio's Aerospace industry. Communicate the story (Note: AIA may provide a base off which to build.)

- From the top down:
 - Organize both formal and informal leadership groups for the industry. Formal leader are big name profiles: e.g., Governor, Senator Glenn
 - Develop consensus on an agenda for the State
 - Communicate a plan and a vision. Focus on main themes of global competition and Ohio's ability to respond through innovation

- From the bottom up:
 - Develop networks and informal leadership; Informal networks emerge from company leaders committed to change
 - Focus on the short-term challenges: Training in six sigma and lean manufacturing. (Note: This is a main focus of the cluster in Connecticut.)

- From the middle out:
 - Develop alignment of financial and other resources with goals
 - Maintain a network database. Who are the players? What does the network look like?

- There are two basic strategic thrusts:
 - Offensive. Bring business into the State based on our innovative capacity
 - Defensive: Help companies become more productive and innovative. Build awareness of Ohio Aerospace. Sponsor company audits on best practices, education

- Develop an aerospace trade group based in Ohio

- One potential organizing technique: Make a problem visible and let the network self-organize. Example: Honeywell suppliers are shown fifteen major problems that Honeywell was having. The big question: can any of you help us solve this? A group of suggestions emerged in response. The same approach could be used here.



Appendix B: Industry Roundtable Participants

Aircraft Engines and Engine Parts:

Al Bonacci	BAE Systems
Carol Cash	GE Aircraft Engines
John Cherr	Argo-Tech Corporation
Ernest D'Amico	Goodrich Aerospace
Gary Horvath	Welded Ring Products Company
Suhas Kakde	US Aeroteam Inc.
Allan Slattery	Aero Propulsion Support Inc.
Al Tusek Marine	Mechanical Corporation
Bob Weideman	Boeing Guidance and Repair Center
Rick Platt	Heath-Newaek-Licking County Port Authority
Gayle Gorman	Freeman Manairco.Inc

Aircraft Parts and Equipment, NEC:

Don Benincasa	All Tools Inc.
Charles Brougher	Eagle Tool & Machine Co., Inc
Theunis Botha	Goodrich - Landing Gear
Thomas Eller	Honeywell
Joseph Murphy	Ferco Tech Corporation
Jeff Rolf	Parker Hannifin
Ken Greene	Tronair, Inc.
John Grisik	Goodrich - Landing Gear
Oscar Mifsud	Aero-Instruments
Ryan Mifsud	Aero-Instruments
Michael Wellham	RTI International

Airport Transportation, Scheduled & Airport Transportation, Nonscheduled:

Joel Biggerstaff	Airnet Systems Inc.
Rod Crane	Med Flight
Ramesh Mehan	Innovative Aviation Systems



Airports, Flying Fields and Services:

Pamela Brown	America Airlines
Craig Bevington	National Flight Services, Inc.
Robert Gray	ABX Air
Richard Hale	Winner Aviation Corporation
Regina Roberts Holman	Department of Aviation
Frederick Krum	Akron-Canton Regional Airport
John Mok	Cleveland Hopkins International Airport
Brad Primm	Air Services of Cleveland
Barbara Schempf	Cincinnati/Northern Kentucky International Airport

Interview Participants:

Mike Benzakein	GE Aircraft Engines
Terry Bosserman, Sr.	Bosserman Aviation Equipment
Keith Deters	Joint Systems Manufacturing Center at Lima (General Dynamics)
Tony Granthom	America West Airlines
John J. Grisik	Goodrich Corporation
Douglas Moseley	Aircraft Braking Systems Corporation
Frank Nichols	Parker Hannifin Corporation
Rick Stanley	GE Aircraft Engines - Engineering Systems
Thomas Walker	GE Aircraft Engines - Engineering Systems



Appendix C: A Characterization of Ohio's Aerospace And Defense Industries

Methodology

This section provides an analytical characterization of Ohio's aerospace and defense (A&D) industry. It begins by defining (segmenting) the industry using a model developed by the Commission on the Future of the U.S. Aerospace Industry. This is followed by a discussion of the data sources used in the quantitative analysis—ES202 and Economy.com. Key messages that were derived from the industry analysis are then presented. Next, is a detailed analysis of the industry from two perspectives. The first characterizes the A&D industry within the state of Ohio using employment and wage data. Ohio's private sector A&D industry is then compared against the 11 leading aerospace and defense states in the U.S. This analysis includes discussions on private sector employment levels, output, value-added, and wages. Finally, detailed data tables are provided for all economic variables included in the discussions.



Defining the Aerospace and Defense Industry (Segmentation):

The aerospace and defense industry segmentation used in this analysis is based on a framework found in the final report issued by the *Commission on the Future of the U.S. Aerospace Industry*.¹³ The framework was modified to include defense-related organizations and to more accurately reflect the industry structure, as it exists in the state of Ohio. The industry is divided into two broad segments—aerospace and defense manufacturing and aerospace and defense services. The manufacturing segment includes four sub-segments: aerospace product and parts; aircraft and missile propulsion; search, detection, navigation, guidance, aeronautical, and nautical systems; and defense. The services segment includes six sub-segments: air transportation; support activities for air transportation; satellite communications; flight training schools; space research and technology; and national security. Tables 1 and 2 detail industry sub-segments by NAICS code and characterize them by employment level and number of establishments in Ohio.

Table C- 1: Ohio Aerospace and Defense Manufacturing Segment, 2003

NAICS		Employment	Establishments
	Aerospace Products and Parts	4,373	65
336411	Aircraft	119	6
336413	Other Aircraft Parts & Auxiliary Equipment	4,254	59
336414	Guided Missiles and Space Vehicles	0	0
336419	Other Missile & Space Vehicle Parts & Equipment	0	0
	Aircraft & Missile Propulsion	10,506	49
336412	Aircraft Engine and Parts	10,506	49
336415	Guided Missile & Space Vehicle Propulsion Units	0	0
334511	Search, Detection, Navigation, Guidance, Aeronautical	722	14
	AEROSPACE SUBTOTAL	15,601	128
	Defense		
332992	Small Arms Ammunition	137	8
332993	Ammunition	286	1
332994	Small Arms	5	3
332995	Other Ordnance and Accessories	57	5
336992	Military Armored Vehicle, Tank & Tank Components	796	4
	DEFENSE SUBTOTAL	1,281	21
	MANUFACTURING TOTAL	16,882	149

Data Source: ES202 Data (see section titled *Data Sources* for a detailed description of ES202 data)

Table C- 2. Ohio Aerospace and Defense Services Segment, 2003

¹³ The *Commission on the Future of the U.S. Aerospace Industry* was established by Section 1092 of the Floyd D. Spence National Defense Authorization Act for fiscal year 2001, Public Law 106-398. The Commission was formed to study the future of the United States aerospace industry in the global economy, particularly in relation to United States national security, and to assess the future importance of the domestic aerospace industry for the economic and national security of the United States.



NAICS		Employment	Establishments
	Air Transportation	12,491	144
481111	Scheduled Passenger Air Transportation	8,091	57
481112	Scheduled Freight Air Transportation	551	8
481211	Nonscheduled Chartered Passenger	3,640	58
481212	Nonscheduled Chartered Freight	176	16
481219	Other Nonscheduled Air	33	5
	Support Activities for Air Transportation	4,924	190
488111	Air Traffic Control	1,445	19
488119	Other Airport Operations	1,581	74
488190	Other Support Activities for Air Transportation	1,898	97
517410	Satellite Communications	124	35
611512	Flight Training Schools	214	32
927110	Space Research & Technology	1,939	1
928110	National Security (Note 1)	21,487	95
	SERVICES TOTAL	41,179	497

Note 1: Employment figures for national security (NAICS 928110) only include civilian workers. The U.S. government does not provide ES202 with employment data for military personnel. Data Source: ES202 Data (see section titled *Data Sources* for a detailed description of ES202 data)



Key Findings

Aerospace and Defense Industry Within Ohio

- Ohio's aerospace and defense (A&D) industry is moderate in size—58,000 workers in 2003.¹⁴ Twenty-nine percent of the workforce (16,900 employees) was engaged by manufacturing companies while 71 percent (41,100 employees) worked for service-related organizations. Between 2000 and 2003, A&D manufacturing reported a net reduction of 2,100 workers, or 11 percent. On the services side, an employment rise of 1.4 percent, or 600 workers, was recorded.
- The average wage paid to all aerospace and defense workers across the state of Ohio in 2003 was significantly higher than the average wage paid to Ohio workers in all industries—\$62,600 vs. \$35,400. Wages paid to A&D manufacturing workers were 65 percent higher than the average wage paid to all manufacturing workers across Ohio—\$76,600 vs. \$46,300. Employees in A&D services reported more than twice the earnings as workers in all other service-related industries—\$56,900 vs. \$26,600.
- The aerospace and defense industry is spread across the State, primarily along the Cleveland, Columbus, Dayton, and Cincinnati corridor.

Aerospace and Defense: A 12-State Comparison

- Private sector aerospace and defense industry employment declined significantly in Ohio by 39 percent and nationally by 19 percent during the 1990s. Ohio not only lost employment, but its A&D employment share declined from 3.8 percent to 2.8 percent

¹⁴ There is a likelihood that Ohio's A&D industry actually had about 66,000 workers in 2003 because several companies were misclassified in the ES202 database. Employment estimates given in this footnote were found in Harris Infosource and verified in company websites and news releases or by company representatives. ABX Air (formerly Airborne Express), Ohio employment = 6,000, classified in ES202 under 492110 (couriers); Grimes Aerospace, Ohio employment = 800, classified in ES202 under 336413 (vehicular lighting equipment); Smiths Industries/Leland Electrosystems, Ohio employment = 300, classified in ES202 under NAICS 541710 (R&D in physical sciences). According to the September 2003 Wright-Patterson Air Force Base (WPAFB) Economic Impact Analysis, there may be significantly more civilian employment at WPAFB than reported in the ES202 database.



between 1990 and 2002.¹⁵ Ohio's A&D gross product share also declined from 5.9 percent to 4.6 percent during the same time period.

- In 2002, Ohio ranked 1st among the 12 comparable states in private sector aerospace and defense manufacturing value-added at \$199,500 per employee. This is almost double the national average of \$101,300. This high ranking resulted from having a number-one value-added ranking in the two segments that comprise A&D manufacturing: aerospace products and parts (NAICS 3364) and military armored vehicles and tanks (NAICS 3369). In each of these segments, Ohio's value added was almost double that reported for the U.S.

- Ohio ranked 1st in private sector aerospace and defense manufacturing wages among the 12 comparable states in 2002. The State's average A&D manufacturing wage of \$70,900 was 20 percent higher than the national average. Ohio also ranked first in wages paid to aerospace products and parts workers and 3rd in wages paid to employees of military armored vehicle and tank manufacturers.

- Ohio reported significant employment concentrations in four aerospace and defense industries: aircraft engines and parts (3 times greater than found on average across the U.S.), nonscheduled chartered passenger air service (2.7 times greater than found on average across the U.S.), space research and technology (2.7 times greater than found on average across the U.S.), and military armored vehicles and tanks (2.3 times greater than found on average across the U.S.).

- The combination of high value-added, high wages, and significant employment concentrations gives Ohio a distinct competitive advantage in the following industries: aircraft engines and parts (NAICS 336412), military armored vehicles and tanks (NAICS 336992), and space research and technology (NAICS 92711).

¹⁵ A&D employment share is defined as the ratio of total A&D employment in the state of Ohio to total A&D employment in the United States.



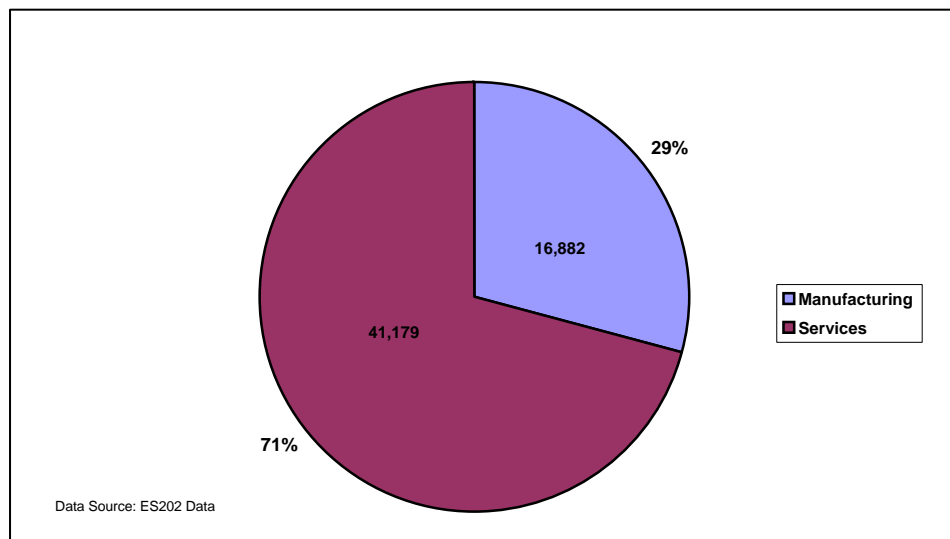
Aerospace and Defense Industry within Ohio

This section presents a brief overview of the aerospace and defense industry within Ohio. The industry is characterized using ES202 employment and wage data. The discussion shows that the aerospace and defense industry is relatively moderate in size, but pays significantly higher wages than other industries.

Employment in Ohio

Aerospace and defense (A&D) industries employed 58,000 workers (excluding military personnel) across Ohio in 2003.¹⁶ Manufacturing companies engaged 29 percent of the workforce with 71 percent in service businesses (see Figure 1). Detailed employment statistics for all A&D industry segments between 2000 and 2003 can be found in Appendix D, Tables D-1 and D-2.

Figure C- 1. Ohio's Aerospace and Defense Employment, 2003



The six largest aerospace and defense organizations in Ohio employed more than 25,000 workers in 2003, which accounts for 44 percent of the State's total A&D employment. These organizations included Wright Patterson Air Force Base (Dayton), General Electric Company

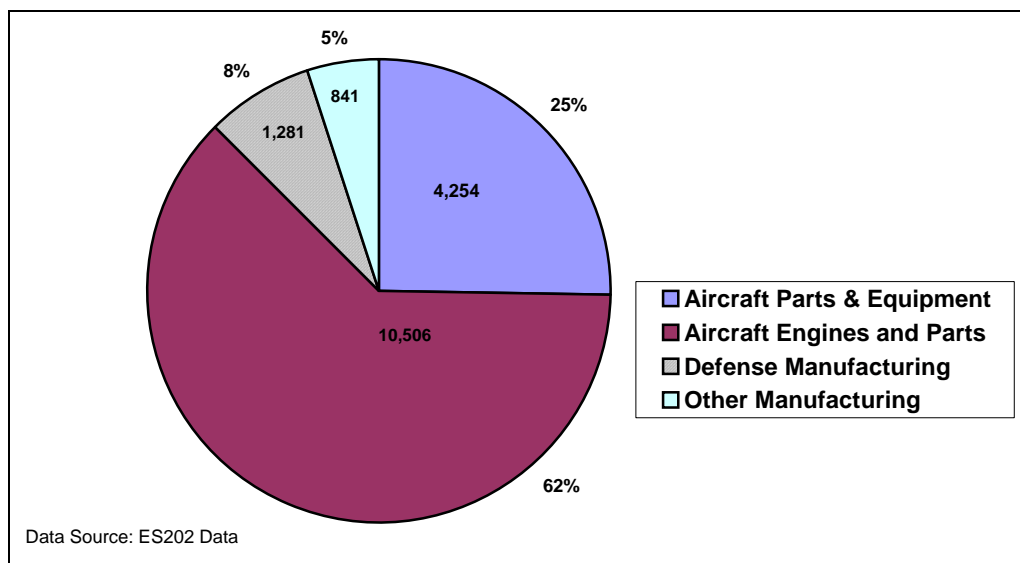
¹⁶ See footnote 13



(Cincinnati region), Defense Finance and Accounting Service (Columbus), Defense Supply Center (Columbus), NASA Glenn Research Center (Cleveland), and the Defense Finance and Accounting Service (Cleveland).

In aerospace and defense manufacturing, employment is concentrated in two industries: aircraft engines and parts (NAICS 336412) and aircraft parts and equipment (NAICS 336413). General Electric (GE) dominates aircraft engine manufacturing.¹⁷ Within Ohio, GE's aircraft engine facilities are concentrated in the southwest part of the State. Its combined workforce accounts for over half of Ohio's employment in NAICS 336412. Among the major players in the aircraft parts and equipment business are Aircraft Braking Systems Corporation, Goodrich Corporation, Grimes Aerospace, Hartzell Propeller and Parker Hannifin. Combined employment in these five companies account for about half of the total A&D manufacturing workforce in the state of Ohio. Figure 2 shows a breakdown of A&D manufacturing employment in 2003.

Figure C- 2. Ohio A&D Manufacturing Employment, 2003



Tier 1 suppliers to aerospace and defense manufacturers are predominantly other A&D companies.¹⁸ Tier 2 suppliers are found primarily in fabricated metal product manufacturing

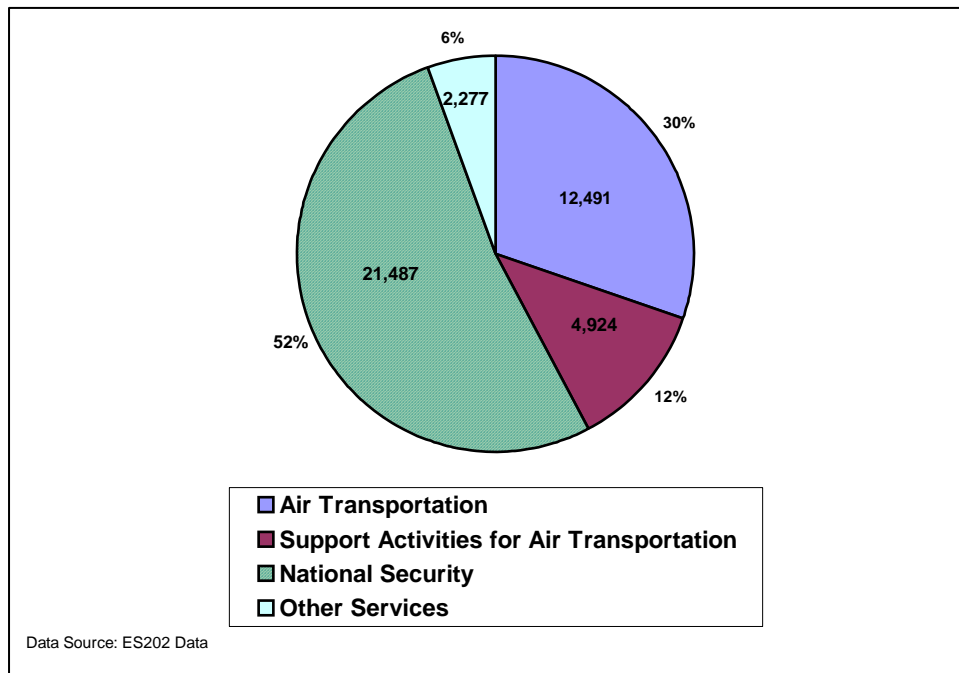
¹⁷ Just as General Electric (aircraft engines) is a dominant employer in Ohio's A&D manufacturing, one or two major companies drive private sector A&D employment in other states. Examples include Honeywell in Arizona, Boeing and Lockheed Martin in California, Cessna and Raytheon in Kansas, and Pratt & Whitney in Connecticut.



(NAICS 332), which includes companies that produce forgings and stampings, plate work, sheet metal work, turned products, and industrial valves. High value-added professional service support providers include firms engaged in research and development, custom computer programming, and engineering.

In aerospace and defense services, national security accounts for over 50 percent of the jobs (excluding military personnel). It includes civil service employees at Wright Patterson Air Force Base, DFAS (Defense, Finance, and Accounting Service) in Cleveland and Columbus, and the Defense Supply Center Columbus. Ohio is the only state that has two DFAS centers. Their creation was authorized in the early 1990s. Eight major airlines employ over 80 percent (10,200 workers) of the workforce that provides passenger and freight service. They include American West, American Air Services, American Airlines, Continental, Delta, Executive Jet, Flight Options, and U.S. Air. Figure 3 shows a breakdown of A&D services employment in 2003. Figure 4 shows a detailed breakdown of national security employment (excluding military personnel).

Figure C- 3. Ohio A&D Services Employment, 2003

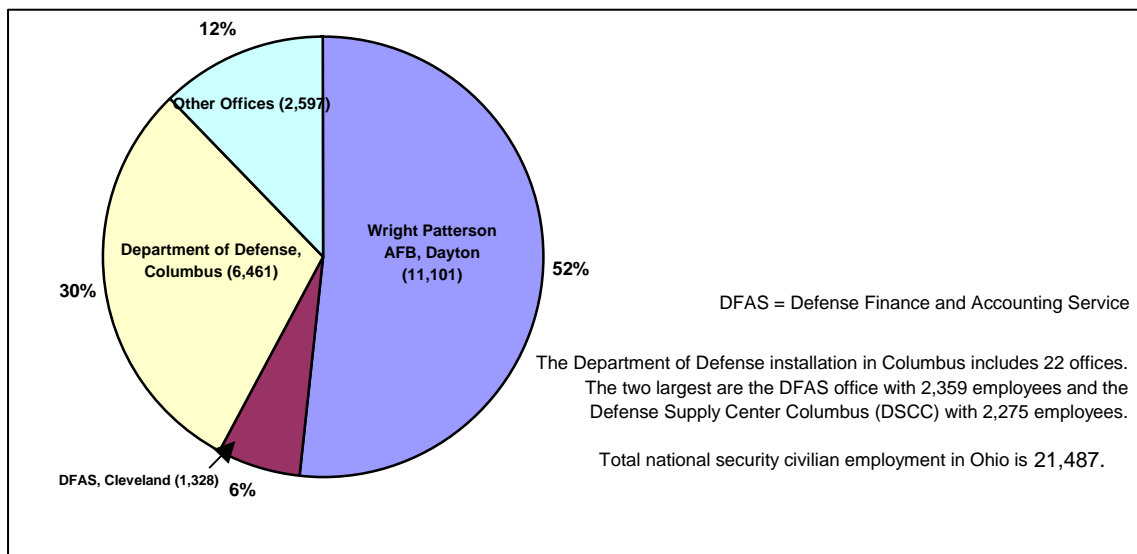


Other Services includes the NASA Glenn Research Center in Cleveland.
National security employment only includes civilian personnel.

¹⁸ Supplier industries to A&D manufacturers were determined using IMPLAN Professional, an economic impact assessment software system. IMPLAN allows the user to develop local level (by county or state) input-output models.



Figure C-4. National Security Employment in Ohio, 2003



Data sources: ES202 data; Cleveland/Columbus DFAS offices.

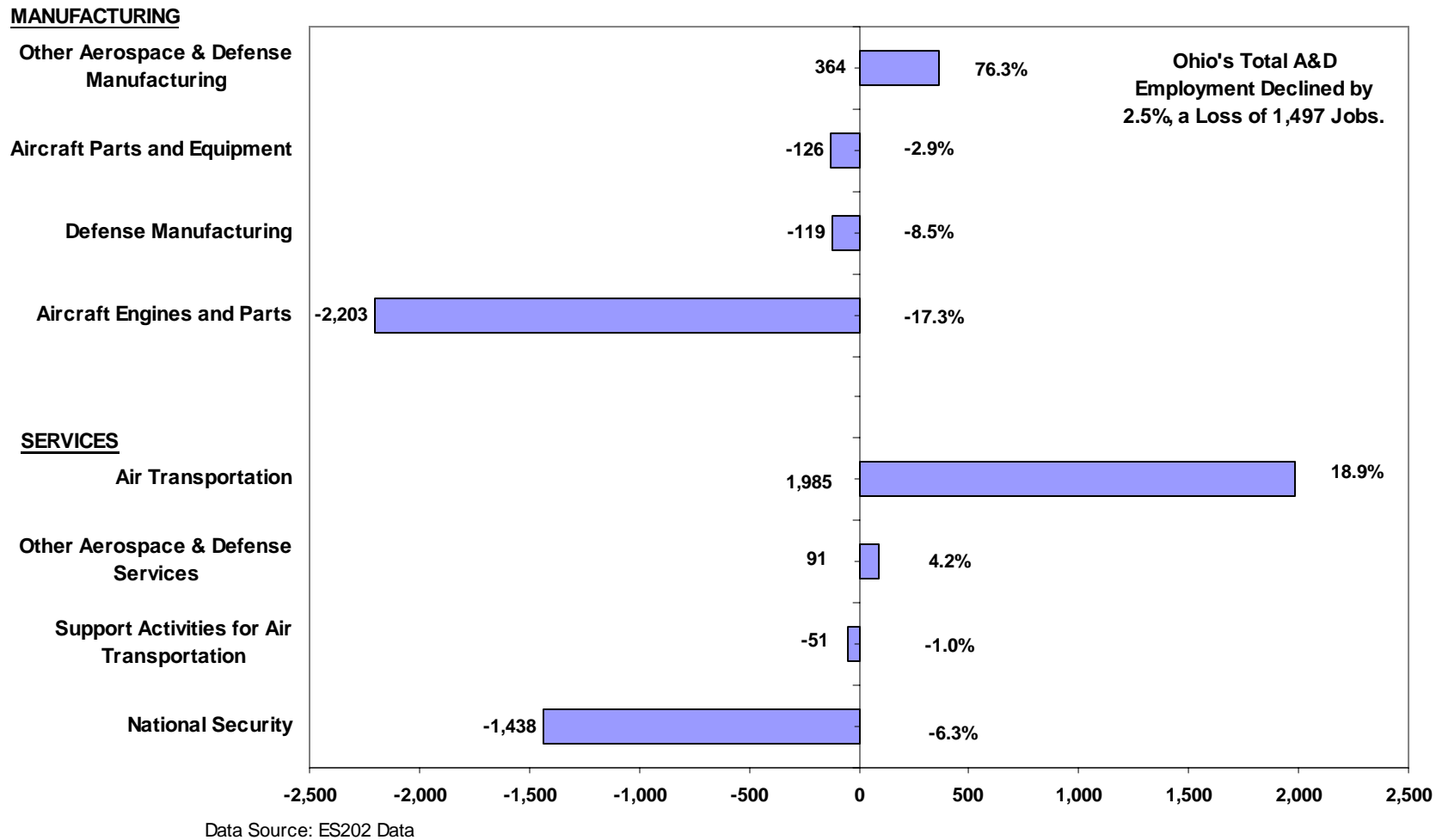
Employment levels for national security facilities only include civilian personnel.

According to the September 2003 Wright-Patterson Air Force Base Economic Impact Analysis, over 12,300 civilian personnel are assigned to the base.

Aerospace and defense reported a small employment decline between 2000 and 2003 with a net loss of 1,500 workers (2.5 percent). Manufacturing absorbed most of the job losses with a net reduction of 2,100 workers, or 11 percent. The largest drop was seen in aircraft engines and parts where 2,200 workers (17 percent) lost their jobs. On the service side, an employment rise of 1.4 percent was reported. Air transportation (including passenger and freight) saw an increase of 2,000 workers (19 percent) while national security reported a workforce reduction of 1,400 (6 percent). National security employment reductions only include civilian employees. Changes in Ohio's A&D employment by segment from 2000 through 2003 can be seen in Figure 5.



Figure C-5. Changes in Ohio's A&D Employment by Segment, 2000 – 2003

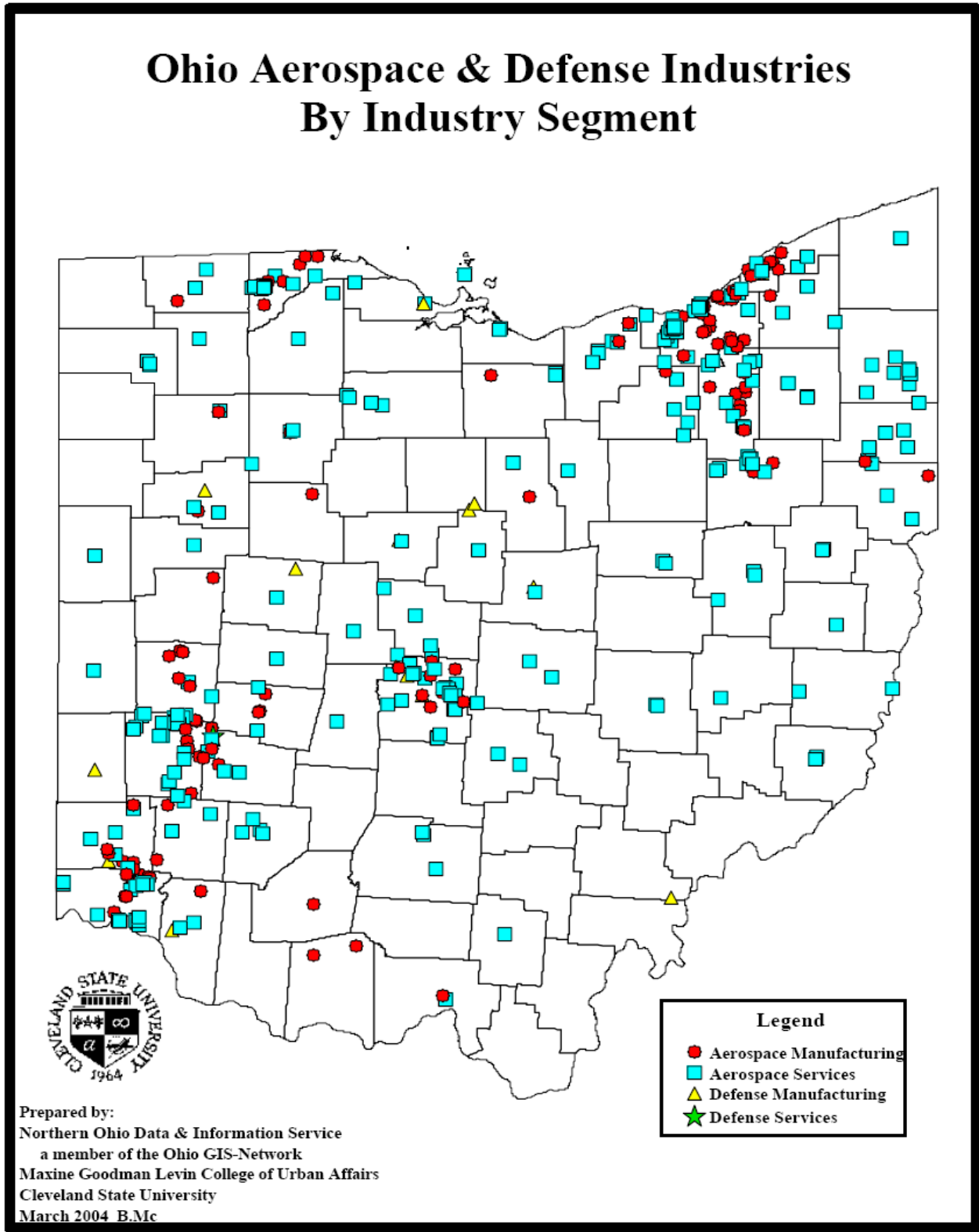




Location of Aerospace & Defense Establishments in Ohio

Most A&D manufacturers and service providers are located along the Cleveland-to-Cincinnati axis. The heaviest concentrations are situated in the Cleveland-Akron, Columbus, and Cincinnati-Dayton regions. There is some activity in the northwest part of the State around Toledo and Lima. The southeast part of the state reports a minimal number of A&D companies. Figure 6 shows the locations of A&D companies by industry segment.

Figure C- 6. Ohio Aerospace & Defense Industries by Industry Segment



Defense services establishments are located in northwest Greene county, central Franklin county, and northern Cuyahoga county.

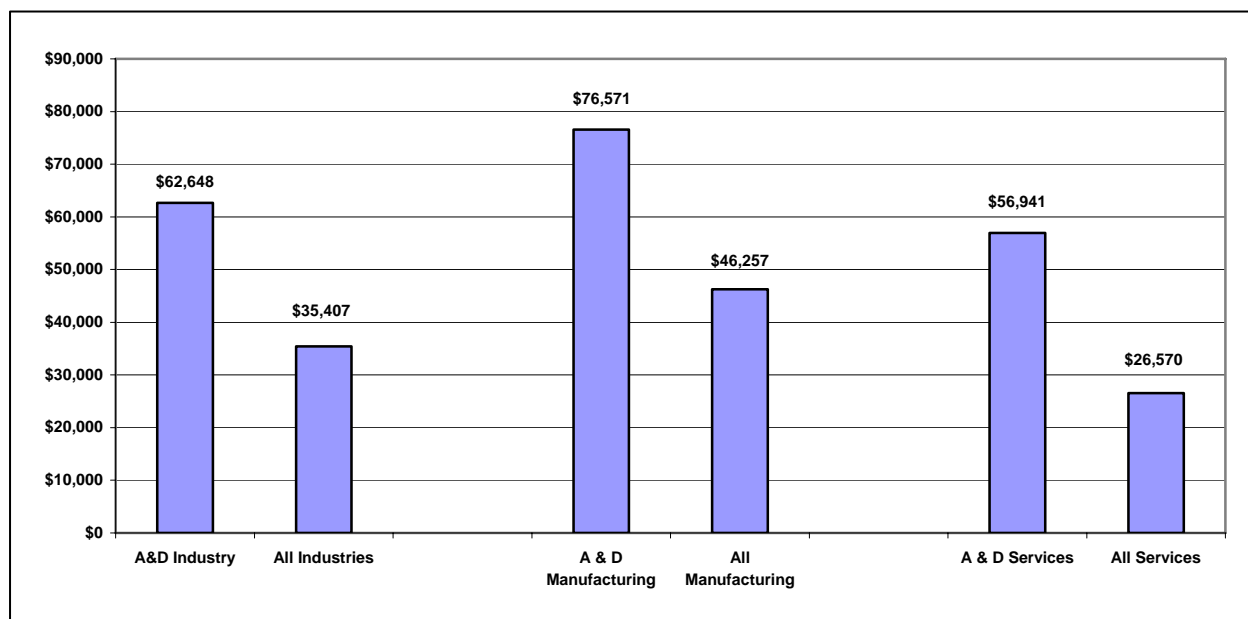


Wages in Ohio

The average wage paid to all aerospace and defense workers across the state of Ohio in 2003 was significantly higher than the average wage paid to Ohio workers in all industries, including those employed by government— \$62,648 vs. \$35,407. High wage jobs have positive effects on the economy both locally and statewide. They increase purchasing power by households, which in turn helps create additional jobs, increase tax revenues for governmental entities including school districts, and increase levels of savings and investment.

Wages paid to A&D manufacturing workers averaged \$76,600 in 2003. The average wage paid to all manufacturing workers across Ohio was about 40 percent less, or \$46,300. Workers in A&D services reported over twice the earnings as employees in all other service-related industries—\$56,900 vs. \$26,600. Figure 7 shows a comparison of Ohio's A&D wages to wages in all industries. Detailed wage data for A&D industry segments between 2000 and 2003 are included in Tables D-3 and D-4, Appendix D.

Figure C- 7. Ohio's A&D Wages in Comparison to Wages in All Industries, 2003





The highest paid workers in A&D manufacturing are those employed by aircraft engine and parts companies—\$87,300. Employees of aircraft parts and equipment manufacturers earned almost 30 percent less or \$62,300. On the service side, air traffic controllers were the highest paid at \$83,000. Workers engaged in space research and development earned \$72,000 annually. Most space research and development workers are NASA employees (NASA Glenn Research Center, Cleveland).

A 2.2 percent increase in real wages was reported across all aerospace and defense industries between 2000 and 2003. On average, manufacturing workers saw no real increase in their paychecks, whereas workers in A&D service-oriented organizations experienced a five percent increase in real wages.¹⁹ Much of the increase seen in the A&D service industries can be attributed to air traffic controllers, whose real wages increased by 10 percent for each of the three years.²⁰

¹⁹ According to the Cleveland Federal Reserve Bank, two factors may contribute to a lack of real wage growth in manufacturing: 1) Beginning in 2001, a steady decline in industrial production was reported. The drop in industrial production seems partially due to a considerable decline in the rate of productivity growth. Consistent with an unanticipated drop in productivity growth, manufacturing inventories began falling precipitously. Given the fall in productivity growth, it is no surprise that growth in manufacturing workers' earnings has also been declining and that it continues to lag growth in total nonfarm earnings. 2) Production workers' real wages, most set in nominal terms through union contracts made long before the wages are paid, dropped sharply in 2000 and 2001.

²⁰ The BLS reports that, across the U.S., the median annual earnings of air traffic controllers in 2002 was \$91,600. The middle 50 percent earned between \$65,480 and \$112,550.



Comparison to Other Core Industries in Ohio

When compared to a select group of core industries in Ohio, A&D is moderate in size.²¹

Employment in the core industries ranges from 25,400 workers (advanced electronics) to 130,400 workers (motor vehicles). Aerospace and defense industries pay the highest wages among the selected core industries. See Figures 8 and 9 for an employment and wage comparison of Ohio's A&D industry with selected core industries.

²¹Core industries and their definitions were taken from a list compiled by the Ohio Department of Development (ODOD). They include aerospace and defense, motor vehicles, advanced electronics, machinery, and rubber and plastics.



Figure C- 8. Employment in Selected Core Industries in Ohio, 2003

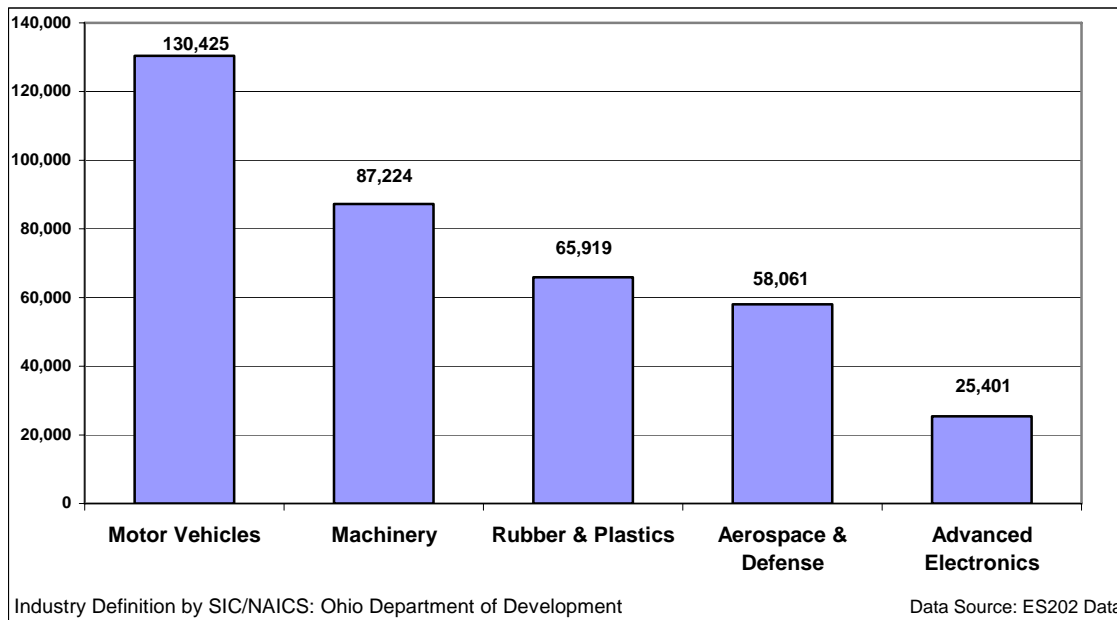
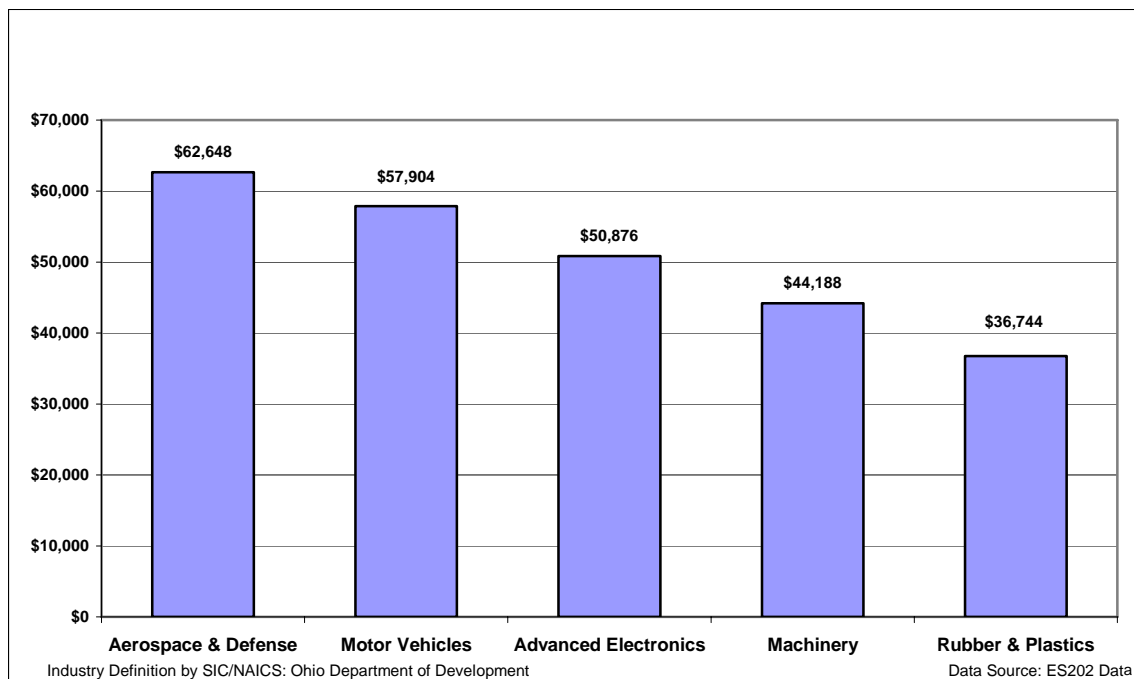


Figure C- 9. Average Wages in Selected Core Industries in Ohio, 2003





Aerospace and Defense: A 12-State Comparison

In this section, Ohio is compared to 11 states that are considered leaders in the aerospace and defense (A&D) industry.²² Comparisons are made in the areas of employment, value-added output, value-added per employee, and wages. Data used pertains only to the private sector portion of A&D.

The discussion shows that although Ohio lost significant A&D employment during the 1990s, the State remains in the forefront of some highly sophisticated A&D manufacturing segments - jet engines and military armored vehicles and tanks. This demonstrates that Ohio has the business climate that can support globally competitive industries with high value-added personnel and equipment.

Employment

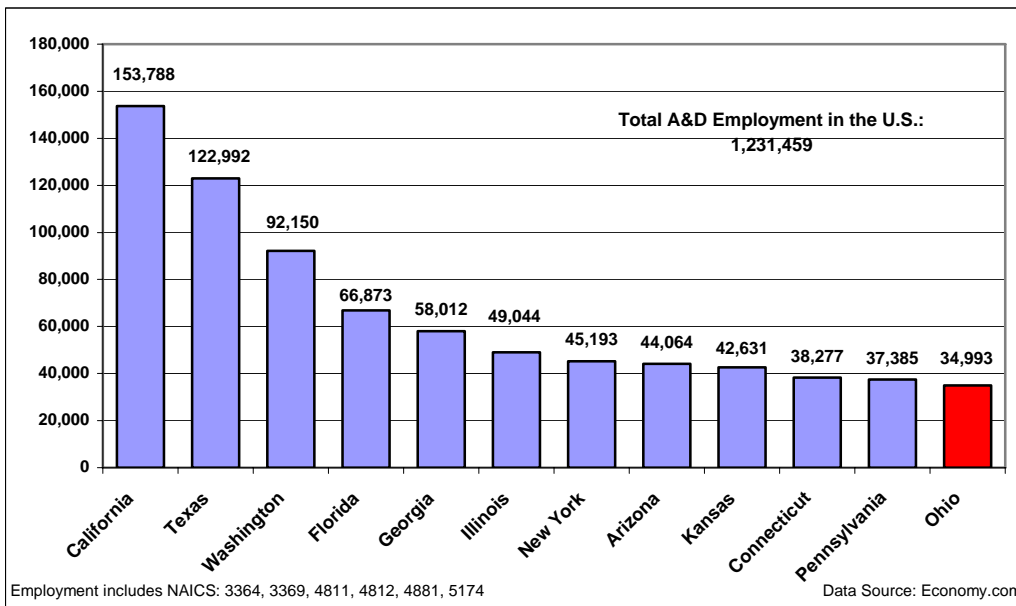
The combined private sector aerospace and defense employment in the 12 comparative states accounted for almost two-thirds of the total A&D workforce (excluding military personnel) across the U.S. in 2002. California and Texas reported the highest employment levels with 154,000 and 123,000 workers, respectively. Ohio ranked 12th with 35,000 A&D workers. In comparison, Ohio is ranked 7th nationally in total employment. Figure 10 shows private sector A&D employment in Ohio and other comparable states. Tables D-5 through D-11 in Appendix D provide a detailed employment breakdown by NAICS.²³

²² Eleven states were selected against which to compare Ohio's aerospace and defense industry. The idea is simply to put Ohio in perspective with other states that are considered leaders in A&D. The primary selection criterion was total A&D employment. Other variables were employment share, employment growth, wages, value-added output, and value-added per employee. States used in the comparison include Arizona, California, Connecticut, Florida, Georgia, Illinois, Kansas, New York, Pennsylvania, Texas, and Washington.

²³ For the 12-state comparison, six four-digit NAICS-based industry groups were used to segment the aerospace and defense industry. They are: NAICS 3364 (Aerospace Product and Parts Manufacturing); NAICS 3369 (Military Armored vehicles, Tanks, and Tank Components); NAICS 4811 (Scheduled Air Transportation); NAICS 4812 (Nonscheduled Air Transportation); NAICS 4881 (Support Activities for Air Transportation); and NAICS 5174 (Satellite Communications). NAICS data was purchased from Economy.com. Since Economy.com does not provide NAICS data at the five or six-digit level, the detailed industry segmentation found in the previous section, "Aerospace and Defense Industry Within Ohio," cannot be provided here.



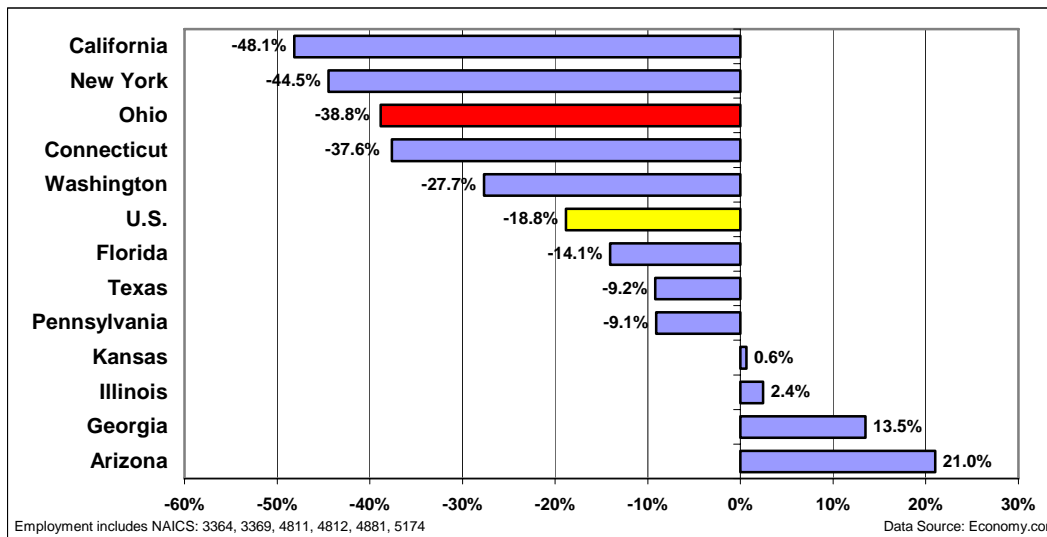
Figure C-10. Private Sector A&D Employment in Ohio and Other Comparable States, 2002



Nationally, a 19 percent decrease in aerospace and defense employment was reported between 1990 and 2002. A&D employment across the 12 comparable states decreased, on average, by 26 percent. Ohio ranked third in employment losses at 39 percent. The only states with significant A&D employment gains were Arizona (21 percent) and Georgia (13.5 percent). Figure 11 summarizes A&D employment change within the U.S. and comparable states.



Figure C-11. A&D Private Sector Employment Change in Ohio and Comparable States, 1990-2002



Focusing on the aerospace and defense manufacturing sector, employment decreased by 42 percent nationally between 1990 and 2002.²⁴ Ohio’s A&D manufacturing losses were even more severe at 58 percent. In contrast, Ohio gained 42 percent in A&D services employment compared to 13 percent across the U.S.²⁵ Possible reasons for the decrease in A&D manufacturing employment nationally include industry consolidation, decreased spending by the federal government, and the emergence of sophisticated foreign competition. In Ohio, there may also have been a movement of high-wage production operations out of the State during the 1990s. Table 3 shows a comparison of employment change for the U.S. and Ohio in each of the four-digit NAICS-based A&D segments between 1990 and 2002.

Table C-3. A&D Private Sector Employment Change in Ohio and the U.S., 1990-2002

NAICS	DESCRIPTION	% Change 1990-2002	
		U.S.	OHIO
3364	Aerospace Product & Parts Manufacturing	-44.0%	-58.0%
3369	Military Vehicle & Tank Manufacturing	11.0%	-62.0%
4811	Scheduled Air Transportation	3.5%	51.1%
4812	Nonscheduled Air Transportation	64.6%	100.7%
4881	Support Activities for Air Transportation	46.6%	10.1%
5174	Satellite Communications	10.8%	4.3%

Data source: Economy.com

²⁴ The A&D manufacturing sector consists of NAICS 3364 and NAICS 3369.

²⁵ The A&D services sector consists of NAICS 4811, NAICS 4812, NAICS 4881, and NAICS 5174.



Most of the U.S. loss in private sector A&D jobs between 1990 and 2002 was due to declines in NAICS 3364, aerospace product and parts manufacturing (370,200 workers). In contrast, all other A&D industries reported a net employment gain of 84,600 employees. Ohio followed the national trend with large losses in aerospace product and parts manufacturing (24,100 workers). All other A&D industries in Ohio reported a net employment gain of 1,900 workers. Figures 12 and 13 show private sector A&D employment changes nationally and in the state of Ohio.

Figure C-12. Employment Change in U.S. Private Sector A&D Industry, 1990 – 2002

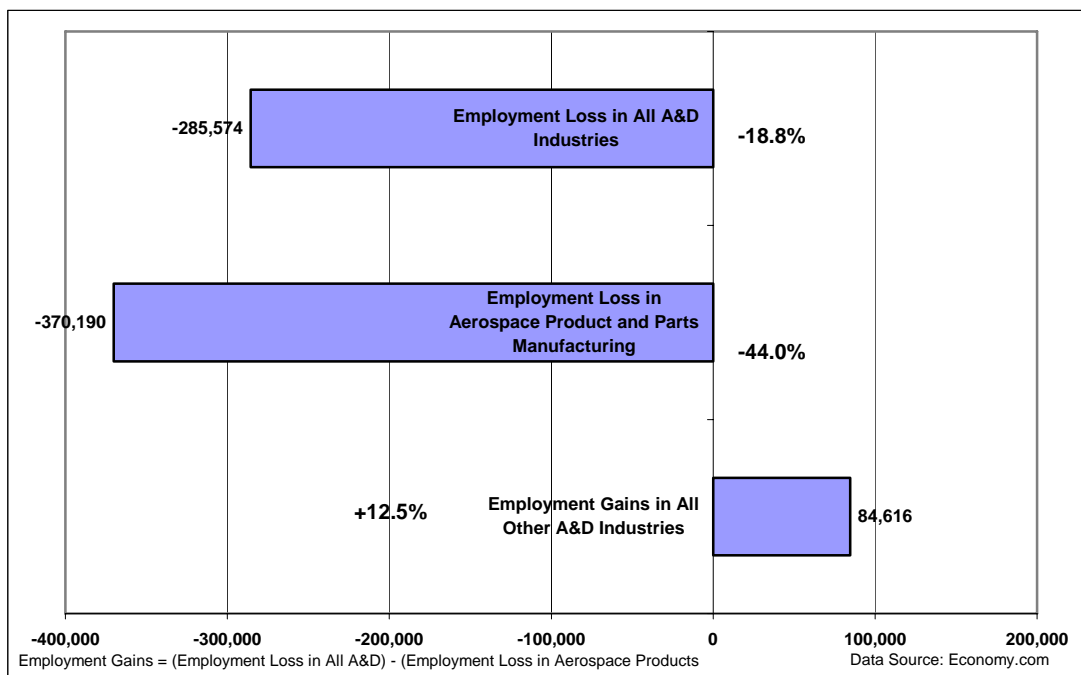
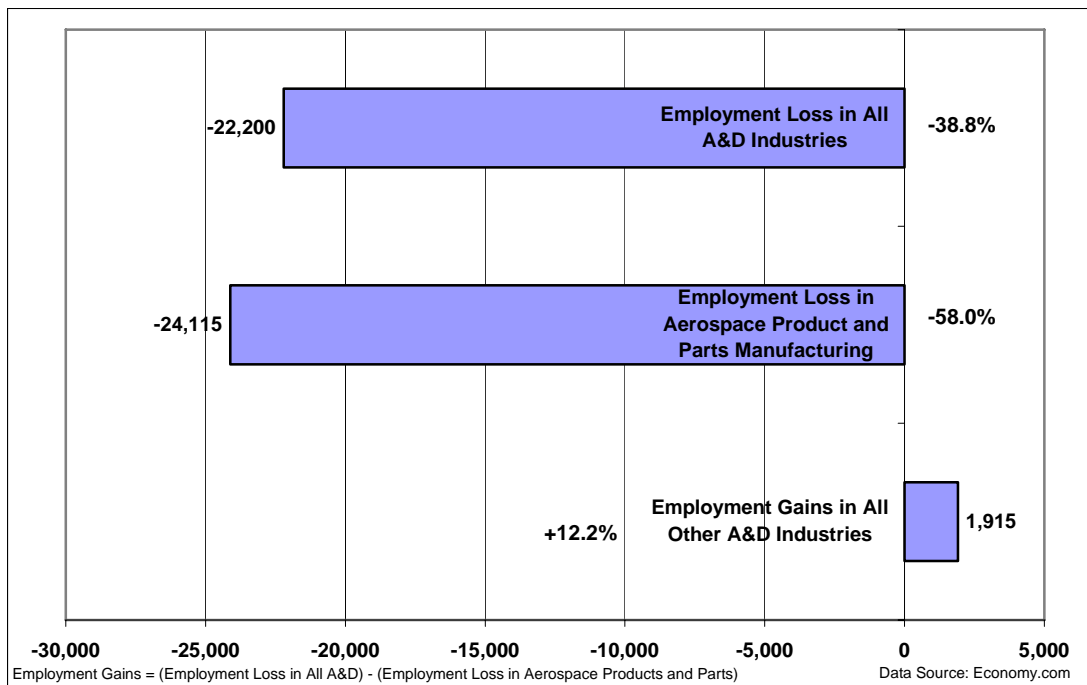




Figure C-13. Employment Change in Ohio Private Sector A&D Industry, 1990 – 2002



Employment Concentration (Location Quotients)

Although Ohio lost significant aerospace and defense manufacturing employment between 1990 and 2002, there are four industries in which Ohio retains a competitive advantage due to their employment concentration and high value-added content.²⁶ They are aircraft engine and parts manufacturing (NAICS 336412), nonscheduled chartered passenger air transportation (NAICS 481211), space research and technology (NAICS 927110), and military armored vehicle and tank manufacturing (NAICS 336992).

²⁶ Location quotients (LQs) were used to characterize the four industries by employment concentration. LQs are used to measure the degree to which an industry is concentrated or specialized in a geographic area relative to a reference economy. The LQs presented in this discussion measure the concentration of aerospace and defense employment at the six-digit NAICS level in the state of Ohio relative to the United States. A useful interpretation of LQs is in determining whether or not a geographic area employs a disproportionately large share of the workforce in a given industry when compared to a reference economy. If an LQ is greater than 1.0, then the state of Ohio has a higher concentration of an industry's employment when compared to the U.S. as a whole. A very high LQ indicates a disproportionately large share of the workforce.



Table 4 provides a list of A&D industries in the state of Ohio and their associated location quotient (LQ). Aircraft engine and parts manufacturing reports a LQ of 3.08. This means that within the state of Ohio, NAICS 336412 has an employment concentration that is three times greater than found on average across the U.S. Space research and technology has an employment concentration that is 2.7 times greater than found on average across the U.S., and military armored vehicle and tank manufacturing reports an employment concentration that is 2.3 times greater than found on average across the U.S. In addition to having high employment concentrations, three of the top four industries, by LQ, are high value-added industries (the exception being NAICS 481211).²⁷ This is significant because of their wealth-generating potential and, in the case of space research and technology, the potential for technology transfer and commercialization.

Table C- 4. Ohio Aerospace and Defense Industries Location Quotients

Code	Industry	EMPLOYMENT 1Q: 2003		
		OHIO	U.S.	LQ
336412	Aircraft Engines and Parts	10,506	82,851	3.08
481211	Nonscheduled Chartered Passenger	3,640	32,040	2.76
927110	Space Research & Technology	1,939	17,312	2.72
336992	Military Armored Vehicle, Tank & Tank Components	796	8,334	2.32
336413	Other Aircraft Parts & Auxiliary Equipment	4,254	82,629	1.25
481112	Scheduled Freight Air Transportation	551	11,526	1.16
928110	National Security (Note 1)	21,487	511,826	1.02
488111	Air Traffic Control	1,445	39,787	0.88
488190	Other Support Activities for Air Transportation	1,898	71,625	0.64
481212	Nonscheduled Chartered Freight	176	7,615	0.56
488119	Other Airport Operations	1,581	82,054	0.47
332992	Small Arms Ammunition	137	7,414	0.45
481111	Scheduled Passenger Air Transportation	8,091	494,191	0.40
611512	Flight Training Schools	214	17,777	0.29
332993	Ammunition Manufacturing	286	27,160	0.26
481219	Other Nonscheduled Air Transportation	33	3,614	0.22
332995	Other Ordnance and Accessories	57	6,901	0.20
517410	Satellite Communications	124	17,616	0.17
334511	Search, Detection, Navigation, Guidance, Aeronautical	722	144,158	0.12
336411	Aircraft Manufacturing	119	214,121	0.01
332994	Small Arms Manufacturing	5	9,763	0.01

Data Source: ES202 Data

Note 1: Employment figures for national security (NAICS 928110) only include civilian workers. The U.S. government does not provide ES202 with employment data for military personnel.

²⁷ See section titled "Total Value-Added Output" for a detailed discussion.



Total Value-Added Output

Total private sector value-added output (VAO) in the aerospace and defense industry was estimated at \$99.3 billion across the U.S. in 2002.²⁸ This represents 0.9 percent of the nation's industry output. The 12 comparative states accounted for 73 percent of the \$99 billion figure. Ohio's aerospace and defense VAO was estimated at \$4.6 billion in 2002, which accounts for 1.1 percent of Ohio's industry output. For a detailed breakdown of A&D value-added output by NAICS, refer to Appendix D, Tables D-12 through D-18.

Aerospace and defense VAO was relatively stable across the U.S. between 1990 and 2002, declining by only 0.5 percent. Seven of the comparative states reported increases, while five reported declines. States with the biggest increase in VAO were Arizona and Georgia at 131 percent and 132 percent, respectively. Ohio experienced a decline of 22 percent.

Value-Added per Employee

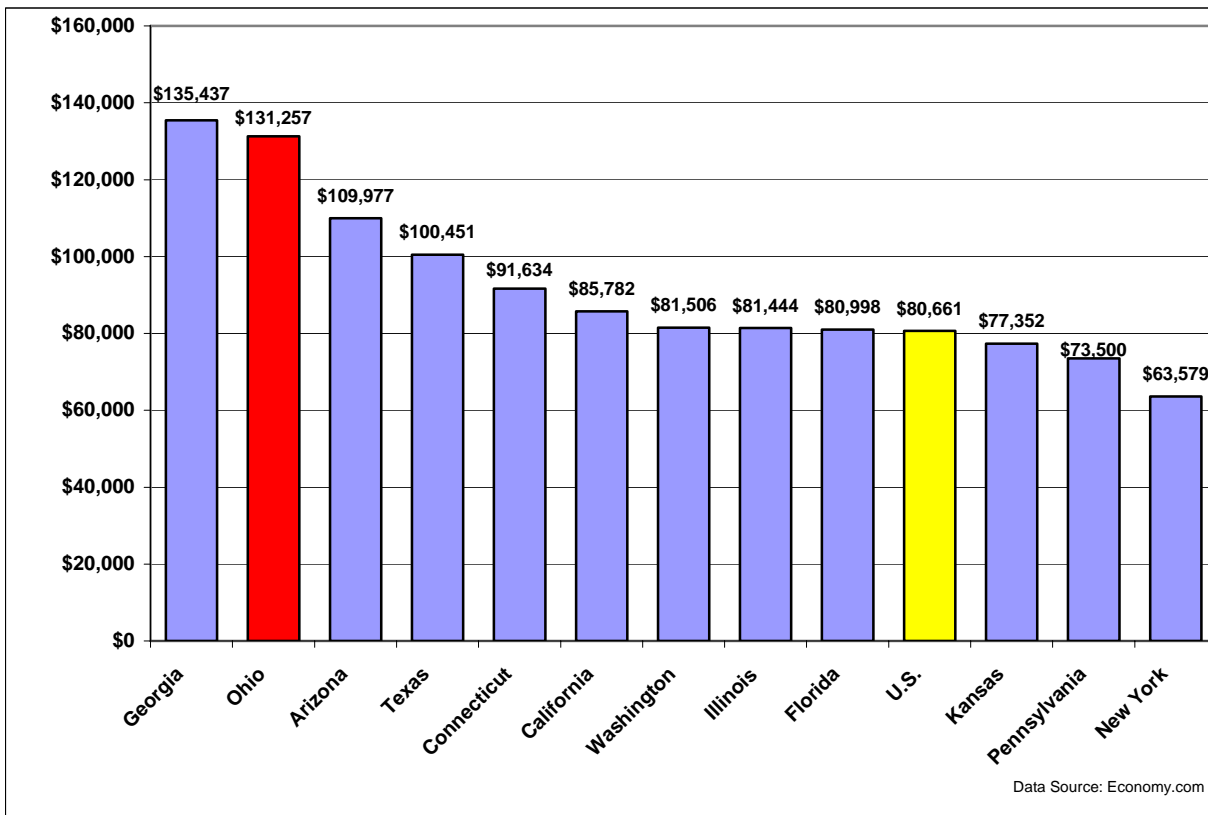
Although Ohio ranked 12th in aerospace and defense employment in 2002, it ranked number two in value-added per employee (VAE) at \$131,200, which is well above the national average of \$80,700.²⁹ The only state with a higher estimated VAE is Georgia at \$135,400. Figure 14 shows a VAE comparison among the 12 states. A value-added per employee breakdown by NAICS can be found in Tables D-19 through D-25 in Appendix D.

²⁸Value-added output (VAO), as defined by the Bureau of Economic Analysis (BEA), is often referred to as "industry output" or "gross output" in conversation, but ultimately it always refers to the same concept – value-added output of a particular industry. By definition, VAO by industry is an industry's gross output less its purchases of intermediate inputs. More specifically, VAO is an industry's sales or receipts and other operating income, commodity taxes, and inventory change minus its intermediate inputs (consumption of goods and services purchased from other industries or imported). Value-added output for a geographic area is the sum of the VAO for all industries in that area.

²⁹ Value-added per employee = Value-added output per employee. See footnote 18 for a definition of value-added output.



Figure C- 14. A&D Private Sector Value-Added Per Employee in Ohio and Other Comparable States, 2002



Disaggregating aerospace and defense into their manufacturing and service segments shows that Ohio ranks number one in manufacturing VAE at \$199,500 per employee. This is almost double the national average of \$101,300. Washington ranks 2nd (\$152,200) followed by Arizona (\$144,200). In sharp contrast, Ohio is ranked last of the 12 comparable states in services VAE at \$48,900 per employee, which is 26 percent below the national average (\$66,132). Kansas is ranked 1st at \$142,600 followed by Georgia (\$134,300). Table 5 shows value-added per employee figures for A&D manufacturing and service segments for the 12 comparable states.



Table C-5. A&D Private Sector Manufacturing & Services VAE

STATE	VALUE-ADDED 2002			
	MANUFACTURING	RANK	SERVICES	RANK
Arizona	\$144,207	3	\$64,284	10
California	\$88,309	9	\$83,104	6
Connecticut	\$89,235	8	\$118,582	3
Florida	\$74,499	11	\$83,228	5
Georgia	\$138,937	4	\$134,329	2
Illinois	\$90,447	7	\$80,863	8
Kansas	\$74,395	12	\$142,617	1
New York	\$93,726	6	\$57,959	11
Ohio	\$199,517	1	\$48,904	12
Pennsylvania	\$78,552	10	\$70,865	9
Texas	\$115,845	5	\$93,629	4
Washington	\$152,187	2	\$80,990	7
U.S.	\$101,268		\$66,132	

VAE: Value-Added per Employee

Ohio's high value-added per employee in A&D manufacturing is attributed primarily to aerospace products and parts (NAICS 3364) where it ranked first among the 12 comparable states in 2002.³⁰ Ohio's reported value-added of \$206,400 per employee in NAICS 3364 was almost double the U.S. average (\$104,200). Arizona was number two at \$145,900, and Georgia ranked third at \$142,900 (see Appendix A, Table A-19 for detailed data). Ohio also recorded a number one VAE ranking in military armored vehicles and tanks (NAICS 3369) at \$129,000. Again, this was almost double the U.S. average of \$65,500. New York ranked number two at \$107,000.

Across all aerospace and defense services, Ohio's value-added per employee ranking was no higher than 8th among the 12 comparable states. The number eight ranking was reported in NAICS 4881 – support activities for air transportation. Ohio recorded the lowest VAE ranking in scheduled air transportation (NAICS 4811). In fact, it was the only state that experienced a VAE decline in NAICS 4811 between 1990 and 2002.

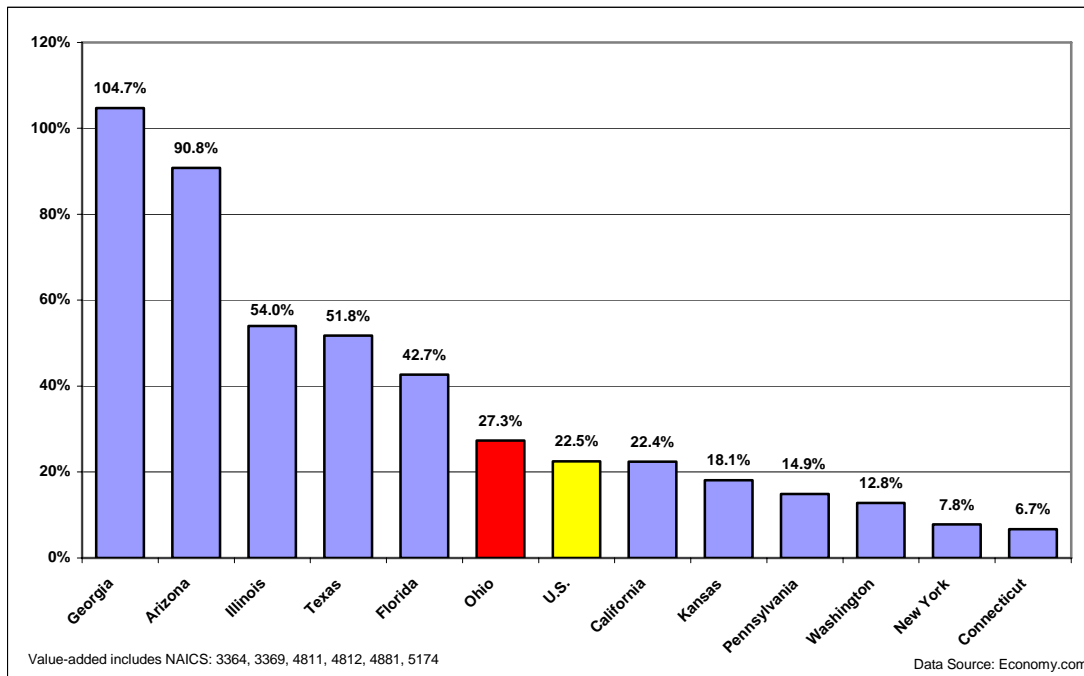
All 12 comparative states reported aggregated value-added per employee increases between 1990 and 2002. Nationally, VAE in aerospace and defense increased by \$15,000 per employee

³⁰NAICS 3364 includes aircraft engine and parts manufacturing and aircraft parts and equipment manufacturing, the two largest industry employers in Ohio under A&D manufacturing.



or 22.5 percent. Ohio A&D companies ranked 6th in VAE increases at 27 percent, five percentage points higher than the U.S. average. Georgia was first with a reported increase of 105 percent. Figure 15 shows the growth rate in value-added per employee for the comparable states.

Figure C-15. A&D VAE Growth Rate in Ohio and Other Comparable States, 1990 – 2002

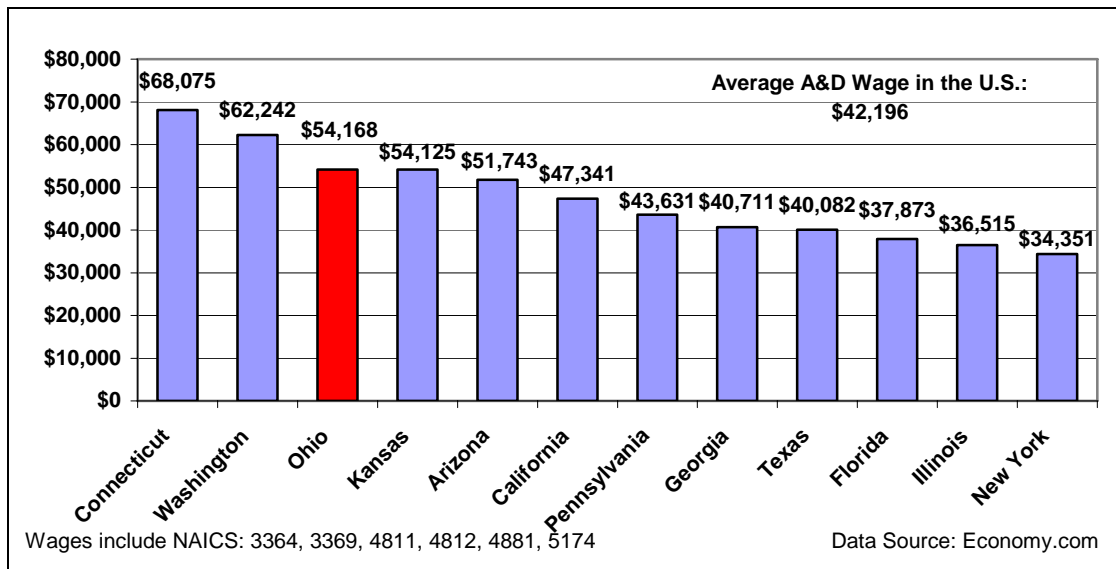


Wages

Ohio ranked 3rd among the 12 comparable states in private sector wages paid across all aerospace and defense industries at \$54,200. This figure is 29 percent higher than the national A&D average in 2002. Connecticut ranked 1st (\$68,100) followed by Washington (\$62,200). Figure 16 shows a wage comparison among the 12 states. A detailed wage breakdown by NAICS can be found in Appendix D, Tables D-26 through D-32.



Figure C-16. A&D Private Sector Wages in Ohio and Other Comparable States, 2002



Considering the fact that Ohio ranked number one in aerospace and defense manufacturing VAE, it follows that the State should rank near the top in A&D manufacturing wages. In fact, Ohio ranked 1st in manufacturing wages at \$70,900 in 2002. Nationally, the average A&D manufacturing wage was \$59,200, which was 16.5 percent less than in Ohio. Washington State was number two in manufacturing wages (\$68,000) followed by Connecticut (\$67,400). Washington also ranked 2nd in A&D manufacturing value-added. Table 6 shows wage figures for A&D manufacturing and service segments for the 12 comparable states.

Table C-6. A&D Private Sector Manufacturing & Service Segment Wages

STATE	WAGES 2002			
	MANUFACTURING	RANK	SERVICES	RANK
Arizona	\$64,144	4	\$35,189	6
California	\$62,202	5	\$31,585	11
Connecticut	\$67,440	3	\$75,209	2
Florida	\$50,763	10	\$33,450	9
Georgia	\$51,289	9	\$37,359	3
Illinois	\$49,500	11	\$35,675	5
Kansas	\$52,913	8	\$80,862	1
New York	\$46,080	12	\$32,165	10
Ohio	\$70,916	1	\$33,962	8
Pennsylvania	\$57,884	7	\$36,199	4
Texas	\$61,123	6	\$30,758	12
Washington	\$68,040	2	\$34,236	7
U.S.	\$59,158		\$30,235	

Data source: Economy.com



Just as Ohio ranked 1st in private sector aerospace products and parts manufacturing (NAICS 3364) value-added, so it ranked number one in wages (\$73,400) paid to NAICS 3364 workers. This is 20 percent higher than the national average and seven percent higher than in Washington State, which ranked 2nd in NAICS 3364 wages. In addition, Ohio ranked 4th in real wage growth in aerospace products and parts manufacturing between 1990 and 2002.

Although Ohio was number one in military armored vehicle and tank manufacturing (NAICS 3369) value-added, it reported a number three ranking in wages (\$45,800) behind New York (\$52,500) and Connecticut (\$49,450). However, NAICS 3369 wages in Ohio were still almost 20 percent higher than the reported U.S. average.

Looking at A&D service-related industry wages, Ohio ranked 8th at \$34,000. The national average in 2002 was \$30,200. This ranking is not surprising because Ohio was last in A&D service industry value-added. Kansas and Connecticut ranked 1st and 2nd in service wages at \$80,900 and \$75,200, respectively.

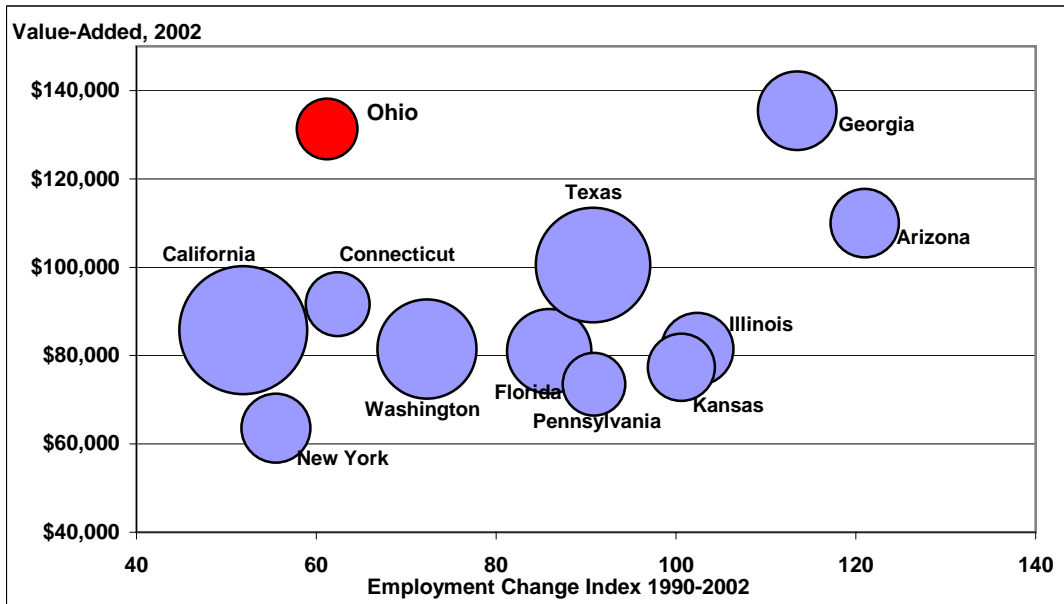
Summary Message

It is important to note that while the A&D industry in Ohio is relatively moderate in its size of employment and it lost jobs at twice the national average during the 1990s, there are two industry segments that stand out. Aerospace products and parts (NAICS 3364) and military armored vehicles and tanks (NAICS 3369) are high value-added per employee and high-paying manufacturing industries that have retained a significant presence in the State. Figure 17 shows a comparison of the 12 leading A&D states in terms of employment, employment change, and value-added per employee.³¹ As seen in Figure 17, Georgia and Arizona were the highest performing among the 12 leading aerospace and defense states in the U.S.

³¹Value-added per employee shown in Figure 17 is the average of all six A&D industry groups (manufacturing and services) discussed in this section.



Figure C-17. Value-Added Per Employee vs. Employment Change in the 12 Comparable States



Vertical axis: value-added

Horizontal axis: employment change index; 100 = no change in employment between 1990 and 2002, <100 = declining employment; >100 = increasing employment

Size of bubble: A&D employment



Appendix D: Aerospace and Defense Industry Statistics

Table D-1. Ohio Aerospace & Defense Manufacturing Employment, 2000 – 2003

		MANUFACTURING EMPLOYMENT			
<i>code</i>	<i>industry</i>	<i>2000:1Q</i>	<i>2003:1Q</i>	<i>Change</i>	<i>% Change</i>
Aerospace Product & Parts					
336411	Aircraft	292	119	-173	-59.2%
336413	Other Aircraft Parts & Auxiliary Equipment	4,380	4,254	-126	-2.9%
336414	Guided Missiles and Space Vehicles	0	0	0	-
336419	Other Guided Missiles & Space Vehicles	16	0	-16	-100.0%
	Subtotal	4,688	4,373	-315	-6.7%
Aircraft & Missile Propulsion					
336412	Aircraft Engine and Parts	12,709	10,506	-2,203	-17.3%
336415	Propulsion Units & Propulsion Parts	0	0	0	-
	Subtotal	12,709	10,506	-2,203	-17.3%
Search, Detection, Navigation Guidance					
334511	Search, Detection, Navigation, Guidance, Aeronautical	169	722	553	327.2%
	AEROSPACE SUBTOTAL	17,566	15,601	-1,965	-11.2%
Defense					
332992	Small Arms Ammunition	115	137	22	19.1%
332993	Ammunition	320	286	-34	-10.6%
332994	Small Arms	13	5	-8	-61.5%
332995	Other Ordnance and Accessories	93	57	-36	-38.7%
336992	Military Armored Vehicle, Tank & Tank Components	859	796	-63	-7.3%
	DEFENSE SUBTOTAL	1,400	1,281	-119	-8.5%
	MANUFACTURING TOTAL	18,966	16,882	-2,084	-11.0%

Data Source: ES202 Data

Prepared by: Center for Economic Development, Maxine Goodman Levin College of Urban Affairs, Cleveland State University



Table D-2. Ohio Aerospace & Defense Services Employment, 2000 – 2003

		SERVICES EMPLOYMENT			
<i>code</i>	<i>industry</i>	<i>2000:1Q</i>	<i>2003:1Q</i>	<i>Change</i>	<i>% Change</i>
Air Transportation					
481111	Scheduled Passenger Air Transportation	7,841	8,091	250	3.2%
481112	Scheduled Freight Air Transportation	497	551	54	10.9%
481211	Nonscheduled Chartered Passenger	1,733	3,640	1,907	110.0%
481212	Nonscheduled Chartered Freight	397	176	-221	-55.7%
481219	Other Nonscheduled Air	38	33	-5	-13.2%
	Subtotal	10,506	12,491	1,985	18.9%
Support Activities for Air Transportation					
488111	Air Traffic Control	1,599	1,445	-154	-9.6%
488119	Other Airport Operations	1,500	1,581	81	5.4%
488190	Other Support Activates for Air Transportation	1,876	1,898	22	1.2%
	Subtotal	4,975	4,924	-51	-1.0%
Satellite Communications					
517410	Satellite Communications	0	124	124	-
Flight Training Schools					
611512	Flight Training Schools	180	214	34	18.9%
Space Research & Technology					
927110	Space Research & Technology	2,006	1,939	-67	-3.3%
Defense					
928110	National Security (Note 1)	22,925	21,487	-1,438	-6.3%
	SERVICES TOTAL	40,592	41,179	587	1.4%
	TOTAL AEROSPACE & DEFENSE EMPLOYMENT	59,558	58,061	-1,497	-2.5%

Note 1: Employment figures for national security (NAICS 928110) only include civilian workers. The U.S. government does not provide ES202 with employment and payroll data for military personnel.

Data Source: ES202 Data

Prepared by: Center for Economic Development, Maxine Goodman Levin College of Urban Affairs, Cleveland State University



Table D-3. Ohio Aerospace & Defense Manufacturing Wages, 2000 – 2003

		MANUFACTURING WAGES			
code	industry	2000	2003	Change	%Change
	Aerospace Product & Parts				
336411	Aircraft	\$50,707	\$51,275	\$569	1.1%
336413	Other Aircraft Parts & Auxiliary Equipment	\$61,823	\$62,313	\$490	0.8%
336414	Guided Missiles and Space Vehicles	\$0	\$0	\$0	0.0%
336419	Other Guided Missiles & Space Vehicles	\$44,763	\$0	-\$44,763	-100.0%
	Subtotal	\$61,072	\$62,012	\$940	1.5%
	Aircraft & Missile Propulsion				
336412	Aircraft Engine and Parts	\$85,559	\$87,271	\$1,712	2.0%
336415	Propulsion Units & Propulsion Parts	\$0	\$0	\$0	0.0%
	Subtotal	\$85,559	\$87,271	\$1,712	2.0%
	Search, Detection, Navigation, Guidance				
334511	Search, Detection, Navigation, Guidance	\$52,824	\$50,999	-\$1,825	-3.5%
	AEROSPACE SUBTOTAL	\$78,709	\$78,512	-\$197	-0.3%
	Defense				
332992	Small Arms Ammunition	\$57,316	\$51,944	-\$5,372	-9.4%
332993	Ammunition	\$40,552	\$46,272	\$5,720	14.1%
332994	Small Arms	\$17,064	\$13,656	-\$3,408	-20.0%
332995	Other Ordnance and Accessories	\$45,895	\$31,608	-\$14,288	-31.1%
336992	Military Armored Vehicle, Tanks & Components	\$52,683	\$57,254	\$4,571	8.7%
	DEFENSE SUBTOTAL	\$49,509	\$52,923	\$3,414	6.9%
	MANUFACTURING TOTAL	\$76,554	\$76,571	\$17	0.0%

Data Source: ES202

2000 wage data has been inflated to 2003 levels.

Prepared by: Center for Economic Development, Maxine Goodman Levin College of Urban Affairs, Cleveland State University



Table D-4. Ohio Aerospace & Defense Services Wages, 2000 – 2003

		SERVICES WAGES			
<i>code</i>	<i>industry</i>	2000	2003	Change	% Change
Air Transportation					
481111	Scheduled Passenger Air Transportation	\$43,741	\$40,521	-\$3,220	-7.4%
481112	Scheduled Freight Air Transportation	\$38,413	\$40,856	\$2,443	6.4%
481211	Nonscheduled Chartered Passenger	\$49,121	\$50,889	\$1,768	3.6%
481212	Nonscheduled Chartered Freight	\$36,731	\$43,945	\$7,213	19.6%
481219	Other Nonscheduled Air	\$26,081	\$12,890	-\$13,191	-50.6%
	Subtotal	\$44,047	\$43,532	-\$515	-1.2%
Support Activities for Air Transportation					
488111	Air Traffic Control	\$63,984	\$83,038	\$19,054	29.8%
488119	Other Airport Operations	\$29,089	\$31,553	\$2,464	8.5%
488190	Other Support Activates for Air Transportation	\$35,880	\$41,733	\$5,853	16.3%
	Subtotal	\$42,865	\$50,585	\$7,720	18.0%
Satellite Communications					
517410	Satellite Communications	\$0	\$48,768	\$48,768	-
Flight Training Schools					
611512	Flight Training Schools	\$33,682	\$41,187	\$7,505	22.3%
Space Research & Technology					
927110	Space Research & Technology	\$65,790	\$72,145	\$6,355	9.7%
Defense					
928110	National Security (Note 1)	\$60,464	\$65,023	\$4,559	7.5%
	SERVICES TOTAL	\$54,203	\$56,941	\$2,738	5.1%
	TOTAL AEROSPACE & DEFENSE WAGES	\$61,320	\$62,648	\$1,328	2.2%

Data Source: ES202

2000 wage data has been inflated to 2003 levels.

Note 1: Wage figures for national security (NAICS 928110) only include civilian workers. The U.S. government does not provide ES202 with employment and payroll data for military personnel.

Prepared by: Center for Economic Development, Maxine Goodman Levin College of Urban Affairs, Cleveland State University.

Subtotal wages are calculated as follows: Total payroll for all industries in the above sub industries divided by total employment in these industries.



Table D-5. NAICS 3364 Aerospace Product and Parts Manufacturing Employment

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	23,199	24,677	22,686	1,478	6.4%	-1,992	-8.1%
California	206,866	72,529	63,800	-134,336	-64.9%	-8,730	-12.0%
Connecticut	58,102	35,015	31,432	-23,087	-39.7%	-3,583	-10.2%
Florida	31,801	16,653	13,363	-15,149	-47.6%	-3,290	-19.8%
Georgia	13,444	13,070	10,639	-373	-2.8%	-2,432	-18.6%
Illinois	3,096	2,401	2,457	-696	-22.5%	56	2.4%
Kansas	40,140	40,351	36,064	211	0.5%	-4,288	-10.6%
New York	20,845	6,631	6,282	-14,214	-68.2%	-349	-5.3%
Ohio	41,552	17,437	15,128	-24,115	-58.0%	-2,308	-13.2%
Pennsylvania	16,941	9,316	8,735	-7,625	-45.0%	-582	-6.2%
Texas	68,995	36,466	32,545	-32,529	-47.1%	-3,922	-10.8%
Washington	113,040	75,720	61,470	-37,320	-33.0%	-14,250	-18.8%
U.S.	840,599	470,409	422,048	-370,190	-44.0%	-48,361	-10.3%

Data Source: Economy.com

Table D-6. NAICS 3369 Military Armored Vehicles and Tanks Employment

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	94	514	564	420	448.4%	50	9.8%
California	3,459	6,614	10,445	3,155	91.2%	3,831	57.9%
Connecticut	89	133	137	44	48.9%	4	3.0%
Florida	255	430	477	175	68.5%	47	10.9%
Georgia	530	887	894	357	67.3%	7	0.8%
Illinois	1,304	577	519	-727	-55.8%	-58	-10.0%
Kansas	432	432	311	-1	-0.2%	-120	-27.9%
New York	142	470	700	328	230.1%	231	49.1%
Ohio	4,481	1,697	1,381	-2,784	-62.1%	-316	-18.6%
Pennsylvania	3,049	3,497	3,772	448	14.7%	275	7.9%
Texas	423	1,302	1,649	878	207.4%	347	26.7%
Washington	250	590	670	340	136.0%	80	13.6%
U.S.	34,989	38,825	38,409	3,836	11.0%	-415	-1.1%

Data Source: Economy.com



Table D-7. NAICS 4811 Scheduled Air Transportation Employment

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	9,849	14,488	17,405	4,638	47.1%	2,917	20.1%
California	68,779	55,887	47,405	-12,892	-18.7%	-8,482	-15.2%
Connecticut	1,779	1,915	1,853	136	7.6%	-62	-3.2%
Florida	31,353	34,023	31,509	2,670	8.5%	-2,514	-7.4%
Georgia	33,612	39,664	42,813	6,053	18.0%	3,149	7.9%
Illinois	38,110	40,700	38,588	2,590	6.8%	-2,112	-5.2%
Kansas	884	1,035	1,037	151	17.0%	3	0.3%
New York	49,764	27,962	23,092	-21,801	-43.8%	-4,870	-17.4%
Ohio	7,220	10,908	12,281	3,688	51.1%	1,372	12.6%
Pennsylvania	18,238	21,655	18,709	3,417	18.7%	-2,945	-13.6%
Texas	52,311	64,664	62,397	12,353	23.6%	-2,267	-3.5%
Washington	12,690	13,190	13,910	500	3.9%	720	5.5%
U.S.	502,795	520,151	487,621	17,356	3.5%	-32,530	-6.3%

Data Source: Economy.com

Table D-8. NAICS 4812 Nonscheduled Air Transportation Employment

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	452	1,140	1,538	687	152.0%	399	35.0%
California	3,858	3,426	2,564	-432	-11.2%	-862	-25.2%
Connecticut	253	118	80	-134	-53.2%	-38	-32.1%
Florida	2,739	3,925	2,778	1,186	43.3%	-1,148	-29.2%
Georgia	599	690	764	91	15.2%	73	10.6%
Illinois	733	1,175	1,273	442	60.3%	99	8.4%
Kansas	131	63	45	-68	-52.0%	-18	-28.5%
New York	2,830	1,819	1,433	-1,012	-35.7%	-385	-21.2%
Ohio	696	1,397	1,628	701	100.7%	231	16.5%
Pennsylvania	1,057	834	515	-223	-21.1%	-319	-38.3%
Texas	3,476	7,141	7,423	3,665	105.4%	282	3.9%
Washington	290	480	430	190	65.5%	-50	-10.4%
U.S.	26,564	43,732	46,074	17,168	64.6%	2,342	5.4%

Data Source: Economy.com



Table D-9. NAICS 4881 Support Activities for Air Transportation Employment

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	2,692	3,057	3,131	365	13.6%	74.5	2.4%
California	12,438	14,087	13,852	1,649	13.3%	-234.5	-1.7%
Connecticut	1,015	957	754	-59	-5.8%	-202.8	-21.2%
Florida	11,177	11,192	9,338	15	0.1%	-1,854.4	-16.6%
Georgia	2,636	3,204	2,581	568	21.6%	-623.3	-19.5%
Illinois	4,286	3,741	2,919	-545	-12.7%	-822.4	-22.0%
Kansas	658	502	356	-156	-23.7%	-146.7	-29.2%
New York	6,954	7,588	7,299	634	9.1%	-288.4	-3.8%
Ohio	2,915	3,211	2,421	296	10.1%	-789.4	-24.6%
Pennsylvania	1,523	1,664	939	141	9.3%	-725.2	-43.6%
Texas	9,591	12,469	11,659	2,878	30.0%	-810.5	-6.5%
Washington	1,040	1,970	2,350	930	89.4%	380.0	19.3%
U.S.	95,345	139,787	145,196	44,442	46.6%	5,409.2	3.9%

Data Source: Economy.com

Table D-10. NAICS 5174 Satellite Communications Employment

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	127	189	219	62	48.5%	30	16.0%
California	1,169	1,245	1,326	76	6.5%	81	6.5%
Connecticut	138	140	140	2	1.7%	0	-0.2%
Florida	500	651	710	151	30.1%	59	9.1%
Georgia	300	496	548	196	65.4%	52	10.4%
Illinois	345	451	485	106	30.7%	34	7.6%
Kansas	118	248	306	131	111.2%	58	23.2%
New York	823	723	694	-100	-12.1%	-29	-3.9%
Ohio	329	343	350	14	4.3%	7	2.0%
Pennsylvania	322	419	462	98	30.4%	42	10.1%
Texas	658	950	928	292	44.4%	-22	-2.3%
Washington	100	200	230	100	100.0%	30	15.0%
U.S.	16,742	18,556	18,207	1,813	10.8%	-348	-1.9%

Data Source: Economy.com



Table D-11. Aerospace and Defense Industry Employment

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	36,413	44,064	45,543	7,650	21.0%	1,479	3.4%
California	296,568	153,788	139,392	-142,780	-48.1%	-14,396	-9.4%
Connecticut	61,376	38,277	34,395	-23,099	-37.6%	-3,882	-10.1%
Florida	77,826	66,873	58,173	-10,953	-14.1%	-8,700	-13.0%
Georgia	51,121	58,012	58,238	6,891	13.5%	226	0.4%
Illinois	47,874	49,044	46,241	1,170	2.4%	-2,803	-5.7%
Kansas	42,362	42,631	38,119	268	0.6%	-4,512	-10.6%
New York	81,358	45,193	39,502	-36,165	-44.5%	-5,690	-12.6%
Ohio	57,193	34,993	33,190	-22,200	-38.8%	-1,803	-5.2%
Pennsylvania	41,130	37,385	33,132	-3,745	-9.1%	-4,253	-11.4%
Texas	135,455	122,992	116,600	-12,463	-9.2%	-6,392	-5.2%
Washington	127,410	92,150	79,060	-35,260	-27.7%	-13,090	-14.2%
U.S.	1,517,034	1,231,459	1,157,556	-285,574	-18.8%	-73,903	-6.0%

Data Source: Economy.com

Table D-12. NAICS 3364 Aerospace Product and Parts Manufacturing VAO

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$1,601,054,340	\$3,599,649,499	\$3,802,572,615	\$1,998,595,159	124.8%	\$202,923,116	5.6%
California	\$15,902,883,133	\$6,622,650,065	\$6,649,954,736	-\$9,280,233,068	-58.4%	\$27,304,671	0.4%
Connecticut	\$5,005,385,701	\$3,127,698,366	\$3,168,648,893	-\$1,877,687,336	-37.5%	\$40,950,527	1.3%
Florida	\$2,426,738,443	\$1,261,998,668	\$1,042,510,003	-\$1,164,739,775	-48.0%	-\$219,488,665	-17.4%
Georgia	\$1,199,953,263	\$1,867,913,080	\$1,908,331,403	\$667,959,817	55.7%	\$40,418,324	2.2%
Illinois	\$292,493,462	\$242,071,984	\$232,186,241	-\$50,421,477	-17.2%	-\$9,885,743	-4.1%
Kansas	\$2,614,280,985	\$3,020,368,424	\$2,943,902,046	\$406,087,439	15.5%	-\$76,466,377	-2.5%
New York	\$1,931,757,426	\$615,359,456	\$568,449,211	-\$1,316,397,970	-68.1%	-\$46,910,245	-7.6%
Ohio	\$4,950,185,276	\$3,598,627,947	\$3,764,145,107	-\$1,351,557,329	-27.3%	\$165,517,160	4.6%
Pennsylvania	\$1,449,906,773	\$824,050,961	\$826,927,539	-\$625,855,812	-43.2%	\$2,876,578	0.3%
Texas	\$5,221,206,156	\$4,324,088,074	\$4,432,291,343	-\$897,118,082	-17.2%	\$108,203,269	2.5%
Washington	\$8,470,711,134	\$6,215,009,553	\$6,166,495,197	-\$2,255,701,581	-26.6%	-\$48,514,356	-0.8%
U.S.	\$67,018,620,278	\$49,025,258,319	\$51,142,091,534	-\$17,993,361,959	-26.8%	\$2,116,833,215	4.3%

Data Source: Economy.com

VAO: Value-Added Output

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels



Table D-13. NAICS 3369 Military Armored Vehicles and Tanks VAO

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$3,047,277	\$33,029,944	\$30,383,900	\$29,982,668	983.9%	-\$2,646,044	-8.0%
California	\$163,122,884	\$366,422,577	\$481,162,700	\$203,299,693	124.6%	\$114,740,123	31.3%
Connecticut	\$4,946,464	\$8,670,327	\$7,638,590	\$3,723,863	75.3%	-\$1,031,737	-11.9%
Florida	\$9,527,933	\$10,641,956	\$9,223,491	\$1,114,023	11.7%	-\$1,418,465	-13.3%
Georgia	\$32,769,026	\$71,250,573	\$64,267,984	\$38,481,546	117.4%	-\$6,982,589	-9.8%
Illinois	\$46,763,042	\$27,240,447	\$16,858,636	-\$19,522,595	-41.7%	-\$10,381,811	-38.1%
Kansas	\$15,655,314	\$13,660,520	\$9,552,190	-\$1,994,795	-12.7%	-\$4,108,329	-30.1%
New York	\$7,621,699	\$50,211,915	\$68,803,530	\$42,590,217	558.8%	\$18,591,615	37.0%
Ohio	\$384,527,241	\$218,838,302	\$197,386,182	-\$165,688,939	-43.1%	-\$21,452,121	-9.8%
Pennsylvania	\$154,626,858	\$182,464,732	\$173,506,979	\$27,837,874	18.0%	-\$8,957,753	-4.9%
Texas	\$14,219,128	\$51,158,491	\$67,138,742	\$36,939,363	259.8%	\$15,980,251	31.2%
Washington	\$10,605,411	\$22,063,347	\$20,017,287	\$11,457,936	108.0%	-\$2,046,060	-9.3%
U.S.	\$1,383,270,804	\$2,543,938,806	\$2,850,631,833	\$1,160,668,002	83.9%	\$306,693,027	12.1%

Data Source: Economy.com

VAO: Value-Added Output

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels

Table D-14. NAICS 4811 Scheduled Air Transportation VAO

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$356,514,645	\$835,925,463	\$1,224,534,514	\$479,410,818	134.5%	\$388,609,051	46.5%
California	\$3,986,297,890	\$4,853,762,311	\$5,376,586,567	\$867,464,421	21.8%	\$522,824,256	10.8%
Connecticut	\$185,872,559	\$224,586,583	\$231,699,392	\$38,714,024	20.8%	\$7,112,809	3.2%
Florida	\$1,398,985,909	\$2,947,252,469	\$4,663,851,796	\$1,548,266,560	110.7%	\$1,716,599,327	58.2%
Georgia	\$1,970,089,906	\$5,564,168,097	\$8,907,170,629	\$3,594,078,191	182.4%	\$3,343,002,531	60.1%
Illinois	\$1,955,500,816	\$3,382,065,227	\$4,228,507,063	\$1,426,564,411	73.0%	\$846,441,836	25.0%
Kansas	\$75,953,703	\$155,736,880	\$195,700,990	\$79,783,177	105.0%	\$39,964,110	25.7%
New York	\$2,339,119,334	\$1,685,342,577	\$1,846,650,310	-\$653,776,756	-27.9%	\$161,307,733	9.6%
Ohio	\$349,110,693	\$471,974,891	\$602,040,140	\$122,864,198	35.2%	\$130,065,249	27.6%
Pennsylvania	\$901,737,574	\$1,600,267,175	\$1,859,338,838	\$698,529,601	77.5%	\$259,071,663	16.2%
Texas	\$2,980,621,094	\$6,608,065,636	\$9,309,414,317	\$3,627,444,542	121.7%	\$2,701,348,681	40.9%
Washington	\$666,037,998	\$1,080,694,791	\$1,486,485,324	\$414,656,793	62.3%	\$405,790,533	37.5%
U.S.	\$25,208,698,203	\$36,912,319,404	\$45,687,809,363	\$11,703,621,201	46.4%	\$8,775,489,958	23.8%

Data Source: Economy.com

VAO: Value-Added Output

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels



Table D-15. NAICS 4812 Nonscheduled Air Transportation VAO

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$14,077,882	\$89,950,242	\$153,671,621	\$75,872,361	538.9%	\$63,721,379	70.8%
California	\$132,138,192	\$340,835,448	\$360,852,338	\$208,697,256	157.9%	\$20,016,889	5.9%
Connecticut	\$14,859,533	\$31,077,912	\$25,839,646	\$16,218,379	109.1%	-\$5,238,266	-16.9%
Florida	\$112,645,265	\$347,014,515	\$444,938,652	\$234,369,250	208.1%	\$97,924,136	28.2%
Georgia	\$32,427,846	\$65,388,770	\$99,676,405	\$32,960,924	101.6%	\$34,287,635	52.4%
Illinois	\$26,737,480	\$76,935,312	\$97,482,790	\$50,197,831	187.7%	\$20,547,478	26.7%
Kansas	\$8,529,297	\$4,684,341	\$3,150,398	-\$3,844,956	-45.1%	-\$1,533,943	-32.7%
New York	\$139,100,741	\$101,988,475	\$97,266,123	-\$37,112,266	-26.7%	-\$4,722,352	-4.6%
Ohio	\$32,279,984	\$85,285,703	\$106,699,426	\$53,005,719	164.2%	\$21,413,723	25.1%
Pennsylvania	\$35,866,170	\$41,447,549	\$32,248,725	\$5,581,379	15.6%	-\$9,198,824	-22.2%
Texas	\$217,860,070	\$494,615,431	\$672,774,457	\$276,755,361	127.0%	\$178,159,026	36.0%
Washington	\$10,241,667	\$39,534,426	\$57,676,158	\$29,292,759	286.0%	\$18,141,732	45.9%
U.S.	\$1,055,865,398	\$2,807,022,337	\$3,740,950,175	\$1,751,156,939	165.9%	\$933,927,838	33.3%

Data Source: Economy.com
 VAO: Value-Added Output
 1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels

Table D-16. NAICS 4881 Support Activities for Air Transportation VAO

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$110,264,197	\$258,826,863	\$307,409,216	\$148,562,666	134.7%	\$48,582,353	18.8%
California	\$418,933,445	\$787,994,029	\$918,054,118	\$369,060,585	88.1%	\$130,060,089	16.5%
Connecticut	\$38,979,887	\$92,289,537	\$78,206,313	\$53,309,650	136.8%	-\$14,083,224	-15.3%
Florida	\$398,739,253	\$753,591,861	\$820,544,491	\$354,852,608	89.0%	\$66,952,630	8.9%
Georgia	\$112,741,134	\$183,729,800	\$134,446,102	\$70,988,666	63.0%	-\$49,283,697	-26.8%
Illinois	\$164,199,827	\$175,780,516	\$151,558,428	\$11,580,688	7.1%	-\$24,222,088	-13.8%
Kansas	\$48,084,661	\$30,052,688	\$20,058,026	-\$18,031,972	-37.5%	-\$9,994,662	-33.3%
New York	\$213,697,292	\$309,853,712	\$324,478,347	\$96,156,420	45.0%	\$14,624,634	4.7%
Ohio	\$138,635,820	\$167,240,352	\$134,094,328	\$28,604,533	20.6%	-\$33,146,024	-19.8%
Pennsylvania	\$46,653,283	\$30,976,519	\$12,939,704	-\$15,676,764	-33.6%	-\$18,036,815	-58.2%
Texas	\$436,323,034	\$675,374,215	\$673,621,503	\$239,051,181	54.8%	-\$1,752,712	-0.3%
Washington	\$34,521,579	\$99,472,617	\$126,060,030	\$64,951,038	188.1%	\$26,587,413	26.7%
U.S.	\$3,980,390,347	\$5,593,698,995	\$7,004,897,154	\$1,613,308,648	40.5%	\$1,411,198,159	25.2%

Data Source: Economy.com
 VAO: Value-Added Output
 1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels



Table D-17. NAICS 5174 Satellite Communications VAO

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$13,481,603	\$28,592,336	\$38,987,980	\$15,110,733	112.1%	\$10,395,644	36.4%
California	\$180,453,296	\$220,656,113	\$242,513,604	\$40,202,817	22.3%	\$21,857,491	9.9%
Connecticut	\$19,819,922	\$23,153,124	\$27,010,652	\$3,333,202	16.8%	\$3,857,528	16.7%
Florida	\$69,363,651	\$96,117,749	\$111,710,545	\$26,754,099	38.6%	\$15,592,796	16.2%
Georgia	\$34,639,750	\$104,550,961	\$125,370,690	\$69,911,210	201.8%	\$20,819,729	19.9%
Illinois	\$45,511,513	\$90,295,981	\$113,852,986	\$44,784,468	98.4%	\$23,557,005	26.1%
Kansas	\$13,056,375	\$73,067,178	\$95,563,869	\$60,010,803	459.6%	\$22,496,691	30.8%
New York	\$167,015,240	\$110,572,231	\$106,808,288	-\$56,443,009	-33.8%	-\$3,763,943	-3.4%
Ohio	\$41,088,431	\$51,082,980	\$58,099,113	\$9,994,548	24.3%	\$7,016,133	13.7%
Pennsylvania	\$41,286,967	\$68,601,686	\$89,788,274	\$27,314,719	66.2%	\$21,186,588	30.9%
Texas	\$95,529,814	\$201,368,792	\$263,337,288	\$105,838,978	110.8%	\$61,968,496	30.8%
Washington	\$13,231,188	\$53,959,149	\$60,495,174	\$40,727,961	307.8%	\$6,536,025	12.1%
U.S.	\$1,221,306,741	\$2,449,050,727	\$2,992,543,144	\$1,227,743,987	100.5%	\$543,492,417	22.2%

Data Source: Economy.com

VAO: Value-Added Output

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels

Table D-18. Aerospace and Defense Industry VAO

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$2,098,439,943	\$4,845,974,348	\$5,557,559,846	\$2,747,534,405	130.9%	\$711,585,499	14.7%
California	\$20,783,828,841	\$13,192,320,544	\$14,029,124,062	-\$7,591,508,297	-36.5%	\$836,803,518	6.3%
Connecticut	\$5,269,864,066	\$3,507,475,849	\$3,539,043,486	-\$1,762,388,217	-33.4%	\$31,567,637	0.9%
Florida	\$4,416,000,454	\$5,416,617,219	\$7,092,778,978	\$1,000,616,765	22.7%	\$1,676,161,758	30.9%
Georgia	\$3,382,620,925	\$7,857,001,280	\$11,239,263,212	\$4,474,380,354	132.3%	\$3,382,261,933	43.0%
Illinois	\$2,531,206,140	\$3,994,389,467	\$4,840,446,144	\$1,463,183,326	57.8%	\$846,056,677	21.2%
Kansas	\$2,775,560,334	\$3,297,570,031	\$3,267,927,520	\$522,009,696	18.8%	-\$29,642,510	-0.9%
New York	\$4,798,311,732	\$2,873,328,367	\$3,012,455,809	-\$1,924,983,365	-40.1%	\$139,127,442	4.8%
Ohio	\$5,895,827,444	\$4,593,050,175	\$4,862,464,295	-\$1,302,777,269	-22.1%	\$269,414,121	5.9%
Pennsylvania	\$2,630,077,625	\$2,747,808,622	\$2,994,750,059	\$117,730,997	4.5%	\$246,941,437	9.0%
Texas	\$8,965,759,295	\$12,354,670,639	\$15,418,577,651	\$3,388,911,344	37.8%	\$3,063,907,012	24.8%
Washington	\$9,205,348,977	\$7,510,733,883	\$7,917,229,170	-\$1,694,615,094	-18.4%	\$406,495,287	5.4%
U.S.	\$99,868,151,771	\$99,331,288,588	\$113,418,923,203	-\$536,863,183	-0.5%	\$14,087,634,615	14.2%

Data Source: Economy.com

VAO: Value-Added Output

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels



Table D-19. NAICS 3364 Aerospace Product and Parts Manufacturing VAE

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$69,014	\$145,870	\$167,621	\$76,856	111.4%	\$21,751	14.9%
California	\$76,875	\$91,310	\$104,232	\$14,434	18.8%	\$12,922	14.2%
Connecticut	\$86,148	\$89,325	\$100,811	\$3,177	3.7%	\$11,486	12.9%
Florida	\$76,309	\$75,783	\$78,017	-\$526	-0.7%	\$2,234	2.9%
Georgia	\$89,258	\$142,912	\$179,379	\$53,653	60.1%	\$36,467	25.5%
Illinois	\$94,461	\$100,828	\$94,488	\$6,367	6.7%	-\$6,340	-6.3%
Kansas	\$65,129	\$74,852	\$81,630	\$9,723	14.9%	\$6,779	9.1%
New York	\$92,672	\$92,795	\$90,482	\$123	0.1%	-\$2,313	-2.5%
Ohio	\$119,133	\$206,383	\$248,812	\$87,250	73.2%	\$42,429	20.6%
Pennsylvania	\$85,584	\$88,452	\$94,674	\$2,868	3.4%	\$6,222	7.0%
Texas	\$75,675	\$118,577	\$136,190	\$42,903	56.7%	\$17,613	14.9%
Washington	\$74,936	\$82,079	\$100,317	\$7,143	9.5%	\$18,238	22.2%
U.S.	\$79,727	\$104,218	\$121,176	\$24,491	30.7%	\$16,958	16.3%

Data Source: Economy.com

VAE: Value-Added per Employee

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels

Table D-20. NAICS 3369 Military Armored Vehicles and Tanks VAE

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$32,536	\$64,312	\$53,888	\$31,776	97.7%	-\$10,423	-16.2%
California	\$47,156	\$55,402	\$46,068	\$8,246	17.5%	-\$9,334	-16.8%
Connecticut	\$55,578	\$65,431	\$55,948	\$9,853	17.7%	-\$9,483	-14.5%
Florida	\$37,337	\$24,756	\$19,355	-\$12,580	-33.7%	-\$5,402	-21.8%
Georgia	\$61,816	\$80,352	\$71,885	\$18,537	30.0%	-\$8,467	-10.5%
Illinois	\$35,858	\$47,233	\$32,490	\$11,375	31.7%	-\$14,742	-31.2%
Kansas	\$36,225	\$31,657	\$30,682	-\$4,567	-12.6%	-\$976	-3.1%
New York	\$53,546	\$106,868	\$98,225	\$53,322	99.6%	-\$8,643	-8.1%
Ohio	\$85,814	\$128,959	\$142,883	\$43,145	50.3%	\$13,924	10.8%
Pennsylvania	\$50,714	\$52,178	\$45,997	\$1,464	2.9%	-\$6,181	-11.8%
Texas	\$33,578	\$39,301	\$40,713	\$5,722	17.0%	\$1,412	3.6%
Washington	\$42,422	\$37,396	\$29,877	-\$5,026	-11.8%	-\$7,519	-20.1%
U.S.	\$39,534	\$65,524	\$74,217	\$25,989	65.7%	\$8,694	13.3%

Data Source: Economy.com

VAE: Value-Added per Employee

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels



Table D-21. NAICS 4811 Scheduled Air Transportation VAE

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$36,197	\$57,700	\$70,357	\$21,502	59.4%	\$12,657	21.9%
California	\$57,958	\$86,850	\$113,418	\$28,892	49.8%	\$26,568	30.6%
Connecticut	\$104,462	\$117,284	\$125,041	\$12,823	12.3%	\$7,757	6.6%
Florida	\$44,620	\$86,626	\$148,017	\$42,006	94.1%	\$61,391	70.9%
Georgia	\$58,613	\$140,282	\$208,047	\$81,669	139.3%	\$67,766	48.3%
Illinois	\$51,312	\$83,098	\$109,582	\$31,785	61.9%	\$26,484	31.9%
Kansas	\$85,929	\$150,540	\$188,653	\$64,611	75.2%	\$38,113	25.3%
New York	\$47,005	\$60,272	\$79,969	\$13,267	28.2%	\$19,697	32.7%
Ohio	\$48,351	\$43,267	\$49,023	-\$5,083	-10.5%	\$5,756	13.3%
Pennsylvania	\$49,444	\$73,900	\$99,380	\$24,456	49.5%	\$25,480	34.5%
Texas	\$56,979	\$102,191	\$149,197	\$45,212	79.3%	\$47,006	46.0%
Washington	\$52,485	\$81,933	\$106,865	\$29,448	56.1%	\$24,932	30.4%
U.S.	\$50,137	\$70,965	\$93,695	\$20,828	41.5%	\$22,731	32.0%

Data Source: Economy.com

VAE: Value-Added per Employee

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels

Table D-22. NAICS 4812 Nonscheduled Air transportation VAE

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$31,128	\$78,935	\$99,903	\$47,807	153.6%	\$20,968	26.6%
California	\$34,250	\$99,477	\$140,734	\$65,227	190.4%	\$41,257	41.5%
Connecticut	\$58,812	\$262,726	\$321,669	\$203,914	346.7%	\$58,942	22.4%
Florida	\$41,123	\$88,407	\$160,185	\$47,284	115.0%	\$71,778	81.2%
Georgia	\$54,125	\$94,753	\$130,538	\$40,628	75.1%	\$35,786	37.8%
Illinois	\$36,480	\$65,485	\$76,553	\$29,005	79.5%	\$11,068	16.9%
Kansas	\$65,229	\$74,580	\$70,134	\$9,351	14.3%	-\$4,446	-6.0%
New York	\$49,147	\$56,084	\$67,855	\$6,937	14.1%	\$11,771	21.0%
Ohio	\$46,373	\$61,034	\$65,525	\$14,661	31.6%	\$4,491	7.4%
Pennsylvania	\$33,924	\$49,707	\$62,663	\$15,784	46.5%	\$12,955	26.1%
Texas	\$62,668	\$69,262	\$90,637	\$6,594	10.5%	\$21,375	30.9%
Washington	\$35,316	\$82,363	\$134,131	\$47,047	133.2%	\$51,767	62.9%
U.S.	\$39,748	\$64,187	\$81,194	\$24,439	61.5%	\$17,007	26.5%

Data Source: Economy.com

VAE: Value-Added per Employee

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels



Table D-23. NAICS 4881 Support Activities for Air Transportation VAE

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$40,964	\$84,678	\$98,179	\$43,714	106.7%	\$13,501	15.9%
California	\$33,683	\$55,939	\$66,274	\$22,256	66.1%	\$10,336	18.5%
Connecticut	\$38,396	\$96,484	\$103,756	\$58,088	151.3%	\$7,273	7.5%
Florida	\$35,675	\$67,334	\$87,876	\$31,659	88.7%	\$20,542	30.5%
Georgia	\$42,774	\$57,343	\$52,096	\$14,570	34.1%	-\$5,248	-9.2%
Illinois	\$38,312	\$46,985	\$51,925	\$8,674	22.6%	\$4,940	10.5%
Kansas	\$73,076	\$59,844	\$56,420	-\$13,231	-18.1%	-\$3,424	-5.7%
New York	\$30,731	\$40,835	\$44,452	\$10,104	32.9%	\$3,617	8.9%
Ohio	\$47,557	\$52,086	\$55,378	\$4,529	9.5%	\$3,292	6.3%
Pennsylvania	\$30,634	\$18,613	\$13,781	-\$12,021	-39.2%	-\$4,833	-26.0%
Texas	\$45,494	\$54,164	\$57,779	\$8,670	19.1%	\$3,615	6.7%
Washington	\$33,194	\$50,494	\$53,643	\$17,300	52.1%	\$3,149	6.2%
U.S.	\$41,747	\$40,016	\$48,244	-\$1,731	-4.1%	\$8,228	20.6%

Data Source: Economy.com

VAE: Value-Added per Employee

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels

Table D-24. NAICS 5174 Satellite Communications VAE

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$105,813	\$151,122	\$177,662	\$45,310	42.8%	\$26,540	17.6%
California	\$154,420	\$177,228	\$182,877	\$22,808	14.8%	\$5,649	3.2%
Connecticut	\$144,113	\$165,581	\$193,611	\$21,467	14.9%	\$28,030	16.9%
Florida	\$138,594	\$147,651	\$157,339	\$9,057	6.5%	\$9,688	6.6%
Georgia	\$115,381	\$210,584	\$228,687	\$95,203	82.5%	\$18,102	8.6%
Illinois	\$131,944	\$200,284	\$234,773	\$68,340	51.8%	\$34,489	17.2%
Kansas	\$111,033	\$294,163	\$312,321	\$183,130	164.9%	\$18,158	6.2%
New York	\$203,004	\$152,961	\$153,818	-\$50,043	-24.7%	\$858	0.6%
Ohio	\$125,056	\$149,021	\$166,102	\$23,965	19.2%	\$17,081	11.5%
Pennsylvania	\$128,336	\$163,563	\$194,435	\$35,227	27.4%	\$30,872	18.9%
Texas	\$145,182	\$211,958	\$283,628	\$66,776	46.0%	\$71,670	33.8%
Washington	\$132,312	\$269,796	\$263,022	\$137,484	103.9%	-\$6,773	-2.5%
U.S.	\$72,948	\$131,984	\$164,359	\$59,036	80.9%	\$32,375	24.5%

Data Source: Economy.com

VAE: Value-Added per Employee

1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels



Table D-25. Aerospace and Defense Industry VAE

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$57,629	\$109,977	\$122,029	\$52,348	90.8%	\$12,053	11.0%
California	\$70,081	\$85,782	\$100,645	\$15,701	22.4%	\$14,863	17.3%
Connecticut	\$85,862	\$91,634	\$102,895	\$5,772	6.7%	\$11,261	12.3%
Florida	\$56,742	\$80,998	\$121,925	\$24,256	42.7%	\$40,927	50.5%
Georgia	\$66,169	\$135,437	\$192,987	\$69,268	104.7%	\$57,550	42.5%
Illinois	\$52,872	\$81,444	\$104,678	\$28,572	54.0%	\$23,234	28.5%
Kansas	\$65,519	\$77,352	\$85,730	\$11,832	18.1%	\$8,378	10.8%
New York	\$58,978	\$63,579	\$76,260	\$4,601	7.8%	\$12,681	19.9%
Ohio	\$103,087	\$131,257	\$146,503	\$28,170	27.3%	\$15,246	11.6%
Pennsylvania	\$63,946	\$73,500	\$90,390	\$9,554	14.9%	\$16,890	23.0%
Texas	\$66,190	\$100,451	\$132,234	\$34,261	51.8%	\$31,784	31.6%
Washington	\$72,250	\$81,506	\$100,142	\$9,256	12.8%	\$18,637	22.9%
U.S.	\$65,831	\$80,661	\$97,981	\$14,830	22.5%	\$17,320	21.5%

Data Source: Economy.com
 VAE: Value-Added per Employee
 1990 data inflated to 2002 levels; 2007 data deflated to 2002 levels

Table D-26. NAICS 3364 Aerospace Product and Parts Manufacturing Wages

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$49,457	\$64,884	\$73,883	\$15,427	31.2%	\$8,999	13.9%
California	\$56,397	\$64,316	\$66,993	\$7,919	14.0%	\$2,678	4.2%
Connecticut	\$55,841	\$67,508	\$80,360	\$11,667	20.9%	\$12,852	19.0%
Florida	\$53,492	\$51,638	\$54,377	-\$1,854	-3.5%	\$2,739	5.3%
Georgia	\$48,297	\$52,757	\$66,842	\$4,460	9.2%	\$14,086	26.7%
Illinois	\$52,431	\$55,182	\$54,364	\$2,750	5.2%	-\$818	-1.5%
Kansas	\$45,215	\$53,238	\$60,846	\$8,023	17.7%	\$7,608	14.3%
New York	\$57,300	\$45,623	\$40,321	-\$11,677	-20.4%	-\$5,302	-11.6%
Ohio	\$57,379	\$73,357	\$79,803	\$15,978	27.8%	\$6,446	8.8%
Pennsylvania	\$52,319	\$65,179	\$74,797	\$12,860	24.6%	\$9,618	14.8%
Texas	\$48,571	\$62,564	\$67,102	\$13,993	28.8%	\$4,537	7.3%
Washington	\$52,322	\$68,412	\$81,297	\$16,090	30.8%	\$12,885	18.8%
U.S.	\$54,104	\$60,875	\$67,142	\$6,771	12.5%	\$6,267	10.3%

Data Source: Economy.com



Table D-27. NAICS 3369 Military Armored Vehicles and Tanks Wages

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$23,316	\$28,606	\$23,753	\$5,291	22.7%	-\$4,854	-17.0%
California	\$34,594	\$39,024	\$29,610	\$4,429	12.8%	-\$9,414	-24.1%
Connecticut	\$36,025	\$49,450	\$44,598	\$13,425	37.3%	-\$4,852	-9.8%
Florida	\$26,173	\$16,869	\$13,490	-\$9,304	-35.5%	-\$3,379	-20.0%
Georgia	\$33,448	\$29,662	\$26,787	-\$3,785	-11.3%	-\$2,876	-9.7%
Illinois	\$19,903	\$25,850	\$18,694	\$5,947	29.9%	-\$7,156	-27.7%
Kansas	\$25,149	\$22,516	\$22,870	-\$2,632	-10.5%	\$353	1.6%
New York	\$33,108	\$52,541	\$43,771	\$19,434	58.7%	-\$8,771	-16.7%
Ohio	\$41,332	\$45,837	\$45,828	\$4,506	10.9%	-\$9	0.0%
Pennsylvania	\$31,003	\$38,449	\$36,340	\$7,446	24.0%	-\$2,109	-5.5%
Texas	\$21,552	\$20,736	\$20,060	-\$816	-3.8%	-\$676	-3.3%
Washington	\$29,647	\$31,162	\$24,207	\$1,515	5.1%	-\$6,955	-22.3%
U.S.	\$26,829	\$38,354	\$41,688	\$11,525	43.0%	\$3,334	8.7%

Data Source: Economy.com

Table D-28. NAICS 4811 Scheduled Air Transportation Wages

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$25,783	\$31,511	\$32,769	\$5,729	22.2%	\$1,258	4.0%
California	\$36,046	\$33,601	\$37,060	-\$2,445	-6.8%	\$3,459	10.3%
Connecticut	\$86,489	\$76,747	\$77,116	-\$9,742	-11.3%	\$369	0.5%
Florida	\$32,929	\$33,583	\$44,451	\$654	2.0%	\$10,868	32.4%
Georgia	\$33,604	\$38,083	\$42,640	\$4,479	13.3%	\$4,557	12.0%
Illinois	\$37,723	\$36,436	\$36,885	-\$1,288	-3.4%	\$449	1.2%
Kansas	\$84,253	\$105,462	\$117,729	\$21,210	25.2%	\$12,267	11.6%
New York	\$35,728	\$33,198	\$36,134	-\$2,530	-7.1%	\$2,936	8.8%
Ohio	\$34,830	\$34,513	\$37,929	-\$317	-0.9%	\$3,416	9.9%
Pennsylvania	\$37,343	\$37,605	\$41,593	\$261	0.7%	\$3,988	10.6%
Texas	\$31,949	\$32,666	\$38,271	\$718	2.2%	\$5,605	17.2%
Washington	\$31,793	\$34,624	\$35,718	\$2,831	8.9%	\$1,094	3.2%
U.S.	\$29,849	\$33,268	\$37,963	\$3,420	11.5%	\$4,695	14.1%

Data Source: Economy.com



Table D-29. NAICS 4812 Nonscheduled Air Transportation Wages

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$22,174	\$43,102	\$46,521	\$20,928	94.4%	\$3,419	7.9%
California	\$21,303	\$38,491	\$45,988	\$17,188	80.7%	\$7,498	19.5%
Connecticut	\$48,698	\$171,893	\$198,339	\$123,195	253.0%	\$26,446	15.4%
Florida	\$30,351	\$34,268	\$48,095	\$3,918	12.9%	\$13,827	40.3%
Georgia	\$31,033	\$25,719	\$26,749	-\$5,314	-17.1%	\$1,030	4.0%
Illinois	\$26,821	\$28,709	\$25,762	\$1,888	7.0%	-\$2,946	-10.3%
Kansas	\$63,961	\$52,239	\$43,758	-\$11,722	-18.3%	-\$8,482	-16.2%
New York	\$37,359	\$30,886	\$30,654	-\$6,473	-17.3%	-\$232	-0.8%
Ohio	\$33,408	\$48,677	\$50,686	\$15,269	45.7%	\$2,009	4.1%
Pennsylvania	\$25,623	\$25,290	\$26,220	-\$333	-1.3%	\$930	3.7%
Texas	\$35,142	\$22,137	\$23,245	-\$13,005	-37.0%	\$1,108	5.0%
Washington	\$21,411	\$34,813	\$44,830	\$13,402	62.6%	\$10,017	28.8%
U.S.	\$23,667	\$30,054	\$32,865	\$6,387	27.0%	\$2,811	9.4%

Data Source: Economy.com

Table D-30. NAICS 4881 Support Activities for Air Transportation Wages

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$28,092	\$48,650	\$54,502	\$20,558	73.2%	\$5,852	12.0%
California	\$20,858	\$18,471	\$17,599	-\$2,386	-11.4%	-\$873	-4.7%
Connecticut	\$31,482	\$62,238	\$68,310	\$30,756	97.7%	\$6,072	9.8%
Florida	\$25,646	\$31,847	\$37,549	\$6,202	24.2%	\$5,702	17.9%
Georgia	\$23,435	\$25,343	\$27,700	\$1,908	8.1%	\$2,357	9.3%
Illinois	\$28,398	\$26,035	\$26,552	-\$2,363	-8.3%	\$518	2.0%
Kansas	\$68,812	\$42,133	\$38,918	-\$26,679	-38.8%	-\$3,215	-7.6%
New York	\$23,068	\$24,027	\$24,046	\$959	4.2%	\$19	0.1%
Ohio	\$34,250	\$23,858	\$22,673	-\$10,391	-30.3%	-\$1,186	-5.0%
Pennsylvania	\$23,078	\$17,598	\$17,177	-\$5,480	-23.7%	-\$421	-2.4%
Texas	\$25,893	\$23,610	\$25,398	-\$2,283	-8.8%	\$1,788	7.6%
Washington	\$20,412	\$24,812	\$23,024	\$4,400	21.6%	-\$1,788	-7.2%
U.S.	\$24,824	\$18,466	\$19,126	-\$6,358	-25.6%	\$660	3.6%

Data Source: Economy.com



Table D-31. NAICS 5174 Satellite Communications Wages

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$35,308	\$51,878	\$59,850	\$16,570	46.9%	\$7,972	15.4%
California	\$51,600	\$70,444	\$75,195	\$18,844	36.5%	\$4,751	6.7%
Connecticut	\$46,737	\$61,087	\$75,409	\$14,350	30.7%	\$14,322	23.4%
Florida	\$40,662	\$49,095	\$53,486	\$8,433	20.7%	\$4,391	8.9%
Georgia	\$49,504	\$73,252	\$82,151	\$23,748	48.0%	\$8,899	12.1%
Illinois	\$47,362	\$65,164	\$72,127	\$17,802	37.6%	\$6,963	10.7%
Kansas	\$36,824	\$63,938	\$58,632	\$27,114	73.6%	-\$5,306	-8.3%
New York	\$60,760	\$80,850	\$87,821	\$20,090	33.1%	\$6,971	8.6%
Ohio	\$42,546	\$51,080	\$56,728	\$8,535	20.1%	\$5,648	11.1%
Pennsylvania	\$42,154	\$59,097	\$68,970	\$16,943	40.2%	\$9,873	16.7%
Texas	\$42,024	\$59,458	\$80,543	\$17,434	41.5%	\$21,085	35.5%
Washington	\$44,052	\$73,865	\$66,527	\$29,812	67.7%	-\$7,338	-9.9%
U.S.	\$25,343	\$34,307	\$38,679	\$8,964	35.4%	\$4,372	12.7%

Data Source: Economy.com

Table D-32. Aerospace and Defense Industry Wages

STATE	1990	2002	2007	Change 1990 - 2002		Change 2002 - 2007	
				Absolute	Percent	Absolute	Percent
Arizona	\$41,019	\$51,743	\$55,226	\$10,725	26.1%	\$3,483	6.7%
California	\$49,457	\$47,341	\$48,795	-\$2,116	-4.3%	\$1,454	3.1%
Connecticut	\$56,248	\$68,075	\$80,035	\$11,827	21.0%	\$11,960	17.6%
Florida	\$40,222	\$37,873	\$45,654	-\$2,350	-5.8%	\$7,781	20.5%
Georgia	\$37,005	\$40,711	\$46,319	\$3,705	10.0%	\$5,609	13.8%
Illinois	\$37,257	\$36,515	\$37,021	-\$742	-2.0%	\$506	1.4%
Kansas	\$46,226	\$54,125	\$61,841	\$7,898	17.1%	\$7,717	14.3%
New York	\$40,478	\$34,351	\$35,411	-\$6,127	-15.1%	\$1,060	3.1%
Ohio	\$51,719	\$54,168	\$57,055	\$2,449	4.7%	\$2,887	5.3%
Pennsylvania	\$42,250	\$43,631	\$49,199	\$1,381	3.3%	\$5,568	12.8%
Texas	\$40,085	\$40,082	\$44,154	-\$3	0.0%	\$4,072	10.2%
Washington	\$49,896	\$62,242	\$70,821	\$12,346	24.7%	\$8,579	13.8%
U.S.	\$42,745	\$42,196	\$46,171	-\$550	-1.3%	\$3,975	9.4%

Data Source: Economy.com

Appendix E: Data Sources

Data used in this report comes from two sources—ES202 and Economy.com. In Appendix C section titled “Aerospace and Defense Industry within Ohio” utilizes ES202 data and the section titled “Aerospace and Defense: A 12-State Comparison” makes use of Economy.com data. Following is a discussion of each source and associated issues.

ES202 Data

ES202 data are based on quarterly unemployment compensation reports collected by each state under federal mandate. Nearly all employers are required to file unemployment reports to their respective states. The data include quarterly information on each company’s name, address, zip code, county, industrial classification, employment, and payroll. One advantage of ES202 data is that it supplies records for each establishment operated by a company. This provides a clearer picture of a company’s presence in a geographic area. ES202 data used in this report is received quarterly from the Ohio Department of Jobs and Family Services and were collected at the six-digit NAICS level.³²

Reporting issues are not uncommon in ES202 data. For example, companies may inadvertently file using an incorrect NAICS code, or an organization with multiple operating facilities may count all employees out of a single establishment, for example, the corporate headquarters. In addition, defense-related facilities only report civilian employees. Finally, some companies simply do not file an ES202 report with the State. The result being that undercounts or counts over for employees and establishments in a particular industry can occur.³³

In this report, there is likelihood that the Ohio aerospace and defense industry is undercounted, perhaps by as many as 8,000 employees. The two main reasons for this undercount are: 1) under-reporting the number of civilian personnel at national security facilities such as Wright Patterson Air Force Base and 2) classifying companies under inappropriate NAICS codes. For

³² NAICS (North American Industry Classification System) uses a six-digit coding system to identify particular industries and their placement in the hierarchical structure of the classification system. The first two digits of the code designate the sector, the third designates the sub-sector, the fourth designates the industry group, the fifth designates the NAICS industry, and the sixth digit designates the national industry.

³³ Undercounting or counts over is not unique to businesses in the state of Ohio. ES202 reporting issues occur across the U.S.



example, a major airfreight company was classified under NAICS 492110 (couriers) instead of the more appropriate NAICS 481112 (scheduled air freight transportation).

Economy.com Data

Economy.com, Inc. is a leading independent provider of economic, financial, and industry research designed to meet the diverse planning and information needs of businesses, governments, and professional investors. Economy.com was selected because their product line includes employment, payroll, and value-added data for all states in the U.S. However, Economy.com only provides data at the four-digit NAICS level, i.e., the industry group level. This limitation becomes apparent further in the analysis: If the reader tries to compare Ohio-specific employment and wage data in the sections “Aerospace and Defense Industry Within Ohio” and “Aerospace and Defense: A 12-State Comparison”, he/she will find they may not be directly comparable. For example, in the former section, employment data is provided for each of the six industries within the aerospace product and parts manufacturing industry group. However, in the latter section, employment figures for those same six industries are aggregated under the industry grouping. More importantly, Economy.com data only includes private sector information whereas ES202 data includes both private and public sector information.

It should be noted that Economy.com uses ES202 data in their estimation algorithms. Therefore, Ohio companies that may not be counted in the section titled “Aerospace and Defense Industry Within Ohio,” are also not counted in the 12-state comparison section.



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