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Industry-Based Competitive Strategies for Ohio: Managing Three Portfolios

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Industry-Based Competitive Strategies for Ohio: Managing Three Portfolios

Economic Development Strategies That Build From Current Strengths
and Address Competitive Challenges

SUBMITTED TO

THE OHIO DEPARTMENT OF DEVELOPMENT

AND

TECHSOLVE

May 2005

ABOUT THE AUTHORS

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Ms. Klawans was Co-Project Manager for the project leading the driver/cluster analysis and business strategy portions of the project. She had a lead role in planning and facilitating the expert panel focus groups, managed and conducted business strategy research for the driver industries, and was a primary writer and editor for several sections of the final report. Ms. Klawans has more than fourteen years of business experience focused on strategic planning and driving growth through marketing and new product development in the consumer packaged goods, health care, and financial services industries. Ms. Klawans has helped guide companies through IPOs, merger & acquisition analysis, acquisition integration, customer/product line profitability analysis, competitive benchmarking, new product development, and marketing projects.

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CLEVELAND STATE UNIVERSITY

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Dean M. Prestegaard (old)

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Larry Ledebur

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Dr. Ledebur earned his Ph.D. and Master's degrees in economics at Florida University and his Bachelor of Arts degree from Austin College. He began his teaching career at Denison University as a professor of Economics and he has authored numerous book and articles on various aspects of urban economic development.

Fran Stewart

Fran Stewart was the project editor. She also compiled focus group responses and contributed to the regional sections. Fran has been writing and editing professionally for 20 years, including several years as an editor at *The Plain Dealer*. She has taught writing, editing, and design at Kent State University and worked as a copy editor for the *Economic Development Quarterly*.

OSA STRATEGY

Jim Podolak

A founding partner of OSA Strategy, Mr. Podolak spearheaded the firm's involvement in the perception survey component of the ODOD program. He has over 25 years of marketing, business and strategic planning experience in both private industry and the public sector. His background includes extensive involvement with many of the world's leading investment promotion and economic development agencies.

Karen TerHaar

Ms. TerHaar managed the design, implementation and analysis efforts for the perception survey component of the ODOD program. She heads OSA Strategy's Key Accounts and Business Retention Group and is currently directing the firm's Business Retention programs for several international economic development agencies.

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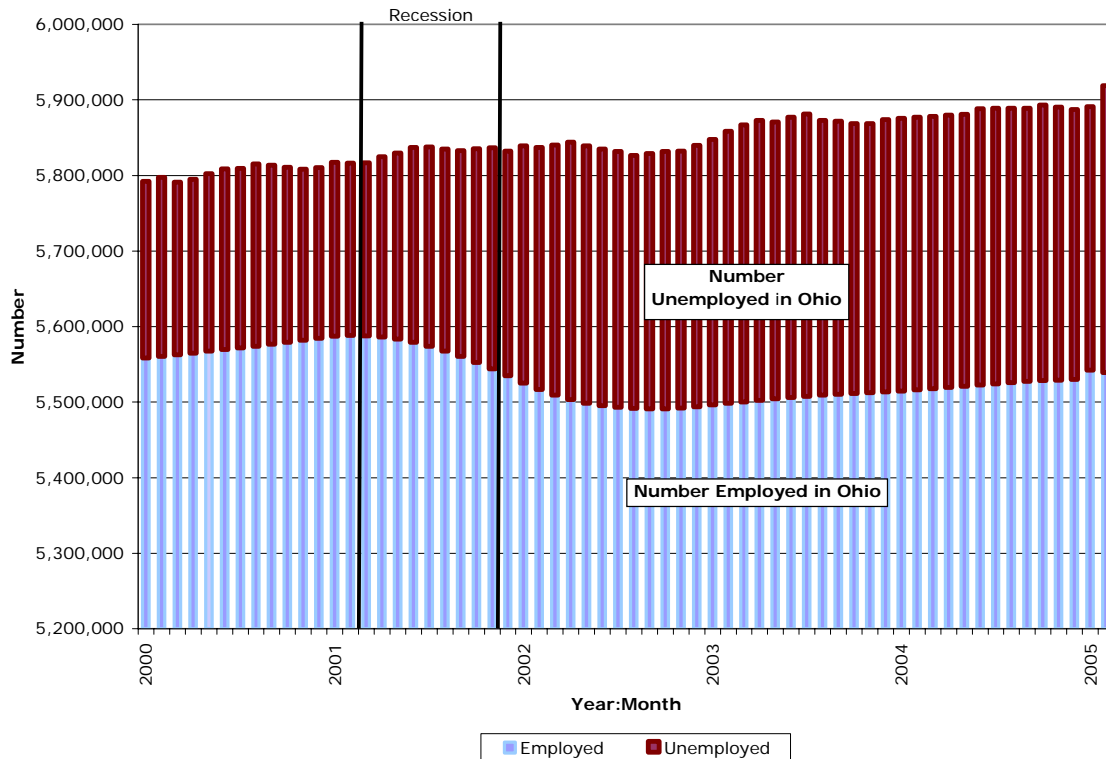
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SECTION 1

EXECUTIVE SUMMARY

The recession of 2001 hit Ohio disproportionately hard. Ohio slid into recession before the nation as a whole and stayed there longer, with recovery only becoming apparent in the labor market in 2003. Since that time, employment growth has remained sluggish.



Source: U.S. Bureau of Labor Statistics, Current Employment Survey, May 2005

Incomes have begun to recover. Ohio experienced a 9.5% increase in per capita income between 2001 and 2004, with most of that growth taking place in 2003. This growth rate is above the national average of 7.7% and is above the average for the Great Lakes states. However, this growth in per capita income has not been enough to regain the losses in momentum experienced during the recession. Ohio's per capita income remains \$1,600 per person below the national average and ranks 28th among the states and Washington, D.C.

Political and business leaders have recognized a need to chart a new economic course for Ohio's future. In fall 2004, the Ohio Department of Development charged a team of Deloitte Consulting and Cleveland State University researchers and analysts with examining the state's economy, exploring core strengths and weaknesses, determining current and future challenges, highlighting potential growth opportunities, and crafting strategies for making Ohio an attractive and competitive place to do business.

This study represents a step toward determining effective uses for limited development dollars in the state and filling in Ohio's economic development strategy. This statewide

industry study has been designed to provide economic development officials with insight, analysis, and strategic tools to help businesses compete more efficiently in an increasingly global marketplace.

The task ahead is to draw on the state's history of innovation to develop creative, cohesive, and useful business strategies for promoting and retaining the state's mature core industries while attracting and nurturing new industries and investment. This study attempts to alert the state to emerging opportunities and suggest policies that will be nimble enough to respond to growth markets and today's fast-paced business environment.

STUDY APPROACH

Findings and recommendations for this study have emerged from objective statistical analysis and "real world" understanding: They incorporate assessment tools, the filters of professional experience, insight gleaned from expert panels of industry leaders throughout the state, and guidance from an advisory panel on best practices.

The study's primary objective has been to identify the industries that are at the heart of Ohio's current competitive advantage and to determine growth opportunities and emerging technologies that hold potential for significant economic benefit to the state and its regions.

The industry-based competitive strategies detailed in this report:

- Highlight the portfolio nature of the state's economy and suggest steps to better support Ohio's mix of regions, industries, and technologies.
- Designate key industry sectors that are drivers of state and regional economies.
- Identify growth opportunities and emerging technologies.

This study begins with a current snapshot of Ohio's economy. The study team has relied on third-party data from Economy.com, IMPLAN, and other sources to provide an objective, statistical look at industries in Ohio and determine which ones form the core of the state's economy.

The statistical model for this analysis incorporated 12 variables to evaluate each industry sector in the state for its productivity and its location quotient, which is a designation of how highly specialized the industry is in Ohio compared to other areas in the nation. This study is heavily weighted toward productivity, which is a reflection of current economic reality. Modern technology allows companies to do more with fewer workers. Today's globally competitive environment forces companies to become more productive simply to survive. More traditional measures, such as employment levels, tell one chapter of Ohio's economy but certainly not the entire story. Quite simply, the state must encourage companies to innovate and adopt technology to be more productive and competitive. In the end, improved productivity is what ultimately will return jobs to Ohio.

To get a clear understanding of the state's competitive business environment, the study team has explored Ohio's economy from the top down and the bottom up. A high-level macroeconomic analysis examined Ohio's economic status and performance, relevant global and national sector trends, and the economic development situation in Ohio. From the microeconomic view, the study team determined industries that formed the core of state and regional economies and the cluster industries that support them. A cluster

simply refers to an industry's supply chain backward and forward, suppliers to consumers.

Next, the study team looked at how Ohio stacks up against competitors. Focusing on target industries and specific functions within those industries, the team compared strengths and weaknesses of Ohio, as well as of particular regions and metropolitan areas, to other states vying for the same types of industries. The statistical model highlighted the industries in which Ohio had a competitive advantage. To complement this benchmarking effort, the study team gathered qualitative data by surveying industry leaders within Ohio and outside the state, venture capitalists, site selectors, and economic development officials to provide "in the trenches" details beyond statistical findings.

This assessment allowed the team to identify issues and gaps that hindered Ohio in its ability to support the identified driver industries and emerging opportunities. Specifically, the team has been able to identify factors limiting Ohio's competitiveness as a location for business retention, expansion, and attraction across multiple dimensions and to highlight key business issues that driver and emerging industries face.

The final phase of this study focused on implementation. It's not good enough simply to know what Ohio is good at now and how its business environment stacks up against competitors. The strength of this study is that, by working with ODOD officials and an advisory committee, the team has developed specific recommendations to help chart Ohio's future economic success. These recommendations provide direction to economic development strategy for increasing Ohio's ability to grow, retain, and attract targeted industries and functions and address factors that impede its competitiveness.

A FEW KEY FINDINGS

- Ohio is a portfolio economy. No one industry, or handful of industries, dominates the state's varied economic landscape. That diversity of industry is good for economic stability but makes crafting public policies and development strategies a challenge.
- Ohio's economy is actually made up of several distinct regional economies. Based on history, demographics and commuting patterns, the team divided the state into six regions: Northeast, Northwest, Central, West Central, Southeast, and Southwest. Each region has its own mix of driver industries and its own economic personality and portfolio.
- The statistical model identified 17 driver industries for Ohio. Only one – motor vehicle parts manufacturing – was a driver in all six regions.
- Improving Ohio's economy requires managing not just one portfolio but three: regions, industries, and technologies.
- Ohio appears to be an attractive environment for banks, corporate and divisional headquarters, and insurance carriers.
- Ohio industries are continuing to innovate and incorporate new technologies to improve their productivity. For some, these are largely labor-saving measures, but other companies are embracing technology as growth opportunities.
- Manufacturing continues to be the state's largest employer – despite absorbing the bulk of the job losses related to the 2001 recession. This sector's obvious importance to the economy is contrasted by a general feeling of limited support and lack of respect among Ohio's businesses.

- Small and midsized manufacturers in the state feel under constant pressure to keep their prices low and absorb increases in material, energy, and compliance costs. They feel assaulted by what they see as the unfair trade of global competition. Most admit to being so overwhelmed with simply surviving and keeping pace with the rapidly changing business environment that they have little time or resources to chart a growth strategy.
- Ohio industries are concerned about the state continuing to provide a fertile environment for business. In particular, they worry about issues of workforce commitment and skill level, an outdated tax structure that they see as a disincentive for growth, health care and benefit costs that continue to soar, and the daunting threat of legal liabilities.
- Ohio companies, small to large, have reasons to remain loyal to the state. Many admit that the costs and time involved in rebuilding their businesses make them reject offers to relocate outside the state. Others cite the personal pull of family and history.

OHIO'S COMPETITIVE POSITION

This analysis of Ohio's economy details key strengths, weaknesses, opportunities, and threats. Many of these may be opposite sides of the same coin. For example, the state's diverse portfolio of economic drivers among different regions may make it impossible to develop a single state development strategy, but this diversity is, in fact, a strength in much the same way that diversified financial portfolios help protect investors from market setbacks. Ohio companies are increasing productivity, which is a strength, but their investments in automation to improve productivity have resulted in ongoing employment losses (a weakness). Ohio has a strong manufacturing supply chain, but that strength is being continually threatened by increasingly sophisticated offshore competition for commodity manufacturing. The automotive industry, in particular, is struggling in a harsh competitive environment, which threatens the overall state economy because of the auto industry's powerful reach throughout the state's supply chain. Ohio travelers may see the drop in the value of the dollar as a definite threat to their vacation plans, but for the state's challenged manufacturers, it comes as an opportunity.

Other identified strengths include the state's central location, its transportation infrastructure, and its high concentration of workers with industry-specific skills. State weaknesses revolve around population, which has been stagnant and particularly lacking in advanced-degree holders, and perception, particularly the view that Ohio has high business costs due to unions, utilities, and taxes. The state's progress into a 21st century economy also continues to be constricted by "rust belt" connotations from its past. Not only is the state challenged by offshore competition, but it is also falling under "friendly fire," facing increasing threats from aggressive economic development programs in other states.

The challenge to Ohio officials is to seize on opportunities that present themselves – and take proactive steps to make opportunities happen. Developing programs that help existing manufacturers capture a larger share of the value chain would be a step forward in addressing identified weaknesses and threats. Identifying and nurturing growth opportunities and emerging technologies, restructuring public policies to attract and retain business, and targeting a marketing effort at dispelling misperceptions are crucial elements for improving the state's economic environment.

RESTRUCTURED STRATEGIES

The diversity of Ohio's current industrial portfolio is a source of strength for the state but has led to significant strategic gaps. Bridging these gaps calls for innovative thinking in how economic development programs are structured and delivered. For example, economic development programs tend to flow down from the state level. However, many industries in Ohio are more closely linked to regional resources. Closing the gap between industries and the support they need often means leading the execution of services from the regional level. This may be best achieved by empowering regional economic development officials to respond to the particular business environment mix in their areas and providing incentives for local development programs to work together for the good of their region.

The study has identified seven driver industries in which focused development efforts have the best present opportunities for protecting and augmenting Ohio's economic base and facilitating growth in the state. These are:

- Motor vehicle and motor vehicle parts manufacturing
- Chemicals and polymers
- Clinical medicine and related industries
- Logistics, distribution, and warehousing
- Corporate and divisional headquarters, back-office, and administrative functions
- Food processing and manufacturing and agriculture value-added products
- Environmental technology

A handful of other growth opportunities are positioned to reinvigorate existing driver industries or serve as stand-alone engines for future growth. For the purposes of this study, growth opportunities are defined as having a growing market for products, increases in productivity, relative Ohio competitiveness, and ability to capture additional market share. Qualitative assessment from venture capitalists, expert panelists, and study advisers also was incorporated into this effort to identify potential growth industries. Those determined most likely to thrive in Ohio are:

- Nondepository credit intermediation (nonbank)
- Headquarters and administrative services
- Computer systems design and related services
- Scientific research and development services
- Specialized design services
- Electronic and precision equipment repair and maintenance
- Tourism and arts

Through a process similar to determining growth opportunities, the study has also identified the following emerging technologies:

- Polymers, particularly in the areas of:
 - Biocompatible
 - Photonic
 - Electronic
 - Conductive
 - Liquid crystal displays
- Medical equipment and research
- Fuel cells, particularly in the areas of:
 - Heating, ventilation, and air-conditioning

- Automotive
 - Electric power generation
- Nanotechnology, particularly in the areas of:
 - Nanomaterials
 - Nanosensing
 - Nanobiological
 - Nanochemical
 - Intersection of polymer technology and nanotechnology
- Information technology, particularly for the:
 - Medical industry
 - Financial service industry
 - Security database and data-mining applications
- Micro-electrical-mechanical systems (MEMS), particularly in the areas of:
 - MEMS machines
 - Automotive

These distinct industry mixes require different economic development strategies and goals. The seven driver industries identified as development opportunities should benefit from a traditional approach to retaining and expanding the state's existing economic base by assisting businesses with individual problems. An attraction strategy for these industries should be focused on providing businesses outside the state with information on Ohio's industrial and workforce strengths, implementing a marketing message promoting the state's array of offerings, and polishing the state's image as a welcoming business environment. The identified growth opportunities and emerging technologies may benefit from these problem-solving and image-enhancing efforts, but they require more – a product development and technology-based strategy focused on developing and attracting entrepreneurial endeavors.

Implementing a cohesive approach to economic development in Ohio requires that state and regional entities collaborate on processes, incentives, and communication of goals and services. Economic development practitioners at the state and regional levels must work together through the stages of implementation to:

- Identify industries and technologies to support
- Prioritize those areas in which development assistance can have optimal effect
- Choose whether the state or regions will take the lead
- Determine how best to support targeted industries and technologies
- Build an action plan

RECOMMENDATIONS

This study sets forth a number of steps the state can take to work toward improving Ohio's economic environment:

- **Shift the state's economic development approach.** The state's economy is a portfolio of industries. No "silver bullet" solution will turn the state's economy around. Therefore, state officials must understand the changing landscape of Ohio's and the world's economy. The first step is assessment: What does the state do well? What industry is in a position to grow? The state's economic development efforts need to proactively target resources toward industries that represent the best opportunities for nurturing growth.
- **Drive change in public policy.** Take care of the basics: resolve tax issues, make incentive programs easier to understand and more accessible, among

other steps. Reward productivity, not simply job creation. Productivity and output are the modern measures of business well being, and state incentive programs need to reflect that. However, the state must understand that the overhauling public policy will not solve the challenges facing Ohio's economy.

- **Cultivate an effective region-state dynamic.** Recognize that the distinct, individual nature of the regional economies requires that solutions be bottom-up. The state's role should be to support and enhance these grassroots responses. Give regions authority to create programs that respond to their unique needs. These programs could be shaped by a strategy framework based on best practices over time and input from researchers, industry leaders, and other regional constituents. State money would follow best practices and encourage regional partnerships among economic development entities. Regional entities, in turn, would be required to match state funding.
- **Strengthen ODOD's industry-specific expertise geared toward region-state management.** Engage in business matchmaking for businesses the state is trying to attract by lining up potential customers. Function as a business accelerator for companies in need of connecting to customers, suppliers, and capital. Tap industry experts to help craft incentive packages and programs that respond to specific needs of individual industries.
- **Develop a marketing message to overcome Ohio's perception problem.** Counter the residual "rust belt" image by promoting state strengths, such as its workforce, its diversity of economic drivers, its broad manufacturing supply chain, and its high concentration of industry-specific skills. Champion not only the overall strengths of the state, but the individual qualities of the regions, as well. Ohio is unusual in having several metropolitan areas with a distinct mix of industries and amenities. This variety should be marketed to Ohio's advantage.
- **Focus on preserving the health of Ohio's automotive industry.** Recognize that Ohio's economy still relies heavily on the well-being of the automotive industry. The automotive industry ripples across many of the state's driver industries. Many Ohio industries are directly part of the automotive supply chain, but countless others are indirectly affected by whether motor vehicle manufacturing is roaring or idling. Develop business strategies for keeping automotive plants and their suppliers in Ohio. The best opportunities may be in the areas of just-in-time delivery and research and development built around facility changes in model design and production processes.
- **Develop a long-term strategy for attracting and growing existing headquarters and divisional offices.** Ohio's strength in headquarters, complemented by its vigor in providing back-office and administrative business functions, represents a growth opportunity.
- **Cultivate growth opportunities and emerging technologies.** Look for emerging industries and technologies that flow from the state's existing industry core. Nurture and facilitate innovation. Innovation has been and continues to be vital to the success of individual businesses and Ohio's economy overall. State programs could be designed to help promote and sustain process improvement, new product development, new categories of product, business strategies, and operating philosophies.
- **Help small and midsize companies compete.** Implement programs that help businesses develop strategies for long-term success instead of simply reacting to the current squeeze of global competition and today's accelerated speed of doing business. Consider applying Manufacturing Extension Partnership programs to

broader industries. Act as process innovator intermediaries for small to midsized enterprises. Small businesses, particularly those in mature market industries, need help with new product innovation and implementation of new technologies and processes.

- **Strengthen education within the state to meet industry needs.** Focus on training programs that develop the technical skills modern employers need. The state has strength in workforce training in its community colleges and career technical centers. Subsidize incumbent worker training, particularly those skills linked to driver industries or priority functions. Provide funds for customized training. Align academic and applied technology resources. Make chemistry a priority in secondary schools and at the university level. Chemistry is a cornerstone of Ohio's technological innovation.

As noted earlier, there is no "silver bullet," quick-fix strategy to right Ohio's recent economic foundering. However, the findings and recommendations presented here aim to draw on the state's past innovation and present strengths to provide the navigational tools necessary to chart a course for Ohio's future prosperity.

SECTION 2

INTRODUCTION

In fall 2004, the Ohio Department of Development (ODOD) commissioned a team from Deloitte Consulting and Cleveland State University to study the current status of industry sectors in Ohio; assess industry contribution to the overall state and regional economies; highlight industries poised for growth; and recommend strategies for helping to grow, retain, and attract successful businesses.

The ODOD goals for the information and insight generated from the study are to:

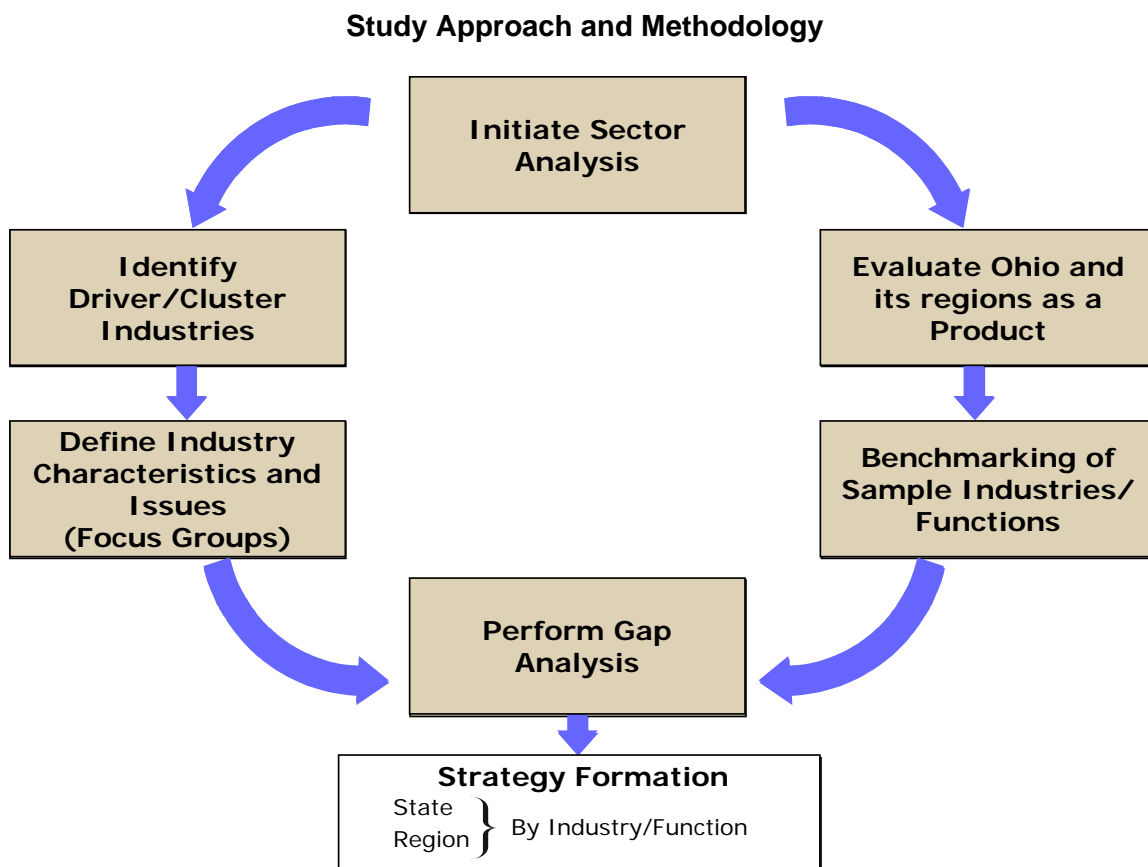
- Position Ohio as a place to locate and grow a business
- Strengthen Ohio's workforce through economic development
- Concentrate, leverage, and integrate new and existing resources

This study represents the first step toward determining effective uses for limited development dollars and providing a road map for future economic success. The task ahead is to draw on the state's history of innovation to craft creative, cohesive, and useful economic strategies and policies that help Ohio build on its business strengths, address its weaknesses, and leverage its competitive advantages for future growth. The study's recommendations will help the state develop plans and tools to promote and retain its core industries, while attracting and nurturing new industries and investment.

This section of the report provides a summary of the study's overall analysis and recommendations. More detailed findings are in Sections 3, 4, and 5 of this report.

APPROACH AND METHODOLOGY

The findings and recommendations of this study are the result of objective statistical analysis and an understanding of “real world” business issues. They incorporate statistical assessment tools, the insight of professional experience, an objective look at competitive forces at work in comparative states and cities, and guidance and feedback from a diverse advisory committee and project working group. Each of the major components of the study is summarized in the pages that follow. The study team first surveyed the state’s historical and current economic landscape to generate a platform on which to build detailed statistical analysis. After the detailed analysis was conducted to identify Ohio’s most important business sectors – in this study, called *driver* industries -- the data were used to identify Ohio’s strengths and weaknesses, pinpoint gaps, and develop recommendations. The graphic below shows the methodology and approach used for this study.



The next several paragraphs provide an overview of the analyses that are summarized in this section of the report and how they fit together to drive the final recommendations.

Macroeconomic Analysis

One of the first objectives of the study was to conduct a high-level macroeconomic review of Ohio’s economy. This section of the report gives a brief look at Ohio’s history

and current demographics to create context for the detailed analysis. Using this as a backdrop, the core components of the economy are highlighted, in addition to related trends in employment, gross state product, and productivity. Observations made within the macroeconomic analysis are echoed throughout the detailed findings and reinforce the final recommendations.

Driver Analysis

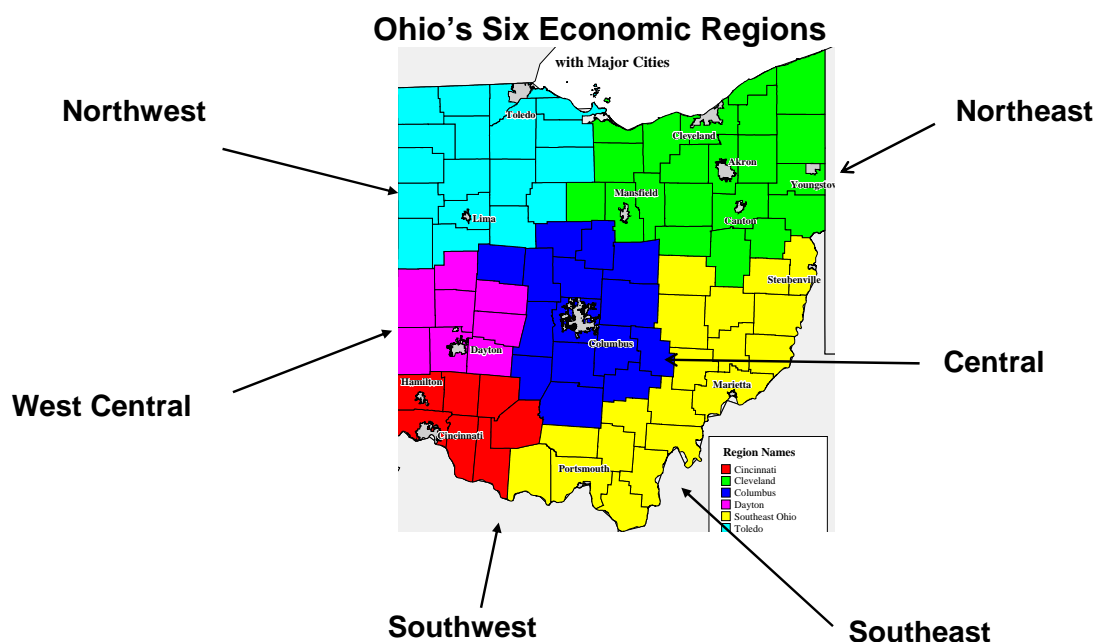
With the macroeconomic analysis in mind, the study team conducted an objective, statistical look at Ohio's economy by identifying key driver industries at the heart of the state's current competitive advantage, using data from Economy.com and IMPLAN. These drivers were then used to identify associated clusters of related supply-chain industries. This level of analysis was particularly useful in establishing an objective, statistical foundation to help rationalize and prioritize areas of focus at state and regional levels. The analysis weighted productivity and output heavily because they are indicators of Ohio's comparative advantage in each industry. This methodology differs from other driver-cluster methodologies, which often focus on employment levels to determine whether an industry is a driver. The study team then measured the overall health of each driver to assist in prioritizing future opportunity. This ultimately enabled the team to make customized economic development recommendations.

Driver Industry Analysis

In addition measuring overall health, select driver industries were subjected to in-depth analysis using both primary and secondary research. This analysis includes an overview of the industry on a national and local level, the overall dynamics of each industry and trends, the key issues that each industry faces, and the industry's overall competitive strengths and weaknesses in Ohio. The secondary research was then supplemented with primary research, drawing on expert panelists, industry experts within the Deloitte network, and industry experts within the ODOD network. For a targeted group of drivers, detailed benchmarking was performed for specific functions, using regional and national "proxy" competitors. This analysis was used to inform both the Industry Profiles and the Competitive Analysis.

Regional Analysis

A major concept reinforced through most components of this study is that Ohio is a portfolio of distinct regional economies. As such, it is important to understand the individual regional portfolios of driver industries. The regional analysis takes the statewide driver analysis to another level by identifying the composition of industry portfolios in each region. The map below shows the six regions identified for the study, based on Bureau of Economic Analysis groupings and business and commuting patterns. Findings within the regional analysis are ultimately combined with findings from the Macroeconomic Analysis and Industry Profiles to generate recommendations that can be applied as region-specific economic development strategies.



Growth Opportunities and Technologies

There are likely growth opportunities that warrant the state's attention but were not immediately apparent from the driver-cluster analysis. To bring these opportunities to the surface, the study team also used a series of statistical analyses and a survey of venture capitalists to identify industries that represent growth opportunities and technologies that are emerging in Ohio. Growth opportunities identified by this analysis are those that are growing in Ohio in terms of both output and location quotient, indicating that Ohio has the potential to capture both growth and a competitive advantage.

Public Policy Analysis

A series of expert panels held in each region of Ohio asked business leaders representing driver industries to identify their business challenges and key issues. The information from these expert panels and a subsequent Internet-based survey was used to identify public policy issues that are affecting Ohio's businesses. These findings were used to add context to other study analyses from the perspective of a real-world business user.

Competitiveness and Benchmarking

The mere presence of an industry cluster in a region or the state does not guarantee the ability to continue to attract, retain, or grow an industry. It is important to establish a level of industry intelligence for the state, and certainly within the regions, around core drivers and clusters. Key to this business intelligence is an understanding of critical success factors for both industries and their related business functions (headquarters, manufacturing, back office, etc.). To assist the regions in beginning to identify these factors and to evaluate their performance within a set of key drivers, the study team examined the strengths and weaknesses of the state, as well as particular metropolitan statistical areas (MSAs) for specific business functions. These locations were compared

at a high level to other proxy locations potentially vying for the same types of industries. The competitive analysis also incorporates the perception surveys of business leaders outside the state and of site selectors. This competitiveness analysis helped drive specific recommendations for improvement and opportunities to capitalize on strengths of Ohio and its regions.

Comparative states used to evaluate Ohio's competitiveness are:

- Alabama
- Illinois
- Indiana
- Kentucky
- Maryland
- Michigan
- North Carolina
- Pennsylvania
- Tennessee
- Texas

The states and MSAs used as benchmarks varied by industry and business function.

Gap Analysis and Recommendations

The combined findings of the study identified issues and gaps that limit Ohio's competitiveness. Based on the analysis, the study team developed recommendations to fill these identified gaps. The analysis also identified Ohio's economic strengths and opportunities, which can be reinforced and used to support expansion and attraction efforts. A detailed set of recommendations, based on the study's key findings, should bolster Ohio's ability to grow, retain, and attract targeted industries and functions and should address factors that impede its competitiveness. The strategic plan provides direction for charting Ohio's future economic success.

The remainder of this report will explore these analyses and findings in greater detail. The goal of this report is that the extensive information included here will be of particular use to economic development officials, business managers, and community leaders operating in the industries and regions discussed.

MACROECONOMIC OVERVIEW

Economic History

To understand the significance of today's business landscape, and the depth and complexities of Ohio's resources, it is important to remember Ohio's legacy as a fundamental American engine of commerce.

Ohio has a history of innovation. The state has proved to be as fertile a ground for invention and entrepreneurship as it has been for the agricultural crops that formed its first major industry. But Ohio's rich vein of innovation has largely come from practical adapters, those who found ways to take an invention and make it better or use it to solve a business problem. Innovation in Ohio is about taking formative breakthroughs and making them practical and useful. From such pragmatists came floating soap, tires with air, cash registers, vacuum cleaners, premixed paints, rolled sheet steel, disposable diapers, aluminum, stepladders, gas masks, stoplights, parking meters, motorized wheelchairs, cellophane tape, artificial hearts, and pull-tab beer cans.

In many ways, the history of Ohio's economy is tied to transportation. The opening of the Ohio and Erie Canal system in 1832 gave the state a waterway of trade, connecting the Ohio River to Lake Erie and beyond. As steamboats began churning up and down the Ohio River and in and out of Lake Erie, the state's economy grew. Shipbuilding was an important industry for a number of Ohio cities during the 19th and 20th centuries. By the 1850s, river transportation was supplanted by railroads. The 20th century ushered in the era of automobiles, which Ohio manufacturers supplied with air-filled tires; a practical engine starter; and a host of metal, rubber, and plastic parts. At the same time, Ohio had given birth to the aviation and aerospace industry, turning the Wright Brothers' 12 seconds in the air into a soaring economic activity – and ultimately ushering in a new economic order in which the entire world is within reach.

Through various facets of this study, Ohio's rich industrial base and legacy of innovation continue to drive its competitive advantages, but this manufacturing core is also subject to increasing competitive pressures. Ohio has an almost unprecedented array of tools at its disposal, but it will need to focus its economic development efforts and resources in areas in which they can have the most impact. Ohio's history of innovation reflects the resourcefulness of its people in tapping the state's rich diversity of raw materials and its knowledge base. An expert panelist summed up the positive aspect of Ohio's array of resources, goods, and services and the can-do spirit of its workforce: "You need it, we've got it."

Ohio's Current Economic Landscape

To provide a framework for analysis, the study team revisited some basic facts about Ohio and compared the state to a number of others in the nation – some completely different with respect to historical and current economic forces and some very similar. The following section provides an overview of Ohio's demographic profile, as well as key economic indicators.

Current Snapshot: Ohio's Economic Sectors

To get some perspective on Ohio's economy, it is helpful to understand the size and dynamics of major economic sectors. For this view, the super sectors of two-digit NAICS

codes have been used. These are the aggregation of industries that make up the complete economy of Ohio.

Evidence of manufacturing's continued significance in Ohio is that the sector remains the state's largest source of output and employment, as illustrated in the following table. Manufacturing accounts for some 15% of all jobs in Ohio and nearly 20% of the state's output, more than twice the output of the next largest sector. Therefore, trouble in the manufacturing sector has meant trouble for Ohio's economy as a whole. The decline in manufacturing employment over the past four years, coupled with employment losses in industries that are tied to manufacturing directly through its supply chain or indirectly through the spending of manufacturing workers, has significantly affected Ohio's economy. Although the percentage of manufacturing workers in both the state and national economy has dropped, Ohio's share of manufacturing jobs has remained nearly 5 percentage points higher than the national share.

Ohio also has a large presence of services industries. The finance, insurance, real estate, and health care sectors all contribute significant output to the state. These sectors appear to be quite healthy: All had fairly strong output growth between 1998 and 2003 and flat to slightly increasing employment.

Ohio's Economic Sectors

2-Digit NAICS Industry Grouping	2003 Output (\$ MM)	Industry Output as a % of Total State Output	1998-2003 CAGR	1993-2003 CAGR	2003 Output Location Quotient (LQ)	2003 Employment	Industry Employment as a % of Total State Employment	1998-2003 Employment CAGR
Manufacturing	\$77,645	19.5	(2.1)	1.2	1.7	844,680	15.4	(3.9)
Finance and Insurance	\$34,288	8.6	8.9	9.1	1.0	241,220	4.4	1.7
Real Estate and Rental and Leasing	\$31,779	8.0	3.6	4.1	0.7	70,640	1.3	(0.1)
Health Care and Social Assistance	\$31,053	7.8	5.9	5.0	1.2	641,750	11.7	2.3
Local Government	\$30,654	7.7	6.3	5.7	1.1	557,240	10.1	1.6
Retail Trade	\$29,834	7.5	2.6	4.9	1.1	627,750	11.4	(1.0)
Wholesale Trade	\$22,255	5.6	1.8	4.4	1.0	235,060	4.3	(0.4)
Construction	\$19,837	5.0	4.5	6.1	0.9	229,860	4.2	(0.1)
Admin and Support and Waste Mgmt and Remediation Services	\$18,004	4.5	4.9	6.8	1.3	294,760	5.4	(1.2)
Professional, Scientific, and Technical Services	\$16,676	4.2	1.8	4.4	0.6	225,690	4.1	0.1
Other Services (except Public Administration)	\$12,352	3.1	5.7	6.1	1.0	227,350	4.1	0.7
Transportation & Warehousing	\$11,689	2.9	1.1	4.9	1.0	159,740	2.9	(0.2)
Accommodation and Food Services	\$11,360	2.9	4.4	5.7	0.9	419,820	7.6	0.8
Management of Companies and Enterprises	\$10,411	2.6	9.5	9.4	1.0	87,800	1.6	2.6
Information	\$8,226	2.1	(0.7)	1.4	0.5	97,260	1.8	(1.4)
State Government	\$7,809	2.0	1.7	2.7	0.8	165,130	3.0	0.2
Utilities	\$6,769	1.7	3.5	4.2	1.1	22,650	0.4	(1.3)
Federal Government	\$6,547	1.6	0.6	2.2	0.6	79,450	1.4	(1.1)
Arts, Entertainment, and Recreation	\$3,174	0.8	8.1	6.4	1.0	68,280	1.2	0.8
Educational Services	\$2,770	0.7	3.7	4.2	0.7	86,150	1.6	0.6
Farms	\$1,549	0.4	(5.7)	(1.0)	0.6	8,910	0.2	(3.9)
Mining	\$1,521	0.4	1.6	4.2	0.3	10,800	0.2	(3.7)
Military Personnel	\$1,489	0.4	4.5	1.7	0.3	35,830	0.7	(0.6)
Private Household Workers	\$309	0.1	(0.5)	2.1	2.1	50,300	0.9	(2.8)
Logging	\$57	0.0	11.2	10.1	0.4	920	0.0	5.0
Fishing, Hunting, Etc.	\$10	0.0	13.3	18.4	0.0	1,340	0.0	5.8
Total	\$ 398,202	100.0	2.8	4.3	1.0	5,490,400	100.0	(0.4)

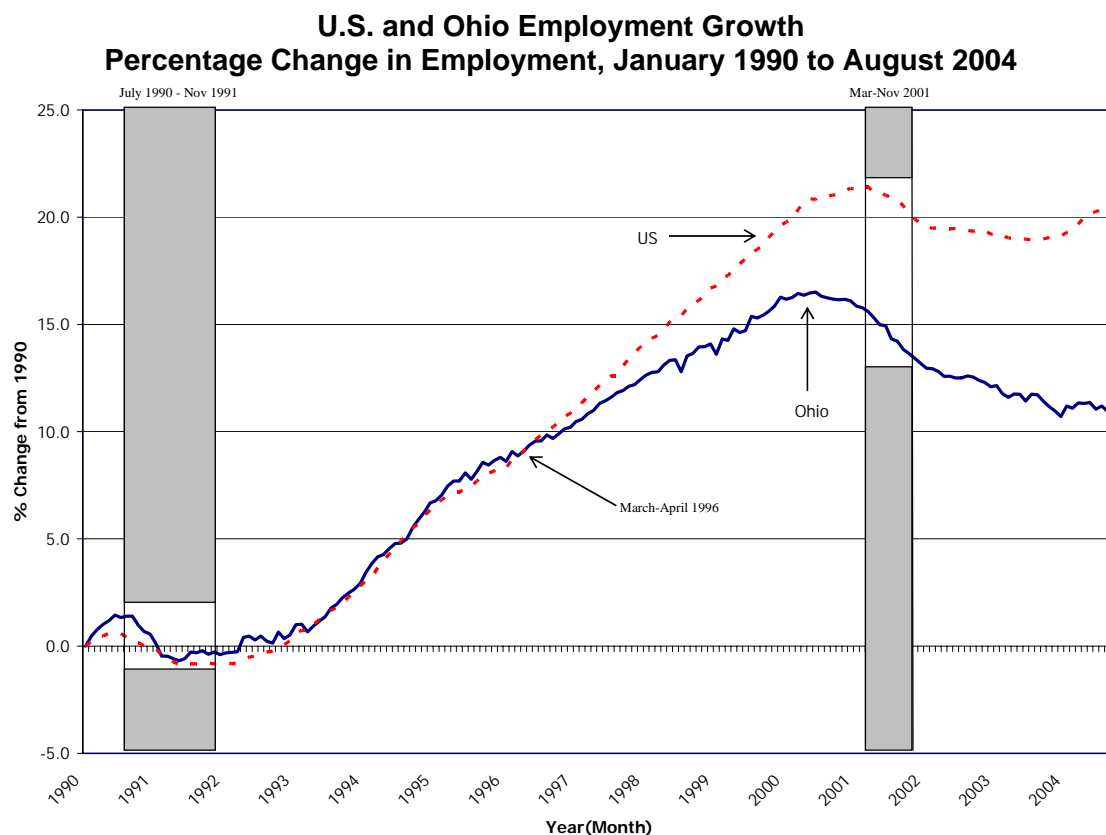
Source: Economy.com

Note: CAGR (compound annual growth rate) is average annual growth rate over a specified period of time. CAGR is calculated using the following formula: $CAGR = \left(\frac{\text{present value}}{\text{base value}} \right)^{\frac{1}{\text{#of years}}} - 1$

Employment

Evidence that Ohio's historical strengths have been subject to increasing competitive pressures recently is indicated by employment statistics. Employment figures offer the most dramatic assessment of Ohio's economic well-being and highlight the impact of the

recent recession on the state. As the following chart shows, Ohio's employment picture fairly closely tracked that of the United States through the mid-1990s, but Ohio diverged from the rest of the nation before the recent recession. The national employment downturn began in March 2001. Employment began to decline earlier in Ohio, starting in July 2000, and the decline has been steeper and longer-lasting than for the nation overall. From Ohio's employment peak in June 2000, the state has lost 263,900 jobs. That number represents 4.7% of the state's total employment at its peak. Ohio's seasonably adjusted jobless rate was estimated to be 6.0% for September 2004, compared with 5.4% for the nation. Preliminary data for November 2004 put the state's unemployment rate at 1.1% higher than the national average. At that time, 39 of the state's 88 counties had unemployment rates that exceeded the state average, with five counties experiencing double-digit joblessness.



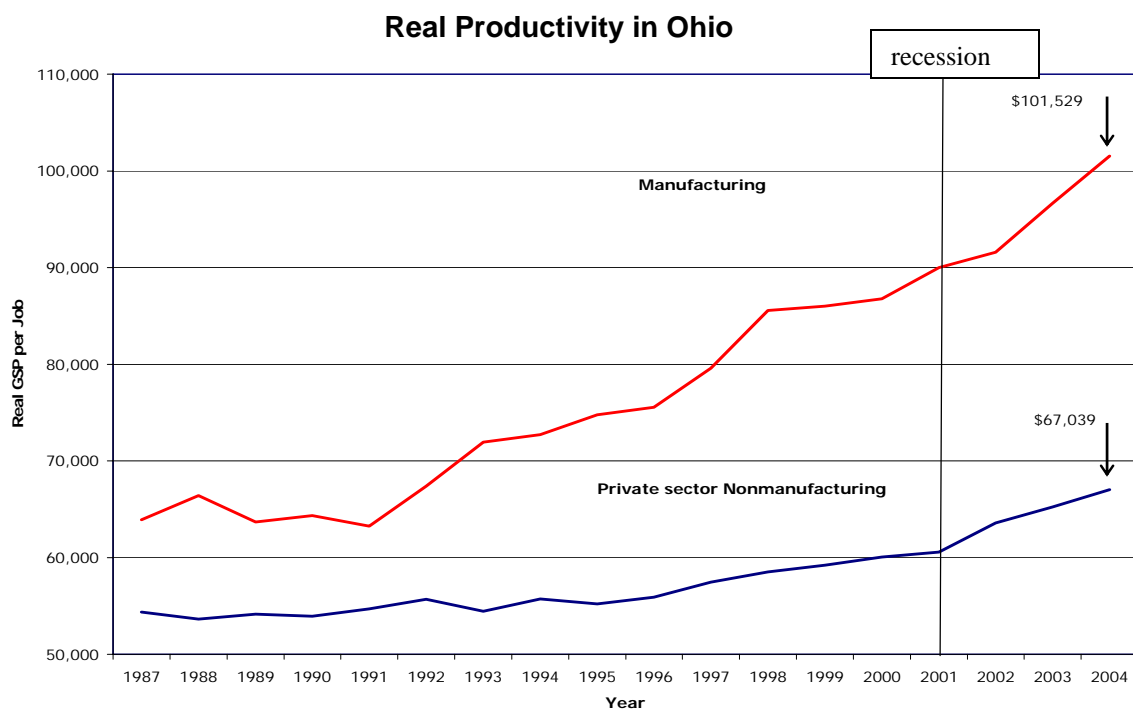
Source: U.S. Bureau of Labor Statistics, CES; shaded areas are periods of national recession

Another way of measuring the depth of employment loss in the state is to note that Ohio has accounted for 26% of the nation's overall loss of 827,000 jobs, measuring from the official start of the recession in March 2001. From its highest point to its lowest point, Ohio lost nearly 5% of its total employment, according to figures from the state's Bureau of Labor Market Information. In contrast, the nation lost little more than 2% of its total employment at its lowest point in August 2002. This change in fortune has left Ohio businesses and workers wary about the future.

Productivity

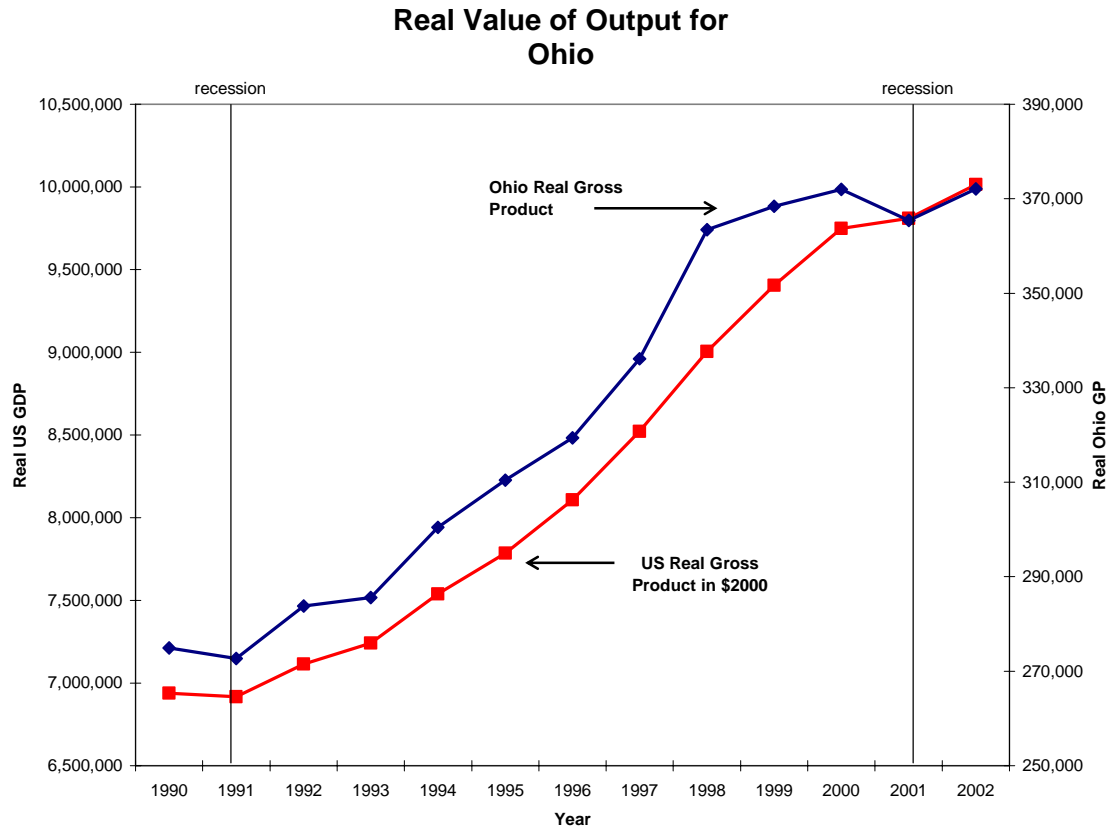
Employment in Ohio has not kept pace with increases in productivity. Although the employment picture for Ohio over the past several years has been less than positive, productivity has risen significantly in Ohio's private sector since the beginning of the 2001 recession. Companies have been adding and investing in technologies and processes that allow them to do "more with less" – maintaining or increasing their output, even as employment has declined. As the following chart shows, although job losses have plagued the industry, manufacturing has decidedly outpaced other sectors in terms of productivity growth. In 2004, manufacturing contributed \$34,490 more per job to the gross state product than non-manufacturing sectors. Manufacturing productivity has improved in Ohio, but, heading into the recession, it fell behind the national average for the first time ever and now lags the nation by roughly \$2,000 per manufacturing job. Productivity growth continued nationally during the recession as companies learned to work leaner and smarter by integrating new technologies and a global supply chain. For the state to excel, continued focus on productivity will be critical.

Improving productivity has contributed to the growth of economic output in the state, which, in turn, will drive job creation. Continuing productivity growth is essential to driving growth in Ohio's economy.



The real value of Ohio's gross state product, shown in the following graph, paints a picture of a vibrant state economy during the 1990s that, in most years, grew at a rate similar to the national average. The value of the total amount of goods and services produced in the state increased at the national rate through the 1990 recession until 1998. At that point, the state entered a recession, a full three years ahead of the nation. However, Ohio's rebound from that recession tracks perfectly with the national recovery.

Although being average should not be an economic goal for the state and its people, the economic reality as depicted by the real value of gross product is very different from the reality as experienced by the state's workers. To grow faster than the national average in future years, Ohio will require a new product set -- a group of goods and services that are new, are likely to experience growing demand, and are not commodities. The approach most likely to yield success is one that begins by looking at the state's current set of economic strengths, builds on those strengths, and then invests in an economic infrastructure capable of generating new product classes.



Source: U.S. Bureau of Economic Analysis, Gross State Product

Summary

Although Ohio's economy had a difficult time weathering the recent recession, especially with regard to job losses, most industry sectors managed to maintain output growth. Hardest hit seems to have been Ohio's manufacturing sector, which has suffered a nearly 4% loss in employment since 1998. Productivity improvements, however, have sustained Ohio's economy, keeping output growing and maintaining incomes. Continuing productivity growth is the key to driving economic output, which is the basis for genuine job creation.

OHIO'S ECONOMIC DRIVER INDUSTRIES

Understanding driver industries, those that make up the economic heart of the state, is critical to understanding Ohio's economic strengths and opportunities and understanding how to target economic development resources. The study team's economic analysis yielded 17 driver industries for the state. Driver industries were identified based on the variables described in Section 5 of this report, which focus heavily on degree of specialization in Ohio, industry output or value added in manufacturing, and productivity. This approach may yield different results from previous studies that emphasized employment to determine key drivers.

Ohio has a broad portfolio of industries, in both manufacturing and services sectors. There is no single, dominant industry although many drivers supply motor vehicle manufacturing. Each of the six regions defined in this study also has its own portfolio of drivers industries, some quite different from those at the state level. Many of the regional drivers cancel each other out in terms of size or importance at the state level. In other words, an industry that is an important driver in one region may be offset at the state level by an industry that is an important driver in two other regions. Nevertheless, these regional drivers are important to each region's economy and, therefore, become important when developing Ohio's economic development strategy and policies. Examples of important regional industries include chemicals, food processing, aerospace products and parts manufacturing, and machinery manufacturing. A detailed table listing driver industries for each region appears in Section 4.

Ohio Statewide Driver Industries (ranked by 2003 output dollars)

NAICS	Industry	2003 Output (\$MM)	1998-2003 Output CAGR	1993-2003 Output CAGR	2003 Output Location Quotient (LQ)	2003 Employment	1998-2003 Employment CAGR
Professional Services/Value-Added Services		\$37,497					
5221	Depository Credit Intermediation (Banks)	\$19,580	12.4%	10.7%	1.6	76,150	0.3%
5511	Headquarters and Division Offices	\$10,411	9.5%	9.4%	1.0	87,800	2.6%
5241	Insurance Carriers	\$ 7,506	5.8%	7.8%	1.3	72,790	0.8%
Automotive and Related		\$20,044					
3363	Motor Vehicle Parts Mfg.	\$12,471	1.3%	3.3%	7.3	96,090	-3.0%
3361	Motor Vehicle Mfg.	\$ 4,969	1.2%	3.4%	7.0	31,210	-4.4%
3362	Motor Vehicle Body and Trailer Mfg.	\$ 2,413	1.1%	2.6%	10.9	10,600	-6.1%
3369	Other Transportation Equipment Mfg.	\$ 191	-8.4%	-8.1%	2.1	980	-15.5%
Bio-Medical		\$10,793					
6221	General Medical and Surgical Hospitals	\$10,793	5.6%	3.8%	1.4	200,040	1.6%
Other Services		\$ 6,330					
5613	Employment Services	\$ 6,330	4.6%	7.7%	1.1	129,780	-1.5%
Energy Production and Transportation		\$5,684					
2211	Electric Power Generation, Transmission and Distribution	\$ 5,128	3.7%	4.0%	1.0	16,870	-1.3%
4860	Pipeline Transportation	\$ 556	2.0%	5.3%	0.7	1,100	-1.6%
Metals and Metal Working		\$4,406					
3311	Iron and Steel Mills and Ferroalloy Mfg.	\$ 1,822	-5.4%	-1.2%	4.6	14,980	-8.4%
3321	Forging and Stamping	\$ 1,596	-3.5%	2.4%	4.5	17,950	-2.7%
3312	Steel Product Mfg. from Purchased Steel	\$ 988	-5.4%	-1.2%	7.5	10,380	-5.6%
Environmental Remediation Technology		\$2,131					
5622	Waste Treatment and Disposal	\$ 2,131	9.2%	9.6%	3.5	5,580	-0.8%
Building Products		\$1,141					
3352	Household Appliance Mfg.	\$ 1,141	2.2%	0.7%	5.3	13,600	-2.0%
Logistics/Distribution Centers		\$708					
4889	Other Support Activities for Transportation	\$ 708	-8.4%	-3.5%	9.2	5,500	-6.9%

Source: Economy.com

Note: CAGR (compound annual growth rate) is average annual growth rate over a specified period of time. CAGR is calculated using the following formula: $CAGR = (\text{present value}/\text{base value})^{(1/\text{#of years})} - 1$

There are a number of reasons why particular industries have historically been or are now based in Ohio and are economic drivers. One reason is access to natural resources or raw materials, such as wood or agricultural products. Unfortunately, many of these industries have become commoditized and are now in decline, as more of the industry's production moves elsewhere (either offshore or to other U.S. regions with additional resources or lower labor costs). An example would be the metals industry, which is still important to the state but has been declining in recent years. Another reason that industries established in Ohio is its central location, which is within a day's drive of most Eastern and Midwestern population centers. Food products are an example of such an industry. Firms that produce in Ohio and ship to other areas often become economic drivers because their level of exports out of the state is strong.

Another characteristic of many of Ohio's driver industries is that they are "supplier" industries: These industries produce goods, such as glass containers or steel plates, that become inputs into other industries. A number of Ohio's driver industries are suppliers to the motor vehicles manufacturing industry, which is one of the few "end customer" industries in Ohio. These suppliers have located in the state to be closer to motor vehicle production plants in Ohio, Michigan, and Kentucky.

It is important to note that, while most of the driver industries have seen output growth over the past five to 10 years, they have not had corresponding employment growth. Ohio's economic growth has been a productivity story over the past decade because companies have been able to increase their output by streamlining or automating processes and systems and, therefore, produce more with fewer resources.

For each driver industry, the economic analysis included an input-output model to determine other industries that supply the driver and those that buy the driver's output. It is important to understand such buy-sell relationships because the dynamics of driver industries affect supplier and buyer industries. For example, when motor vehicle production declines, the market for Ohio industries supplying motor vehicle materials and parts declines as well. Another example is the growth of insurance sales, which has driven benefits in the entire supply chain, from call centers and sales offices to business services such as legal and advertising.

An in-depth exploration of the particular dynamics and challenges of each of the state's six economic regions appears in Section 4 of this report. To explain the portfolio nature of the state's economy, the following are regional summaries with driver industry overviews:

- **Northeast** -- The Northeast region has a diversified portfolio of driver industries in many different sectors. Noted for its tradition of steel and other heavy manufacturing, which still has a strong presence today, the region is also very strong in high-growth services industries. Insurance, banking, and other professional services top the list of 32 identified drivers. The next biggest category of industries in the Northeast region is metals and metalworking.
- **Northwest** -- The Northwest region has a highly diversified portfolio of 30 driver industries, with a primary concentration in manufacturing, especially automotive-related manufacturing. A large chemicals sector is driven by plastics and rubber products manufacturing, which supplies the automotive industry. Food manufacturing is also substantial. Notable service industries in this region include

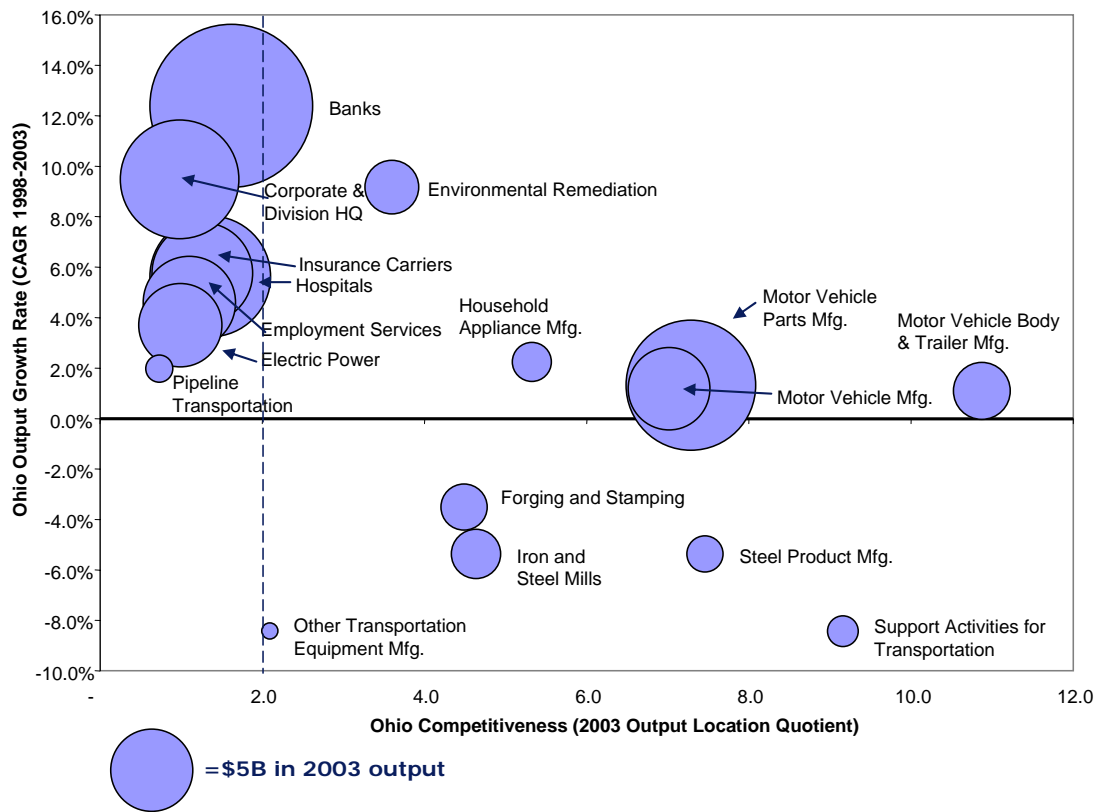
hospitals and a substantial number of corporate and regional headquarters offices.

- **West Central** – The West Central region is dominated by the presence of two manufacturing industries: automotive and aerospace. Banking is also large for this region. Additional drivers include other manufacturing industries, such as machinery, chemicals, building products, metals, and food. Energy production and environmental technology are also important economic drivers in the West Central region. In all, the statistical analysis identified 18 drivers for the West Central region.
- **Central** – This is an economy that is divided fairly equally between manufacturing and services activities. Although the region is associated with such service industries as insurance, retail, and distribution, there is also a strong presence of manufacturing industries, including automotive, chemicals, and food. Among the 23 identified drivers, the automotive industry and professional services are the two largest and are of equal size in the Central region. The Central region is home to many headquarters, many of them “homegrown” companies such as Wendy’s and Limited Brands, and a significant distribution and warehousing sector capitalizes on the region’s central location and its access to transportation.
- **Southeast** – The Southeast region is not dominated by any one driver industry. Rather, it is a portfolio of 14 moderately sized driver industries, many of which are tied to the region’s rich natural resources. It is no surprise that industries such as coal mining, iron and steel mills, wood products, and food manufacturing make the list of economic drivers for this region.
- **Southwest** – The economic analysis yielded 20 drivers for the Southwest region. The region is dominated by two services industries: corporate and division headquarters and banking, both of which have experienced strong output and employment growth. Hospitals are another notable service industry in the region. There is also a strong presence of manufacturing, especially in the aerospace and automotive sectors, which have been experiencing healthy growth. Chemicals, energy, food, and environmental technology are other leading industries for the region.

PORTFOLIO ANALYSIS FOR STATE DRIVERS

To evaluate the relative health of driver industries and their economic development needs, it is helpful to analyze them as a portfolio. The following chart shows Ohio’s statewide drivers represented by their output growth rate and output location quotients. The X axis represents the industry’s output location quotient, or level of specialization and exports, and the Y axis shows each industry’s average annual output growth between 1998 and 2003. The size of each “bubble” represents the dollar level of gross product, which is similar to the value added for that industry. Thus, the industries in the upper right-hand quadrant are industries with high growth rates and a high degree of specialization in Ohio, and those in the lower left-hand quadrant have had slower growth and have a lesser degree of specialization. A similar portfolio analysis for each of Ohio’s six regions is in Section 4 of this report.

Statewide Driver Portfolio Analysis



Source: Economy.com; CSU/Deloitte Analysis

Quadrant Analysis

Each quadrant of the chart represents a group of industries facing similar strategic issues and opportunities. Therefore, the dynamics of each quadrant will drive economic development objectives and service needs.

Portfolio Analysis Framework



Upper Right Quadrant – Strong Economic Base

This quadrant shows industries that can be regarded as strong economic base drivers. The industries are typically dominated by large establishments, have experienced stable

growth and are highly competitive in Ohio, with output location quotients greater than 2.0. These industries are generally in good health. These industries include household appliance manufacturing, motor vehicle and parts manufacturing, motor vehicle body and trailer manufacturing, and environmental technology.

- **Economic Development Objective:** Sustain growth by supporting competitiveness through companies' income statements. Develop state policies that either encourage top-line revenue growth or minimize operating costs.

Lower Right Quadrant – Traditionally Competitive Base Drivers

This quadrant contains industries that are highly competitive but manufacture commodity products. In recent years, they have suffered a cyclical decline. These companies' strategies may be challenged, and they rely on new product development and process improvement for growth and financial health. In the state, these industries are: support activities for transportation, steel products manufacturing, iron and steel mills, forging and stamping, and other transportation equipment manufacturing.

- **Economic Development Objective:** Sustain competitiveness as growth slows in the national industry. Support strategy change and innovation efforts to improve growth.

Lower Left Quadrant – Important Supplier Base

This quadrant typically contains industries that are less competitive than the other drivers in Ohio and are not growing. These drivers need a strategic transformation to improve their economic health and move up the value chain. Fortunately, Ohio does not have any state driver industries in this quadrant.

- **Economic Development Objective:** Retain stronger, more aggressive segments of industries by focusing on firm-level strategies. Individual firms, rather than the industry as a whole, must change their specific ways of doing business by developing new products, tightening their supply chain or leaning out their production process.

Upper Left Quadrant – Growth Opportunity Base

This quadrant contains industries that have grown significantly over the five-year study period within the state but are not yet strongly competitive nationally. These are industries that Ohio may be able to build; they are industries that have the opportunity to become stronger economic drivers for the state in the future.

- **Economic Development Objective:** Provide opportunities to sustain and increase competitiveness in the state. Opportunities have to be addressed industry by industry. (Section 3 addresses several in detail.)

Generally speaking, Ohio's services industries, such as banking, hospitals, and insurance, are in the upper left quadrant of the matrix. These industries have high output growth rates and moderately high location quotients. There is a real opportunity for Ohio to drive growth in these industries. Ohio merely capturing its "fair share" of industry growth will drive fairly significant economic growth for the state. Ohio's manufacturing industries, on the other hand, are highly specialized, with high output location quotients, but output and employment for most of these industries either are not growing or are growing at very modest rates. Many of these industries have challenged strategies and need help with process improvement and product innovation to sustain their businesses.

Driver Interactions

Three driver industries and their supply chains have especially large, important, and visible constituencies in Ohio — the automobile assembly industry, the chemicals industry and its polymer component, and the food products industry. Each tends to claim parts of the other when representing itself to the public and, at times, when vying for public attention and resources, the three industries are placed in a zero-sum game. As the graphic on the following page shows, this is an incomplete view of economic reality in Ohio.

When viewed in isolation, each industry is a large and important contributor to the state's economy. In 2003, the motor vehicle industry contributed \$20 billion in gross product to Ohio and had a broad supply chain. Chemicals is a \$12 billion industry, and the food industry generates \$6 billion in gross product. However, these three industries cannot be viewed in isolation because they are interrelated in two dimensions.

The chemicals industry is a direct supplier to the automobile industry, accounting for 4% of its supply chain. The chemicals industry is also a contributor to the food products industry through packaging. In the future, farm products will become a source of polymer feed stocks. Soybeans are a source of inks, and corn byproducts are competitive in the market for environmentally sensitive plastics.

As with many industries in Ohio, these three drivers are mutually supportive: They are interconnected through their supply chains. They have overlapping business functions -- many of which are themselves activities important to the state -- such as headquarters, research design, product development, back-office administration, production, procurement, logistics, customer support, and sales. Economic development opportunities lie at the intersection of industry and business function.

For example, as the graphic illustrates, all industries have headquarters in their supply chains. They also require research and development, warehousing, and information technology functions. These particular business functions are themselves drivers in the state or regional economies. The distribution and warehousing industry, for example, provides functions critical to the growth and success of the automotive, chemicals, and food products industries. In turn, the business demands of the automotive, chemicals, and food products industries are critical to the growth and success of Ohio's distribution and warehousing industry.

This interconnectedness of business needs and activities extends to industries, such as medical equipment, that represent critical growth opportunities for the state. As can be seen in the graphic, the supply chain and business function needs for the medical equipment industry overlap the supply chain and business function needs for the three driver industries shown. Industries do not function in isolation; they make up an interconnected constellation of activities and needs.

OHIO'S GROWTH OPPORTUNITIES AND EMERGING TECHNOLOGIES

Introduction and Methodology

The primary goal of the overall sector study has been to assess Ohio's economy and that of its six regions, with a focus on identifying industries at their core and highlighting the challenges and opportunities those industries face. However, a road map for Ohio's economic future would be incomplete without looking down the road to what industries, technologies, and opportunities may be emerging.

There is no single method that can identify the industries and technologies that are emerging as sources of competitive advantage in Ohio and its regions. The project team took a multidimensional approach to this challenge. Two separate analyses were undertaken to identify emerging opportunities: one for industries and another for technologies.

To determine growth opportunities, the study team began with a quantitative analysis of gross product and productivity data at the four-digit level of NAICS for all industries that were not identified as drivers of the state's economy. (Drivers of each regional economy were excluded from the subsequent regional analyses; regional results appear in Section 4). This analysis identified industries experiencing large growth in gross product, large increases in productivity, and low gross product location quotients. These factors indicate a growing market for the product, Ohio's competitiveness, and the state's opportunity to capture market share. A parallel set of calculations identified large and important industries that were not classified as drivers. These industries had large increases in gross product, increases in productivity, and high gross product location quotients. These analyses were supplemented by qualitative findings from industry specialists, expert panelists, and business leaders who responded to an Internet-based survey.

More detail regarding the methodology and the findings of this analysis can be found in Section 3 of this report.

A Future Built on Strengths

To put it succinctly, Ohio's future lies in its past. Growth opportunities and emerging technologies largely are being built on the state's current and historical strengths. Innovation and adaptation are growing out of the state's existing economic base.

"Following the money" is a useful and enlightening exercise in understanding Ohio's most likely opportunities for future economic success. The study team surveyed a sample of venture capital firms across North America to determine the technologies and industries they were investing in and to ascertain their opinion of Ohio's technology specializations. Respondents were asked to rate each technology or product as a potential investment in Ohio and in the United States. The venture capital community, which typically finances innovations, stakes its business success on identifying investment areas that represent the best opportunities for market success.

Ohio has newly found acceptance among venture capitalists for the potential investment opportunities it provides. Survey respondents identified several areas in which the state holds a competitive advantage. These are:

- Medical equipment and research
- Fuel cells, with off-grid civilian applications being favored:
 - Heating, ventilation, and air-conditioning
 - Automotive
 - Electric power generation
- Nanotechnologies, particularly
 - Nanomaterials
 - Nanochemical applications
 - Nanobiological applications
 - Intersection of nanotechnology and polymer science
- General polymer technologies, as well as:
 - Photonic polymers
 - Electronic polymers
 - Biocompatible polymers
 - Conductive polymers
 - Liquid crystal displays
- MEMS (micro-electrical-mechanical systems) applications, particularly in the areas of:
 - Micromachining
 - Automotive
- Information technology, particularly for the:
 - Medical industry
 - Financial service industry
 - Security database and data-mining applications

These particular technologies and products were most likely chosen as the best fit for Ohio because they are directly related to the state's key industrial and research strengths.

For example, the polymer industry forms a dominant portion of Ohio's depth in chemistry and bridges the lubricants, coatings, rubber, and plastics industries. The strength of this industry is historical, intellectual, and corporate. Several of Ohio's regional economies are effectively chemistry economies when agricultural chemicals, soaps and cleaning compounds, and petroleum products are added to polymers. Ohio also has deep strength in its corporate laboratories in advanced materials research, such as steel, polymer chemistry based on oil and gas, and products that can be developed from corn and soybeans. There is the real prospect of major advances when Ohio's agricultural research engine, biotechnology, and organic chemistry meet.

Medical equipment and instruments flow out of the clinical strengths of Ohio's research hospitals and out of the state's established industry strengths in imaging, sterilization, equipment, instruments, and contract pharmaceutical processing. Ohio is a leader in clinical trials, and external rankings of clinical excellence place Ohio's hospitals and clinical practices at the top of national lists.

The state has unusual research depth in power and propulsion systems at NASA Glenn Research Center, General Electric's jet engine division, and the companies that revolve

around military contracting at Dayton's Wright-Patterson Air Force Base. This is augmented by a large number of automobile engine manufacturing facilities that are located across the state. Battery technologies and alternative energy sources are the focus of research at NASA Glenn, Energizer Corporation, and a number of embryonic fuel cell companies. A supply chain is organizing in Ohio around fuel cells.

A number of cross-cutting areas of technology cannot be captured through an industry lens. Ohio is becoming recognized as a center for nanotechnology research and production. Nanotechnology represents a set of technologies that cut across medical, polymer, and advanced materials research. The technology can be applied everywhere from sunglass film to medical membranes, but area venture capitalists noted that the technologies have yet to find substantial market penetration.

Ohio is also a place where "machines on chips" or micro-electro-mechanical systems (MEMS) technologies are being "packaged" and adopted into instruments, controls, and electronics processes. Ohio was named by *Small Times* magazine as the 10th MEMS hotspot in the United States.

These strengths recognized by the venture capital community also largely echo the six areas of core technology competencies already identified by Ohio Governor Bob Taft and the Ohio Department of Development. These areas build on the state's existing research strengths in universities, hospital-affiliated institutes, federal government laboratories, and private-sector research institutions clustered in the study and development of:

- Advanced materials
- Biosciences
- Instruments
- Controls and electronics
- Information technology
- Power and propulsion

Each of these areas is associated with demonstrated intellectual and human capital depth within the state. And, as commercial investment opportunities have emerged, private companies have organized to leverage the flow of research and development dollars into the state.

These technological and research strengths largely complement and bolster the industries that the study team identified as growth opportunities for Ohio. Just as identified emerging technologies tend to stem from the state's existing knowledge base, so too do seven potential growth industries.

- Nondepository credit intermediation, which includes credit card issuers, consumer lending, and sales financing, is an emerging driver statewide and in the Northeast, West Central, and Southwest regions. This industry has a large back-office component and has characteristics that are similar to general shared-services business functions.
- Headquarters and administrative services, an opportunity linked to the nondepository credit intermediation industry, is emerging as a statewide driver, as well as a driver of the West Central economy.
- Computer systems design and related services is an industry largely associated with the state's identified driver industries, such as health care, finance, and

distribution. The industry appears as an emerging driver in all regions of the state, with the exception of the Northwest and Southwest.

- Scientific research and development services is an emerging driver in the Southeast. However, prominent establishments in this industry are located throughout the state. Many of the facilities have a direct connection to the state's industrial heritage. This is true in aerospace, automobiles and the automobile supply chain, polymers and other chemistry-based products, and metalworking. Other research facilities are tied to the clinical medical excellence of Ohio's regional economies.
- Specialized design services is an emerging driver industry in the Southeast. However, there is strength in industrial design in the Central and Northeast regions, as well. Design represents a major resource in freshening the state's product base, and it is an area in which the state has demonstrable intellectual excellence.
- Electronic and precision equipment repair and maintenance is a statewide emerging driver, even though it is not a driver in any one region. This industry is linked to the state's central location in the industrial heartland of America, and repair facilities are spread across the state's economic regions.
- Tourism was identified as a growing industry in the Northeast and Southwest in the data analysis, and the growth of leisure industries is an opportunity for all parts of the state. All regions of the state have growing tourist industries. These industries are parts of the base of the regional economies of Ohio — from the sport fishing industry along Lake Erie to the lure of the Appalachian hardwoods of the Southeast. The business challenge presented by the tourism and arts industries in Ohio is that, setting aside the two major theme park operators, this is an industry of small businesses that do not have the scale or ability to advertise in multistate regional markets. Additionally, the region-states within Ohio have different product mixes and value propositions. This means that a single and simple brand for Ohio as a whole will have difficulty conveying the recreational opportunities in each of the state's regions. What the region-states do share is a market failure in their ability to support their regional brands. Ohio and its regions cannot promote a tourist brand without state and regional intervention. The industry needs to fund its brand through taxes or industry membership fees, and it needs a government-supported body to develop and market tourism under a brand.

The common thread uniting these diverse industries and technologies is their tie to Ohio's existing comparative advantage. Industries that represent growth opportunities, for the most part, reflect business services that support Ohio's driver industries and leverage the state's industry knowledge and comparative strengths. The technologies for which Ohio is most likely to achieve a comparative advantage are those that can be applied to driver industries. Examples include fuel cells for the heating, ventilation, and air-conditioning industry, the automotive industry, and electric power generation; nanotechnology and precision machining to support manufacturing; information technology for the medical and financial industries; and medical equipment that is driven by Ohio's expertise in clinical medicine. This finding underscores an imperative for future economic success: Ohio must continue to drive new and emerging growth from its core strengths, and the state must help align knowledge resources with those that can commercialize ideas.

PUBLIC POLICY ANALYSIS

Overall Findings

It is important to understand how Ohio's public policy and other general business issues affect businesses in the state. These factors are critical when businesses are making investment decisions. Ohio must be competitive with other locations on basic public policy issues to retain and attract investment. Although Ohio consists of six distinct regional economies, for the purposes of this study, industry leaders from each of those regions generally agree on major public policy issues. During 12 expert panels held throughout the state, participants voiced similar concerns: the Ohio tax system, health care costs, workers' compensation, liability and torts, global competitiveness, and utility costs. They also listed workforce issues, although these varied by region, industry, and job level. Environmental regulation enforcement was a concern for specific industries and in the Northeast, Northwest, and Southeast regions. There were few concerns about infrastructure: Southeast panelists saw problems with rail and electricity services; Central panelists said the trucking and transportation network was becoming a problem; West Central panelists considered air service to be lacking.

Public policy concerns common to all six regions were:

- Ohio's tax system
- Health care costs
- Workforce
- Workers' compensation costs and system
- Liability and torts
- Global competition and fair trade
- Natural gas costs
- Global availability and cost of raw materials

Surveys conducted during the expert panels and over the Internet indicate the greatest concerns shared by Ohio business leaders. The following table summarizes the public policy data from the Internet-based survey of business leaders. Health care costs are of most concern to respondents, followed by energy prices, Ohio's tangible personal property tax, torts, and the other Ohio taxes. Infrastructure and utility availability are not considered to be problems by the majority of respondents.

Responses to the Question:
Which of the following public policy areas is a problem for your business?

Public Policy Area	1 Not a Problem	2	3 Neutral	4	5 Major Problem	N/A	Response Average Rating
Health care insurance costs	4%	1%	3%	24%	64%	3%	4.5
Energy Prices: Electricity	8%	8%	24%	30%	26%	3%	3.6
Energy Prices: Natural Gas	9%	10%	23%	32%	24%	3%	3.5
State of Ohio Business Taxes: Tangible personal property tax	8%	10%	21%	29%	20%	11%	3.5
Torts & associated insurance & legal costs	13%	8%	20%	28%	26%	5%	3.5
State of Ohio Business Taxes: Corporate Franchise Tax	8%	8%	33%	24%	15%	13%	3.4
State of Ohio Business Taxes: Municipal profits tax (wage tax)	8%	8%	30%	25%	16%	12%	3.4
Workers compensation	10%	14%	21%	34%	15%	6%	3.3
Corporate Sales Taxes	10%	13%	36%	19%	13%	10%	3.1
Environmental Regulations	11%	17%	42%	17%	8%	4%	3.0
Tax abatement	14%	10%	47%	11%	8%	9%	2.9
Availability of bank loans/ capital	31%	9%	26%	13%	14%	7%	2.7
Electricity Service & Availability	23%	19%	31%	18%	5%	4%	2.6
Wireless network availability	31%	15%	31%	14%	4%	4%	2.4
Road infrastructure	30%	18%	33%	9%	5%	5%	2.4
Railroad infrastructure	41%	11%	30%	5%	3%	10%	2.1

Source: Sector Analysis Study online expert panel survey

Business leaders shared a concern about Ohio's current business climate. They acknowledged that issues such as global competition and health care costs transcend Ohio and are economic concerns of national scope, but respondents wanted the state to address problems within its control – the tax structure, workers' compensation, and legal liability -- to provide a reason for companies to remain in, expand in, or come to Ohio.

The following are summaries of major public policy issues for business leaders across the state. Because these are based primarily on expert panels and an Internet survey, they are not exhaustive examinations of these issues. Rather, the study team has assembled participants' and respondents' candid points of view.

Health Care Costs

Sixty-four percent of survey respondents reported that health care costs are a major problem for their businesses, compared to only 5% who said health care costs are not a problem. Although this study did not explore whether costs are higher or rising faster in Ohio than the rest of the nation, panelists consistently cited the health care costs as a top concern. Business leaders noted 15% to 20% increases in health care costs, which are outpacing companies' profitability growth and claiming 5% to 30% of revenue. In response, business leaders said they have tried to offset price spikes by taking such actions as demanding greater contributions from employees, reducing coverage, offering medical savings account to encourage employees to make more fiscally prudent health care choices, offering wellness programs, and self-insuring. But they acknowledged that there is little to be done on the state or regional level. Health care, they said, must be viewed as a national issue. One manufacturer pointed to the "steep hill" of health care costs as contributing to the outsourcing of U.S. jobs "because health care and benefits costs are so small in China." The loss of manufacturing jobs in the United States "is not just a wage issue." He said he has been able to offset wage increases through increased productivity, but productivity improvements have not been able to keep pace with increases in health care costs and other benefits. "My productivity hasn't been able to overcome those issues."

Representatives of the hospital industry have their own concerns about rising health care costs. Although public hospitals must operate according to national and state policies, industry representatives said most employers view health care as an out-of-control budget item. Health care representatives advocated tort reform as a measure that would help grow business, noting that annual increases in Medicaid costs of up to 10% make it “tough to cut business taxes and grow the economy.”

Energy Costs

More than half of survey respondents reported that natural gas and electricity costs are a problem for their businesses; few than 20% said energy costs are not a problem. Utilities represent a significant proportion of cost for many of Ohio’s heavy manufacturing industries. Most business leaders acknowledged that the cost of electricity in Ohio is competitive with other states, but cost increases in energy, particularly natural gas, have had a significant impact on manufacturers’ profitability. Oil and gas price increases are also driving increased costs for distribution and transportation. There is no easy solution for energy cost increases, they acknowledged. Respondents noted that deregulation would probably make things worse, not better. Energy prices were generally a more pressing subject in the northern portions of the state.

Taxes

The state’s tax system was seen by many business leaders as overly complex and burdensome; fewer than 20% considered the tax system not to be a problem. It stifles growth, business leaders said, and puts Ohio at a disadvantage with other states. When companies consider their next business investment, one panelist said, “You’re going to be penalized in Ohio. You have to go through so much government red tape, compared to other states.”

At the top of the list of tax concerns among business leaders was the tangible tax on equipment and inventory. They said the tax penalizes success, discourages investment and expansion within the state, and forces business owners to consider relocating out of the state. “How can you keep people in Ohio when they can go two states away and they don’t have to pay personal property tax?” said one business leader. Manufacturers noted that the tax affects how they think about inventory and cited the tradeoffs they have to make between carrying inventory to provide immediate customer service and the tax costs of carrying the inventory.

Even though the state may provide abatements and tax credits that make Ohio a competitive location option, the system’s complexity and lack of transparency is an impediment when businesses need to make fast-paced investment decisions. Out-of-state investors and site selectors may see Ohio’s “list price” for taxes and move on to consider another location without spending the time to understand the state’s “discounted price” after abatements and incentives. Ohio’s list price of taxes results in a “sticker shock” that eliminates the state from consideration, panelists said. Other business leaders noted the cost of complying with state tax codes and regulations, citing the need to hire more accountants.

Business leaders also cited the complex, fractured local taxing system as a problem. Some noted that Ohio’s tax structure might inhibit the attraction of top executives and their potential investment capital.

Many of the panelists' concerns will be addressed if recently proposed changes to Ohio's business tax code are enacted.

Torts and Legal Liability

Although business leaders consider health care primarily a national issue, they said the state should take action to curb the costs of lawsuits. Fear of legal liability can change the way that businesses, governments, and professionals provide goods and services, often in ways that are not consumer-oriented. Tort reform can bring economic benefits: A National Bureau of Economic Research study estimated that states adopting lawsuit abuse reforms experience employment growth, productivity growth, and growth of total output. "Until something is done about the amount of punitive damages," said one expert panelist, "we will have a problem with health care and everything else." One manufacturer estimated that trying to protect himself from legal claims costs his company about \$100,000 a year. Insurance deductibles are now \$150,000 per case, and premiums are five times what they were five years ago, he said.

One expert panelist said Ohio was experiencing a brain drain of physicians and business leaders relocating to states where there are caps on liability. A representative of the hospital industry noted that the Southwest Region, in particular, is beginning to experience a shortage of doctors. "When we're looking at recruiting neurosurgeons and surgical specialists, they're beginning to know which states have reasonable malpractice rates and which don't."

Workers' Compensation

Expert panelists throughout the state expressed concern that the workers' compensation system is biased against business owners. They noted that even when they investigate fraud and abuse, their evidence is frequently dismissed. Many cited examples of workers doing heavy lifting, hunting, or engaging in other strenuous activities away from work, but the workers' disability claims were still upheld by the judge. "You can't win. You're just trying to minimize your losses," said one panelist. Costs per employee are high, business leaders said, even for companies that don't have many claims. One noted that only a year ago his company faced a 400% spike in workers' compensation insurance fees, which the company was able to lessen by joining an alliance to manage costs. Others said recent state measures to control rising costs have helped, but they worried that the credit programs might be discontinued or lose their effectiveness.

Environmental Regulations

Most survey respondents did not consider environmental regulations a problem for their business. However, concerns about environmental regulation were greater in the Southeast, Northeast, and Northwest regions. Specific industries, such as chemicals, were also more significantly affected by environmental regulations. Specific concerns included the cost and time for permitting expansion or improvement, lack of transparency of regulations and changes, and costs and resources needed for compliance. One universal concern was that global competitors such as China do not have to comply with environmental regulations. Ohio companies are concerned that they will lose their competitiveness or that all manufacturing will move overseas, panelists said. Their recommendation, however, was not that Ohio relax its standards; they want China to adopt regulations that will help "level the playing field."

Infrastructure

On a positive note, Ohio's business leaders seem satisfied with the state's infrastructure. Although there were pockets of concerns, the vast majority did not consider electricity or wireless availability and service, roads, and railroads to be a concern. In fact, Ohio's transportation infrastructure and network is often cited as a positive factor for the state.

Economic Development Programs and Policies

Discussions with Ohio's business leaders indicate that Ohio has developed attractive incentive packages that help significantly with retention and expansion of many companies that are struggling with the state's high cost structure. For companies that understand the system and have the resources to access the benefits, Ohio's economic development programs have been beneficial, and many business leaders sang the praises of their local economic development representatives. However, Ohio's economic development resources (incentives, training programs, tax breaks, R&D) are fragmented and companies – especially smaller ones -- don't always have the resources to find or access them. Both business leaders and economic development representatives said the state's economic development programs are often not flexible enough to adapt to specific situations or needs. The process to qualify for, apply for, and receive economic development incentives in Ohio can be cumbersome and does not keep pace with today's rapid speed of business decision-making.

Other states offer highly attractive incentives bundled in packages that “make it easy” for companies, panelists said. As a result, some companies, including those with strong Ohio heritage, admitted that they frequently consider whether it would be best for them to move out of state. Loyalty to the state is often family- and heritage-based, not based on business logic.

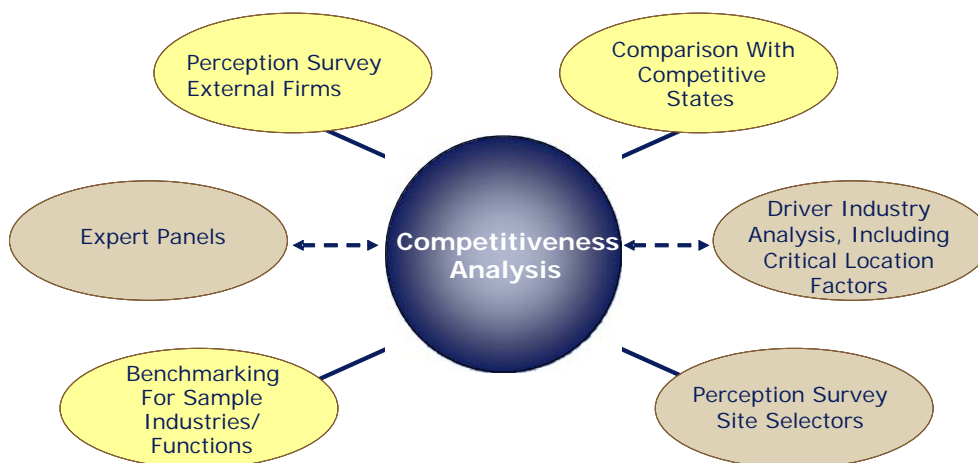
Many economic development incentives are employment-based. Employment-based incentives tend to reward attraction of out-of-state business; however, such incentives tend to discourage in-state businesses wanting to make incremental capital investments that enhance productivity and increase output but that may not create any net new jobs. Benefits tend to be back-end loaded, but companies need benefits up front to make an initial investment possible. There is also a perception among business leaders that incentives create unfair competitive advantage when one company in an industry receives benefits from the state that its competitors do not.

OHIO'S COMPETITIVENESS

Using findings from each component of the study, the project team synthesized an overall competitiveness profile for Ohio and its regional economies. This overall competitiveness was framed within the context of the corporate decision maker, leveraging the study team's experience locating operations for clients around the world. The competitiveness analysis was designed to highlight the strengths and weaknesses of Ohio and its regions as a business location and to identify opportunities to improve the ability of the state and specific regions and metropolitan areas to attract new investment.

The following graphic shows some of the elements that contributed to this competitiveness analysis. Surveys of site selectors and firms located outside Ohio were conducted to assess business perceptions of the state. The study team compared Ohio against 10 competitive states for key demographic variables and operational indicators. Analysis of Ohio's driver industries helped inform the competitiveness assessment. Finally, the study team benchmarked select Ohio MSAs versus key competitive MSAs for specific industry/function intersections.

Inputs to Competitiveness Analysis



Competitiveness Key Findings & SWOT Analysis

Ohio's competitiveness varies significantly by business function and region. Each region has a different profile with respect to demographics, industry mix, and, of course, geography. Recommendations for industry attraction need to be focused on competitive variables unique to the particular regions. Furthermore, each region should be aware of its strengths and weaknesses with respect to critical location factors for particular industries and functions.

Generally, Ohio locations benchmarked in this study were average in terms of labor and real estate costs when compared to regional competitors. When the competitive field was expanded to include national competitors for various functions and industries, cost differences increased (some dramatically more and some dramatically less than Ohio locations). These findings indicate that the perception of Ohio as a "high cost" location is

likely to be inaccurate when looking at many other key Midwest locations. This may be an important marketing message to explore and capitalize on.

As expected, Ohio demonstrates a solid skilled employment base, accentuated by a nationally competitive high school graduation rate and strong metrics around indicators of innovation (patents, federal research funding). However, many of the demographics, again within specific MSAs, are not promising. In particular, the employment and population growth rate is at or below the national average. In addition, in terms of advanced educational attainment, Ohio begins to lose its competitive advantage over both regional and national competitors. All of these factors highlight Ohio's difficulty in retaining talent. Although the state's slow growth cannot likely be curbed overnight, a number of short-term initiatives, such as broadening Ohio's higher educational tradition of supporting internships and cooperative education at the undergraduate level to the postgraduate level, may assist in slowing the "brain drain."

Other statewide competitive attributes probably come as no surprise, although many aspects of the competitive analysis provide further support as to their continued importance. For instance, there are very few states with such a wide diversity of large metropolitan areas, including three major cities (Cleveland, Columbus, and Cincinnati) and several medium-sized cities with distinct economies (e.g., Toledo, Akron, Youngstown, and Dayton). Most of these cities take advantage of Ohio's world-class transportation network and its proximity to most of the nation's population centers. Furthermore, cities in Ohio are consistently ranked as having a high quality of life, despite common misconceptions about the ailing cities of the "rust belt." Although the commonalities of the state's MSAs should help develop Ohio as a product, the uniqueness of the regions should also be exploited. Much as a store owner benefits from diversity of product offerings, Ohio is uniquely positioned to benefit from a variety of regional economies that may appeal to a wide variety of customers. The state's economic development approach should be to direct projects to where the key indicators, or "order winners," are most likely to meet the needs of the customer.

Qualitative location factors vary widely across MSAs and cannot be generalized for the state as a whole. For instance, Cincinnati often ranks well for various industries and functions based on the quality of its local transportation network (especially the airport). Columbus' notable strengths include its road transportation network and basic demographics, such as population growth. In addition, Cleveland's industrial base provides key location attributes for industries such as banking, finance, and chemicals. All Ohio MSAs investigated feature unique operating characteristics that present both opportunities and challenges. The regions' economic development authorities should familiarize themselves with these key operating factors to develop their own strategies for marketing strengths and mitigating weaknesses.

The following summary draws from each of the study's analyses to profile Ohio's key strengths, opportunities, weaknesses, and threats (SWOT) from an economic development point of view. This SWOT analysis formed the basis for identifying significant gaps in Ohio's current capabilities when measured against performance expectations for the key industry drivers. This section concludes with specific recommendations for closing these gaps.

Strengths

- History of applied, practical innovation
- History of manufacturing and support for entire supply chains
- Central location and strong transportation infrastructure
- Multiple large and medium-sized markets, each with unique operating characteristics
- Certain demographic fundamentals, such as high school educational attainment, quality of life, and a high concentration of industry-specific technical skill-sets
- Strong manufacturing presence (largest source of output and employment)
- Regional strengths in service industries such as banking and insurance
- Increasing productivity in the face of decreasing unemployment
- Six distinct regional economies offering an array of location choices within the state
- Industries emerging from within Ohio's existing industrial base and areas of established competitive advantage
- Assistance programs to support expansion in manufacturing (e.g., incentives, Manufacturing Extension Partnership)
- A multitude of regional and local economic development initiatives providing a potential foundation for regional economic development efforts

Weaknesses

- Perception of Ohio as a single "rust belt" economy
- Low to stagnant population and labor force growth
- Challenges in retaining populace with advanced academic degrees
- Decreasing employment and continued vulnerability within the manufacturing sector
- A largely reactive, state-driven approach to economic development instead of a region-state view that reflects the state's six distinct regional economies
- Perception of economic decline because of employment losses among state and region driver industries and clusters
- Inconsistent financial support for and outcome measurement of innovation within existing and emerging industries
- Poor reputation for entrepreneurship
- Shallow local pools of management talent with experience running high-growth and startup companies
- Perception of a unionized labor environment across industries and policies that adversely affect employers (i.e., workers' compensation)
- Perception of high operating costs, including utilities, labor, and taxes
- Overall lack of transparency of tax, business, and environmental policies
- Economic development programs that have historically focused on manufacturing and failed to address needs of service industries and small businesses

Opportunities

- Leverage the state's rich availability of manufacturing skill-sets and R&D fundamentals to help manufacturers to move up the value chain
- Capitalize on the infrastructure of the automotive industry and its supply chain to help leverage the success of other industries (aerospace, medical instruments)

- Help Ohio's automotive supply chain companies expand globally
- Improve linkages between R&D resources and commercialization opportunities
- Retain the state's talent pool by closely linking research institutes and companies to universities at the graduate level through student placements
- Take a problem-solving, customer-service approach to economic development that helps businesses shorten time-to-market and serve their customers better at a lower cost
- Infuse industry expertise at all levels of economic development (regional and state)
- Leverage regional industry-specific strengths and competitive advantages to address weaknesses
- Use region-state collaboration to allocate and expand the reach of the state's economic development resources
- Expand the state's expertise in process improvement to make service sectors more competitive
- Demonstrate intellectual leadership in chemicals and polymers (driver) and industrial design (emerging driver)
- Develop a portfolio strategy to prioritize innovation investment opportunities. This can be done by identifying the intersections between driver industries and technologies to find those opportunities that best fit Ohio
- Develop a center of excellence in the state for logistics and transportation (e.g., RFID research at Dayton's Wright Center of Innovation)
- Restructure the state's business tax code to expand opportunities in capital-intensive industries and distribution and position Ohio as a leader in economic development innovation
- Develop attraction messages that communicate the rich variety of Ohio's resources (i.e., closely located MSAs with individual strengths, variety and depth of industries and supply chains, quality of life)
- Help drive top-line economic growth by investing in new products for new markets that will drive revenue
- Exploit Ohio's central location and efficient transportation network to attract and expand manufacturing and distribution operations that cannot move offshore because of customer service, legal, regulatory, or scale constraints

Threats

- Ohio's business leaders and residents are not consistently strong ambassadors for the state and its strengths. They are losing faith in Ohio's "product."
- The currencies of major global trading partners need to float if competitive equilibrium in trading is to be established.
- International trade treaties need to be enforced.
- Offshore competition (India, China) for traditional commodity market manufacturing is likely to increase in the future. Ohio can't compete with these locations from a pure cost perspective.
- Offshore competitive locations are becoming more sophisticated in the operations they can support.
- The automotive industry is facing challenging times -- slow demand, cost increases, and pricing pressures -- which could lead some Ohio firms to relocate to more cost-competitive locations.

- Intense competition exists from other states, which often have favorable business operating environments and increasingly sophisticated economic development programs.
- Trends toward more sophisticated technology in manufacturing will require a more skilled labor force that is able to adapt to innovative manufacturing environments.
- Ohio is currently being screened out as a business location in some cases because of negative cost and competitive perceptions that are inconsistent with reality.

GAP ANALYSIS

This study identified a number of gaps at the state and regional levels in the economic development performance of the state. This section of the report addresses overall gaps and recommendations for Ohio. Section 3, in part, focuses on specific recommendations for seven industries that have been identified as opportunities for Ohio and select regions within the state

Gap: Ohio “basics,” including tax and environmental policies, are not viewed as competitive. The state needs to develop a problem-solving focus and approach to economic development.

Competition for business investment is intense, and Ohio has a number of attributes that can make it competitive. However, there are also factors that, at least at first consideration, may eliminate Ohio from contention for business investment. Tax policy is one such factor. Although the state is usually effective at providing companies compelling incentive programs, smaller companies have difficulty finding and accessing resources. Some projects may not make it past initial stages of due diligence based on how Ohio’s fundamentals look “on paper.” Ohio’s environmental policies, although no stricter than those of other states, are often difficult to understand. Improving accessibility, transparency, and transaction speed of economic development incentives and policies will make Ohio more competitive. Furthermore, taking an approach that is mindful of and proactive with respect to industry and company-specific business issues (near-term and long-term) will help the state win investments. It should be noted that getting the basics right is important for effective economic development, but that alone will not solve all of the challenges facing Ohio’s economy.

Gap: The state is a *portfolio* of regions and industries. However, policies are structured for a state-level strategy. Currently, economic development is largely deal-oriented, reactive, and not necessarily focused on business problem-solving. There are a few industry exceptions, especially in technology and emerging areas (i.e., IT, aerospace, and polymers), where the state is leading industry-focused development strategies.

There is no “silver bullet” or quick fix that will turn the state’s economy around overnight. Instead, it is important to focus on what makes Ohio unique and develop a strategy to help businesses solve the problems and challenges they face. The state needs to support regional economic drivers, not just those that have a statewide presence, and

recognize that the distinct, individual nature of the regional economies requires that solutions be bottom-up. The state's role should be to support and enhance these regional responses. Individual regions may choose to leverage resources and maximize cooperation between other regions that share similar clusters.

Gap: Based on key operational variables in the state-to-state comparisons and MSA benchmarking, the state's competitiveness differs significantly depending on function, industry, and region. In general, Ohio is "middle of the pack" and, therefore, may not make the list of preferred locations for investments.

Given that Ohio's regions have unique portfolios of industry drivers and that each region has different operational and cost characteristics, the state's competitiveness varies based on, among other factors, which region, MSA, industry, and specific business function is being examined. Generally speaking, Ohio is "middle of the pack" in terms of competitiveness. This finding refutes common misperceptions that Ohio is a costly or difficult business environment. Unfortunately, being "good enough" is not enough to win investments. Instead, the state should use this intelligence and other findings of this study to design unique economic development policies to help distinguish Ohio and its regions from the "pack."

Gap: Ohio's driver industries are increasing their *productivity* and *output*, but not necessarily their *employment*. However, Ohio's economic development programs tend to be evaluated on employment metrics.

Success measures for economic development investments traditionally focus on employment levels and job creation. As Ohio's driver industries demonstrate, economic growth does not always mean job growth. Although it is politically difficult, it is more forward-thinking to use output and productivity measures to help drive economic development policy and programs. By driving output of goods and services, companies will grow, and jobs will follow.

In addition, many growth opportunities may consist of industry business functions that have relatively high value activities but low headcount and initial investment. Examples are research and development activities that are not part of an otherwise large operation, as well as startup administrative offices. It is important to recognize that these types of operations have very unique needs and react with appropriate economic development tools. .

Gap: Ohio's driver industries have a strong tie to motor vehicle manufacturing. The depth of industry knowledge has yet to be fully capitalized on and the reliance on a single industry for so much of Ohio's economic well-being can become a problem if the industry suffers declines.

Motor vehicle manufacturing and motor vehicle parts manufacturing are two of the biggest drivers in Ohio's economy. But the reach of the automotive industry goes beyond those two industries. Many of the other driver industries identified in this study are directly related to automotive, supplying such critical parts and components as tires, electronics, metal components, and even floor mats. Ohio's economy will continue to depend on the well-being of the automotive industry well into the future. Ohio's industries represent much of the supply chain for this motor vehicle manufacturing and not as much of the end product. This is a strength in that many of these processes also overlap

with the needs of other existing and emerging industry clusters. For example, propulsion and engine components and technologies cut across the automotive and aerospace industries. Because both are drivers for Ohio (when regions are considered), there is an opportunity to align resources and improve collaboration between the two industries at the level of parts and components suppliers. Another example of this type of collaboration is in fuel cell development. In addition, the networks, intelligence, and relationships that already exist within this industry should be leveraged to help Ohio's automotive companies respond to industry pressures. Automotive suppliers are under pressure to globalize to serve growing international markets, such as China. This requires a proactive approach to help Ohio companies adjust their supply chains to encompass a global strategy, rather than simply a regional or national one.

Gap: Ohio's strength is in *pragmatic* innovation that helps improve the productivity of industries already in Ohio or that helps solve business problems. However, there seem to be barriers between the resources generating new ideas and those commercializing them.

Ohio's economy was built on pragmatic innovation, and economic growth depends on continuing that tradition. The basic building blocks to become a regional center of innovation, rather than simply competitive, are already in place: established experience with a variety of industries, strong academic and public institutions with world-class R&D, even venture capitalists with Midwest-oriented funds. However, the connection between these points of innovation needs to be strengthened. Ohio's business leaders report a weak entrepreneurial environment. Research institutions and leaders of private equity firms report a dearth of managerial talent for fast-growth and startup technology firms in the state. Venture capitalists report insufficient density of ideas in which to invest. Manufacturers indicate that they lack the time to find new product ideas and that they are investing in technologies to improve productivity but often cannot access capital to introduce those technologies in their plants. Ohio needs to return to its pragmatic innovation roots and build a structure that enables companies to link to the innovation resources they need. In the face of increasingly limited funds, the state must leverage its innovation resources for these critical initiatives.

Gap: Emerging industries primarily come from Ohio's driver industries and the clusters of industries around them. Emerging technologies most likely arise from existing strengths in Ohio's economy. However, investment does not always align with the growth opportunities in which the state can have the most success.

Building from strength should be an important cornerstone for Ohio's economic development. It is the foundation of this study. Emerging industries and technologies that are the best fit for Ohio and the are best bets for creating competitive advantage are those that draw on the resources, skills, and supply chains already existing in the state. Although this study identifies some industries and technologies that represent growth opportunities (discussed in detail in Section 3), it is important to note that not one is guaranteed to succeed. Therefore, economic development officials must consider and invest in a variety of industries to create a portfolio of opportunities. Economic development efforts must also nurture and foster innovation and work to align the state's resources to best support these growth opportunities. The study team suggests beginning with the identified driver industries and clusters. A unified approach built around a world-class understanding of business issues germane to these industries will position the economic development community to respond to the needs of emerging

industries. In fact, around each of the industry initiatives, a portion of activities and resources should be devoted (in measured amounts) to emerging technologies that sustain or disrupt current products and processes. Although not part of the core economic development approach, opportunities that arise from nondriver industries still need to be addressed with an appropriate level of attention and investment.

Gap: Service industries offer an opportunity for expansion and attraction in Ohio, primarily in the functions of back-office and associated information technology and divisional headquarters. To date, state and regional economic development efforts have not focused on cross-industry business functions as a means of specializing and adding value.

In the driver portfolio analysis, many of Ohio's services industries are in the upper left-hand section of the graph, indicating that they are growing but are less competitive than other industries in the state. These industries offer an opportunity for Ohio. First, because they are growing nationally, Ohio will see economic benefit simply by capturing its "fair share" of national growth. Second, Ohio can build on its strengths in these industries, and corresponding emerging industries and technologies, to increase its competitive advantage. For example, headquarters and division offices are a strong driver function. Computer services and administrative services are two of Ohio's emerging industries that directly support the headquarters function. These industries are mutually beneficial, and each can be used to strengthen and attract the other: Strong support services in the state can be used as a selling point to attract new headquarters, and a critical mass of headquarters establishments can be used as a selling point to attract service providers. A similar relationship exists between back-office services, information technology, and Ohio's medical and financial industries.

Gap: A set of manufacturing driver industries have challenged strategies, as evidenced by consistently low growth. These industries need assistance with process improvement and product innovation to help sustain their businesses, but they do not always receive the help they need.

Although many services industries fall in the growth portion of the portfolio analysis, many of Ohio's manufacturing industries appear in the bottom half of the chart: Their output has not grown, and they are struggling with day-to-day survival. Some of the apparent weakness in manufacturing is cyclical; manufacturing employment will rebound with a prolonged and strong economic expansion. However, part of this performance is structural and requires new product or process innovations to trigger growth. Manufacturers rely on new products for growth, but many are so busy cutting costs to sustain their business that they do not have the time or skills to nurture innovation. There is a need for a specialized state or regional strategy to assist these companies with day-to-day process improvements and longer-term strategy and innovation. Again, an industry-intelligent approach can help define where in the supply chain economic development policy can best affect a company's success. This knowledge is key for allocating limited economic development resources. It also will help define a strategy around retention, growth, and attraction. Furthermore, this approach is iterative. Each project and relationship will build real-world industry knowledge to solidify Ohio and its regions as a product.

Gap: The needs of small and midsize enterprises are as complex in many cases as those of larger organizations. However, a market inefficiency exists in providing many of these companies the assistance they need.

Small and midsize enterprises (SMEs) face the same business issues as larger companies. Because they are small, they are even more focused on day-to-day business issues than their larger counterparts. Often, they do not have a team of attorneys, accountants, or real estate experts to help them make major investments and business decisions. Additionally, they do not have the resources to navigate the economic development world. SMEs are a major component of Ohio's economy; in most industries, more than 80% of establishments have fewer than 500 employees. These are the companies who need the most assistance, yet many lack the resources or know-how to access it. As global consulting firms focus more and more on increasing their scale, many smaller companies are left without access to business services.

Gap: Labor issues, with respect to workforce development and training, although not a key part of the scope of this work, surfaced during several analyses and warrant further discussion.

Labor issues vary by region and by job level. They cut across manufacturing and services industries. Business leaders throughout Ohio raised labor issues as an important consideration so it seems relevant for the state to consider programs to help solve some of the biggest workforce issues. The state has lost a large number of traditional jobs over the past several years, and future disruptions due to global competitive pressures are likely. Therefore, state programs must respond to the needs of existing businesses that will remain an important part of Ohio's economy. Worker training programs should be specifically designed to help workers prepare for industries and functions for which Ohio will be competitive now and in the future.

RECOMMENDATIONS

This study assessed the state of Ohio's economy and each of its six regions, emerging growth opportunities, strategic industries, Ohio's competitiveness, and gaps.

Recommendations from this analysis focus on the ways in which the state can better align its economic development policies and programs to retain, support, and expand core industries and build from that base to attract new businesses and industries.

RECOMMENDATION	STEPS
Shift Ohio's economic development approach and drive change in public policy.	<ul style="list-style-type: none"> • Enhance accessibility, transparency, and speed of incentive programs. • Emphasize revenue growth and productivity within the context of employment, retention, and expansion when considering incentives. • Focus incentives on investments that increase earnings through enhanced productivity, that are consistent with regional strategies, and that complement job-creation goals. • Reconsider the structure of programs through the lens of driver industries, opportunities for growth, and possible changes in tax code. • Work to restore Ohio's competitive position with business tax reform. • Improve the transparency and predictability of environmental regulation enforcement.

Public policy analysis indicated that taxes (specifically the tangible personal property tax); environmental regulation; and accessibility, transparency, and speed of economic development incentives are all concerns at some level for business leaders in Ohio and site selectors considering Ohio as an investment location. These are the basics that Ohio must fix to be competitive. Solving these issues will not solve all of the challenges facing Ohio's economy, but it is necessary for establishing competitiveness.

Another step in shifting Ohio's economic development approach is politically difficult but economically important: The state should expand incentives beyond an employment-based focus. Although economic development incentives and programs are often based on job creation, true economic growth comes from increasing revenue and output, which is frequently tied to introducing new products. For many companies, this comes from increasing their productivity. If companies grow by selling more products or services, jobs will follow – either directly from the company or indirectly through the multiplier effect. Therefore, development programs and policies should be driven by contribution to state and regional economies, not just the number of jobs created.

Although it is important that economic development incentives be targeted toward attracting new businesses to the state, they also should be used to help retain and

expand existing Ohio companies. Often, these companies may need help with productivity-enhancing investments and innovations. It is important to keep in mind that retention and expansion can be even more valuable to the state than attraction.

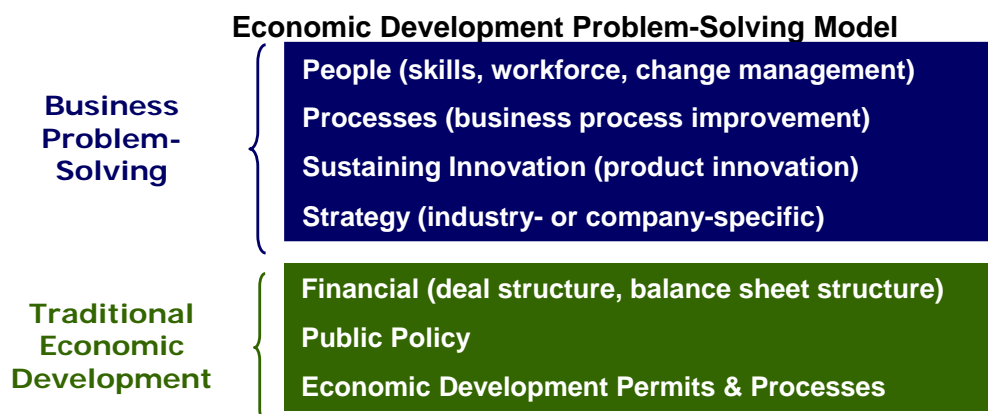
RECOMMENDATION	STEPS
Strengthen the Ohio Department of Development's industry-specific expertise geared toward region-state management.	<ul style="list-style-type: none"> • Establish industry experts within development organizations. • Focus the economic development process on facilitating business problem-solving. • Develop a single point of contact for each of the state's distinct economic regions. • Enhance relationships between economic development organizations and driver industries.

Ohio can establish itself as a preferred business location by building a capability or advantage in customer service. The state's economic development services and delivery mechanisms should be reconsidered from a *problem-solving* and *project management* point of view, thinking less about specific transactions and more about what business problems industries or individual companies have and how best to solve them using the resources available in Ohio. There are two major components that would help in delivering such services. The first is having economic development personnel at the state and local level who have the management skills required to shepherd long-term projects: They would understand what needs to be done in a variety of different situations and marshal the resources to take action. A regional project manager who knows the region and companies and who has a vested interest in the success of the outcome would help companies make the best investment decisions. Regional project managers would have a deep level of knowledge about critical location factors and an understanding of the region's specific areas of specialization within each industry.

Second, Ohio can become even more service-focused by establishing industry experts within economic development organizations. These experts would be familiar with an industry's key issues, supply chain, critical location factors, and other business needs. They would have in-depth knowledge of Ohio's specific capabilities and its advantages compared to other states. More importantly, these experts would proactively call on companies within the state to understand their business problems and identify resources to help solve these problems.

Customer service means that the state would be a partner with companies in solving business operational issues. An example of such service would be supporting and attracting supplier and customer chains for important driver industries. By strengthening the cluster of industries around its drivers, Ohio would build an even stronger competitive advantage. "Matchmaking" by linking companies to suppliers and customers would be another way to provide customer service and strengthen Ohio's existing companies. The state could also improve its customer service by expediting workforce training, assisting with business startups, improving transparency of incentives and public policies, and providing a regional single point of contact for Ohio's existing

businesses, as well as those interested in locating in the state. The following graphic shows the customer-service, problem-solving model for delivering economic development services. There are seven main skills. Financial, public policy, and economic development skills are those traditionally considered in an economic development context. However, Ohio would distinguish itself in customer service by adding business problem-solving skills. The state would not need to deliver all of the problem-solving services. However, the state could add value for its business customers by facilitating access to resources that help solve problems or by helping to manage projects. This model is based on knowing the state's current and prospective business customers, understanding their key issues, and helping deliver solutions to problems.



RECOMMENDATION	STEPS
Cultivate an effective region-state dynamic that capitalizes on Ohio being a portfolio of distinct but interconnected regional economies.	<ul style="list-style-type: none"> • Provide incentives for regions to develop strategies, establish best practices, and cultivate key industries. • Co-locate state and regional economic development professionals. • Develop a model for state-regional project management collaboration.

It is important to focus on what makes Ohio and each of its regions unique and to develop a strategy to help businesses solve the problems and challenges they face. Because regional economic development organizations are most closely in tune with local business issues and attraction opportunities, it makes sense to locate state economic development professionals in regional offices. Doing so would help economic development staff better understand the dynamics of each region, define the needs of industries, and address problems.

Giving regions authority and resources to create region-specific economic development strategies and problem-solving programs that fit each region's unique needs would be another important component of regional economic development strategy. Unless Ohio fixes region-specific issues relating to critical success factors evaluated by site selectors, there can be no unified state message.

In this scenario in which regions help lead economic development strategy, the state would make regional agencies responsible for identifying regional strengths, determining

business weaknesses, and developing a strategy for fixing weaknesses. Regional agencies would also be responsible for developing investment strategies, coordinating with the state on attraction that leverages state and regional resources, and creating a task force to better understand regional industries and areas of specialization. State funds would flow through a designated regional authority to empower the relationship.

There is a continuum of activities that should be led by the state versus those that should be led by the regions. For state drivers such as motor vehicles, which also is a driver industry in virtually every region, the state should take the lead. For region-specific drivers, such as warehousing, the region should take the lead. However, the state can and should set overall strategies and guidelines with which the regions would need to align. For industries such as chemicals, which span many regions, the state should be heavily involved, but each region would have its own specific strategies targeted at its areas of specialization. The following table summarizes how the state-region methodology could be executed for different industries.

State-Regional Model Examples

Skill Set	Auto	Chemicals/ Polymers	Logistics/ Warehousing/ Distribution
People	State with regional support	State – education Regions -- workforce, skills	Regions
Processes	State with regional support	Regions	Regions
Sustaining Innovation	State with regional support	State – Third Frontier funding Regions – link companies with resources	Regions
Strategy	State with regional support	Regions	Regions
Financial	State	State	Regions/State
Public Policy	State	State	Regions
Economic Development Permits & Processes	State/Region	State/Regions	Regions/State

RECOMMENDATION	STEPS
Develop a marketing message or brand to overcome Ohio's perception problem.	<ul style="list-style-type: none"> • Capitalize on Ohio being a portfolio of regions and industries. • Communicate the various strengths of individual regions. • Steer industries considering relocating to Ohio to regions in which the skills, resources, and industry makeup best suit their needs.

In much of the competitiveness analysis, Ohio ranked as “middle of the pack” – neither the best nor the worst place to do business. The state and its regions need to take action to establish themselves as a preferred business location. Ohio's competitive strengths can and should be used in developing focused marketing messages at the state, region, and industry level under a statewide umbrella brand to help with business attraction.

Attraction initiatives should focus on a targeted set of industries that best fit within a regional strategy based on existing drivers, resources, and skills.

Ohio's competitiveness, based on a number of site selectors' critical factors, largely varies by region. Focusing on economic development customer service and problem solving would be a way to differentiate Ohio and make it more attractive as a place to do business and make an investment. Developing marketing messages that communicate Ohio's many strengths and help overcome perception problems is important for increasing competitiveness. Effective attraction campaigns should communicate the strength of the state's supply chains for various industries to help companies understand why locating in Ohio would improve their business efficiency.

RECOMMENDATION	STEPS
Focus on preserving the health of the automotive industry.	<ul style="list-style-type: none">• Focus on retaining motor vehicle original equipment manufacturers (OEMs).• Aggressively recruit foreign-based parts suppliers to establish a U.S. presence in Ohio.• Help Ohio's auto parts suppliers build a global presence.• Build deep auto parts industry expertise within ODOD.

Motor vehicle manufacturing and its supply chain drive a significant portion of Ohio's economy. These industries also consume a good deal of ODOD's resources. It is important to establish at least one expert for this industry who would focus on retention, expansion, and attraction. Because it is unlikely that a new motor vehicle manufacturer will make an investment in the state, Ohio's OEM focus should be on retention. Economic development organizations should develop relationships with Ohio's automotive parts suppliers to help them solve business problems, such as how to establish a global presence. The state should also aggressively recruit new suppliers, with a special focus on attracting U.S. investments made by foreign-based companies.

The state also should understand the underlying technologies in the motor vehicle supply chain and leverage those to expand or attract growth industries that use related knowledge. For example, precision machining capability, and possibly production capacity, could be leveraged to help design and manufacture medical instruments.

RECOMMENDATION	STEPS
Cultivate growth opportunities and emerging technologies.	<ul style="list-style-type: none"> • Nurture and expand existing connections between intellectual capital and commercial innovation. • Focus innovation investment in areas connected to the state's key value chains. • Evaluate sustaining, disruptive, and formative innovation separately. • Develop programs to recruit and retain entrepreneurial talent.

Ohio's economic history has long been driven by practical, applied innovation, and that innovation continues today. Future economic development activity and investment should keep in mind that rich tradition of applied innovation. Programs could help promote and sustain process improvement, new product development, business strategies, and operational philosophies.

Critical to driving successful innovation is the ability to leverage and nurture existing links between academic, public, and private research institutions and high-value commercial innovation connected to Ohio's driver and growth opportunity industries and emerging technologies. Commercialization examples and opportunities include medical device manufacturing, software development, and computer services. In addition, it is important to support and strengthen university programs in chemistry and information systems to help foster technology-based development and to retain innovative talent in the state.

The state must also recognize that sustaining, disruptive, and formative innovations are different and require different skills, management tools, and evaluation metrics. Separating Ohio's economic development services for innovation into different categories would help deliver customized service to each type of innovation and would help manage and monitor the state's portfolio of technology investments. The state should focus on developing economic policies to benefit startups that have a high likelihood of commercial application and economic growth. One critical component of this would be strategies that help recruit and retain entrepreneurial talent in Ohio, as well as management talent with experience in running high-growth startup companies.

RECOMMENDATION	STEPS
Develop long-term strategies for attracting and growing existing headquarters and division offices, and focus on promoting the state's strength in specific business functions as a means of specializing and adding value.	<ul style="list-style-type: none"> • Monitor merger and acquisition activity for opportunities. • Provide or facilitate process improvement services and services to help entities adopt new technologies or automate processes. • Leverage Ohio's strength in driver industries to expand and attract companies in related industries, such as medical instruments, back-office services, or computer services. • Support growth strategies by focusing on building out customer and supply chains.

Ohio has strength in headquarters and division offices, along with strength in services and functions to support such offices. These strengths can and should be used to attract other headquarters and division offices. However, a long-term, patient approach is required because major location decisions are made infrequently. Fortune 1000 corporations rarely relocate their headquarters. Ohio's opportunity is in luring smaller growth companies or U.S. divisional headquarters of global companies. The best likelihood for success would come from focusing on companies related to Ohio's driver industries, supply chain clusters, and emerging opportunities, or those companies with existing business relationships in the state.

Hospitals are late adopters of technology, but they are now recognizing the need to improve processes and automate functions for more accurate recordkeeping and increased efficiency. The state should facilitate services or offer incentives to help services industries improve processes and adopt technologies. The state should also facilitate relationships between its driver industries and the emerging industries that support them and leverage Ohio's driver industry strengths and knowledge to expand and attract companies in related fields. For example, Ohio could use its leadership in clinical medicine and clinical trials to attract medical instruments companies, or the state could leverage its strengths in computer services and distribution to build or attract logistics companies.

RECOMMENDATION	STEPS
Help small and midsized companies compete.	<ul style="list-style-type: none"> • Implement programs that help businesses develop strategies for long-term success instead of simply reacting to the current squeeze of global competition and rapid change. • Help struggling industries refocus through product or process innovation. • Support MEPs and other organizations that serve smaller companies. • Align incentive and assistance programs to meet the needs of small and midsized companies.

Ohio has a rich base of small and midsized enterprises (SMEs), all of which have complex needs and are facing difficult business issues. Many of Ohio's manufacturing driver industries have been subject to competitive pressures in recent years, which have resulted in challenges for growth and profitability. Manufacturing SMEs have been especially challenged. These companies need help with basic business blocking and tackling, such as process improvements, but also with product innovation, technology implementation, and long-term strategies. SMEs' needs are as complex, in many cases, as those of larger organizations, but market inefficiency makes it difficult for them to access necessary assistance.

The state taking, or facilitating, a problem-solving approach to these issues should benefit these organizations tremendously, as would establishing industry experts within economic development organizations. In combination, these two forces would help the state recognize and develop solutions for SMEs. Programs such as Manufacturing Extension Partnerships and the product development pilot program of the Third Frontier are important to help close the gap in consulting services available to SMEs and improve their competitiveness. By better understanding the needs of SMEs, the state would be able to recommend an expansion of the type of services offered by MEPs or the industries to which MEP services are offered.

GAP	RECOMMENDATIONS
<p>Strengthen education within the state to meet industry needs.</p>	<ul style="list-style-type: none"> • Build university strength in applied chemistry and technology development with true industry partnerships and standards. • Extend undergraduate cooperative education and internship programs to graduate levels. • Support professional master's degrees in sciences related to Ohio's industrial strengths. • Fund nondegree supplemental training for skills needed in driver industries. • Build on community college and career centers to develop technical skills. • Sustain world-class basic chemistry skills and research. • Work with elementary and secondary schools to enhance soft skills for entry-level workers.

Although this study did not focus on labor issues, a number of concerns were raised through the expert panels, online survey, and perception studies. Two ways to help Ohio's employers would be to focus and fund state programs for incumbent worker training and establish programs that develop technical and other skills needed by today's employers.

There are three challenges that the state must address in its workforce development policies:

1. Recognize that replacing retiring workers, not adding net new jobs, will be the primary challenge for the next 10 to 15 years.
2. Understand that Ohio, and the nation as a whole, faces a soft-skills crisis in its low and semiskilled workforce. Soft skills are as important as literacy and numeracy and are not being taught and reinforced in many of Ohio's households.
3. Respond to public policy problems that inhibit incumbent workforce training: State support for technical training that reflects industry standards or is industry certified is largely nonexistent outside of formal degree-granting programs. Currently, only the six community colleges with access to property tax revenue or the regional vocational schools with access to local or county funding have the flexibility to subsidize this type of training.

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SECTION 3

PRIORITIES FOR SUPPORT

Addressing public policy issues and tackling Ohio's competitiveness and perception challenges are steps that cut across all industries and have the potential to affect all companies in the state. This broad-spectrum strategy is necessary to improve the state's overall business climate. However, a more fine-tuned economic development approach is also needed to promote and protect key driver industries and nurture and grow emerging opportunities and technologies. This study has identified a number of industries and technologies in which targeted, coordinated economic development activities at the state and regional levels have the best likelihood for retaining and expanding existing businesses and attracting new investment to Ohio.

Based on Ohio's competitive position, historical strengths, and future areas of opportunity, the study team has identified seven driver industries that have strong significance for the state's economy and that appear to offer significant opportunity for economic development impact. Within each industry, there are retention, expansion, and attraction opportunities. These industries are:

- Motor vehicles and motor vehicle parts manufacturing
- Chemicals and polymers
- Clinical medicine and related industries
- Logistics, distribution, and warehousing
- Corporate and division headquarters, back-office, and administrative functions
- Food processing and manufacturing and agriculture value-added products
- Environmental technology

A handful of growth opportunities and technologies are positioned to reinvigorate existing driver industries or serve as stand-alone engines for future growth. For the purposes of this study, growth opportunities are defined as having a growing market for products, increases in productivity, and the ability to capture market share. Qualitative assessment from venture capitalists, expert panelists, and study advisers also was incorporated into this effort to identify potential growth industries. Those determined most likely to thrive in Ohio are:

- Nondepository credit intermediation (nonbank)
- Headquarters and administrative services
- Computer systems design and related services
- Scientific research and development services
- Specialized design services
- Electronic and precision equipment repair and maintenance
- Tourism and arts

The study has also identified the following emerging technologies using a survey of venture capitalists:

- Polymers, particularly:
 - Biocompatible
 - Photonic
 - Electronic
 - Conductive
 - Liquid crystal displays

- Medical equipment and research
- Fuel cells, particularly in the areas of:
 - Heating, ventilation, and air-conditioning
 - Automotive
 - Electric power generation
- Nanotechnology:
 - Nanomaterials
 - Nanosensing
 - Nanobiological
 - Nanochemical
 - Intersection of polymer technology and nanotechnology
- Information technology, particularly for the:
 - Medical industry
 - Financial service industry
 - Security database and data-mining applications
- Micro-electrical-mechanical systems (MEMS), particularly in the areas of:
 - MEMS machines
 - Automotive

These distinct industry mixes require different economic development strategies and goals. The seven driver industries identified as development opportunities should benefit from a traditional approach to retaining and expanding the state's existing economic base by assisting businesses with individual problems. An attraction strategy for these industries should be focused on providing businesses outside the state with information on Ohio's industrial and workforce strengths, implementing a marketing message promoting the state's array of offerings, and polishing the state's image as a welcoming business environment. The identified growth opportunities and emerging technologies may benefit from these problem-solving and image-enhancing efforts, but they require more – a technology-based strategy focused on developing and attracting entrepreneurial endeavors.

Implementing a strategy to support and grow these targeted industries and technologies first requires collaboration between state and regional development entities on processes, incentives, and communication of goals and services. Economic development practitioners at the state and regional levels must together work to:

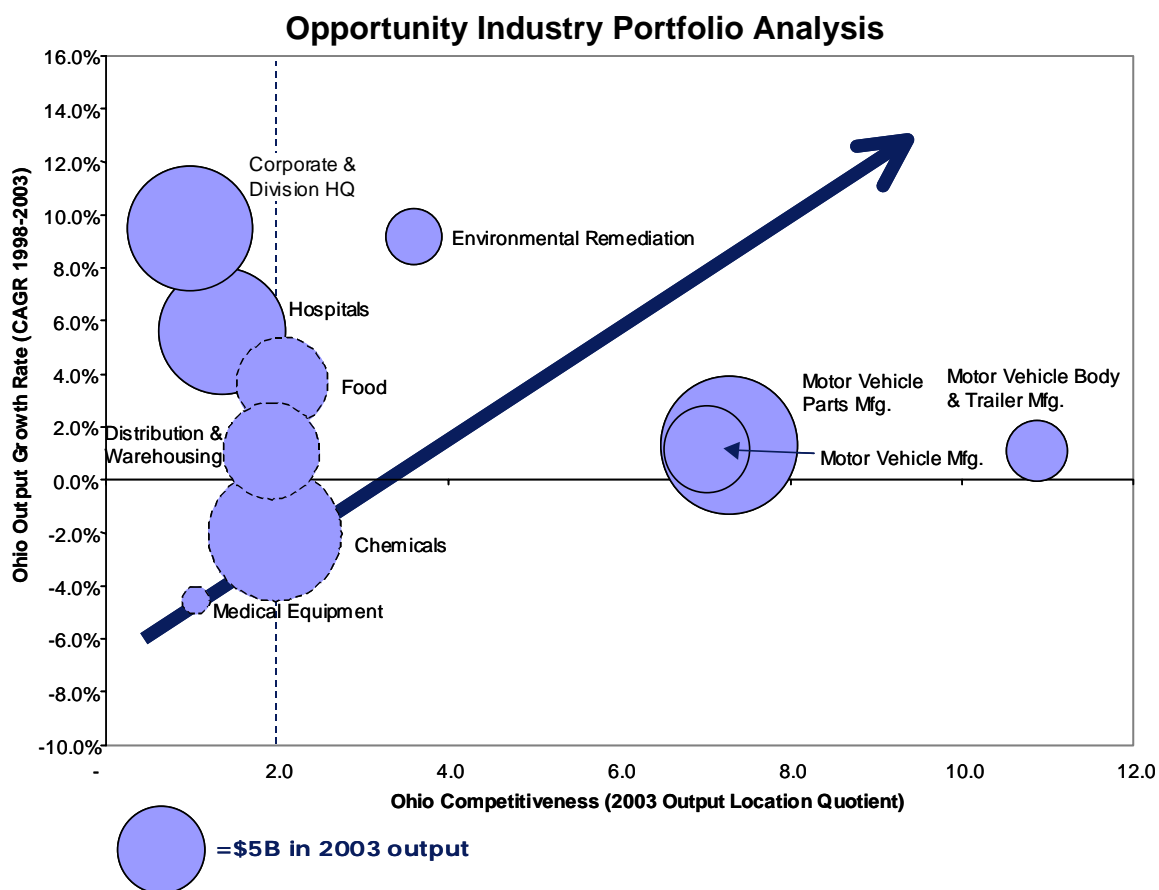
- Identify industries and technologies to support
- Prioritize those areas in which development assistance can have optimal effect
- Choose whether the state or regions will take the lead
- Determine how best to support targeted industries and technologies
- Prioritize activities as a basis of an action plan

The remainder of this section discusses these targeted industries and technologies in greater detail.

A. SEVEN KEY DRIVER INDUSTRIES

Crafting a cohesive, comprehensive strategy and implementation process must begin by better understanding where those opportunities for economic development impact lie. The following pages briefly profile each of the seven targeted driver industries, detailing their contribution to Ohio's economy, supply chain, critical location factors, current industry trends and key issues, areas of investment, Ohio's competitiveness, key strengths and weaknesses, and industry-specific recommendations and implementation strategies.

To provide a stylized visual representation of how these seven targeted industries and business functions perform and compare to each other, the following figure depicts their output growth and output location quotient.



Economic development opportunities within these seven industries and business functions lie at the intersection of product, function, and technology. The challenge is to drive these industries into the favored upper right quadrant. Meeting that goal will require focus, patient investment, and world-class intellectual leadership.

For example, what are the challenges to a focused series of economic development investments in medical instruments and chemicals? The challenge, as presented in the previous figure, is that the medical equipment industry is small and had a 4% decline in gross product from 1998 to 2003. It is not yet a nationally dominant economic

specialization in Ohio. The chemicals industry was negatively affected by the recession of 2001, experiencing a 2% decline in real value of its gross product, and it had an output location quotient of 2.0. The chemicals industry is a demonstrated competitive strength of the state, but its location quotient is about average for the state's drivers and is located in the lower left quadrant.

The argument in favor of making medical instruments a focus of economic development efforts is based on the strengths that exist in the state's economy, the fractured nature of the industry, and the expected growth in demand. There is risk of failure due to competition from other regions, but this industry is one in which the state can ride the growth stage of the product life cycle.

The rationale for chemistry as a targeted industry is a bit more challenging despite its size and importance to the state's economy. If the industry becomes a commodity provider of chemical products, margin pressures will dominate the future of the industry. If, however, the industry and the state's university system collaborate to create true intellectual leadership in chemistry, the industry can be at the forefront in generating technologies that are unimagined today.

MOTOR VEHICLES

Overview of the Industry in Ohio

The motor vehicles industry is an integral part of Ohio's economy. Nearly ubiquitous across the state, it is Ohio's single largest economic driver. In fact, most of the economic driver industries for the state are in some way linked to the motor vehicle industry as part of the related supply chain. Despite current and future challenges, Ohio's economy still depends on the well-being of the automotive industry.

The motor vehicle parts industry has flourished in Ohio for many reasons, the most prevalent of which is its proximity to the Detroit headquarters of the traditional Big Three, or "old domestics," original equipment manufacturers. Proximity to OEMs and their major suppliers has historically been key to the success of the parts industry. In addition, early development of industries associated with the motor vehicle industry within the state helped cement the strong network of associated activities seen today. For instance, steel manufacturing in Northeastern Ohio laid a solid foundation for raw materials. Toledo capitalized on the discovery of natural gas in the area to create an industry in glass manufacturing and development. Akron's rubber industry has a similar legacy.

Both motor vehicle suppliers and motor vehicle manufacturers have been in Ohio for quite some time. Ford and General Motors assembly plants have been in Ohio for decades. The first U.S. Honda plant was built in Marysville in 1979 as a motorcycle producer. Toyota's plant in Georgetown, Kentucky, and Nissan' in Tennessee followed. Although the motor vehicle industry's growth used to be tied to the U.S.-based manufacturers (Ford, General Motors, and DaimlerChrysler), its future is being shaped by foreign-based "new domestic" manufacturers, such as Honda and Toyota.

Role of the Industry in Ohio's Economy

The motor vehicle manufacturing industry has significant impact in Ohio. Direct motor vehicle manufacturing and motor vehicle parts manufacturing contributed \$20 billion in 2003 gross product (in 1996 constant dollars) to Ohio's economy, as shown in the following table. Employment has been declining in this sector, while output has increased, albeit at a low rate. Employment declines in conjunction with output increases indicate that productivity in this industry continues to increase. Ohio's motor vehicles industry is highly competitive, as indicated by its very high output location quotients.

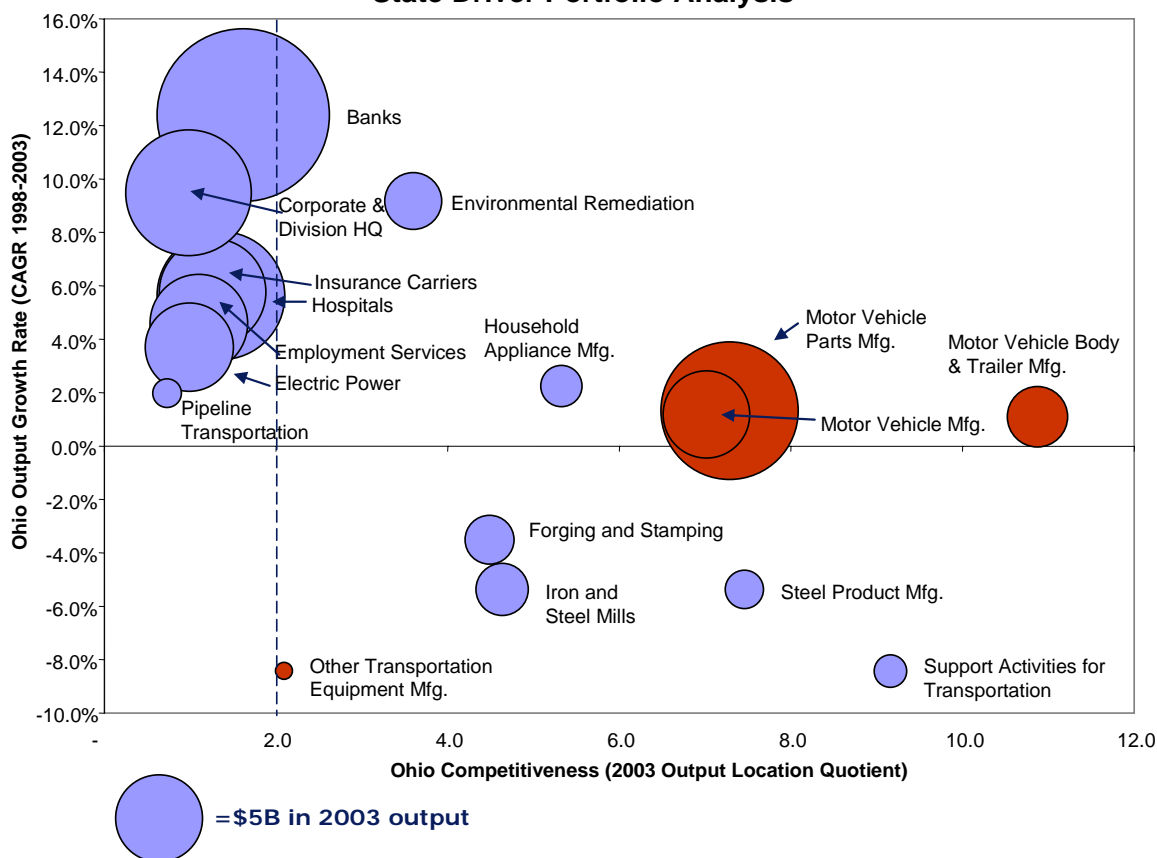
The industry is a driver for each of the six regions in the state. However, industry growth varies by region. The Central, Southwest, and Southeast regions have the strongest growth rates, perhaps driven by their strong association with the "new domestics," overseas manufacturers that have located in the United States in recent decades.

Economic Overview of the Automotive Industry in Ohio

NAICS	Industry	2003 Output (\$MM) in 1996 Dollars	1998-2003 Output CAGR	1993-2003 Output CAGR	2003 Output Location Quotient (LQ)	2003 Employment	1998-2003 Employment CAGR
Automotive and Related		\$20,044					
3363	Motor Vehicle Parts Mfg.	\$12,471	1.3%	3.3%	7.3	96,090	-3.0%
3361	Motor Vehicle Mfg.	\$ 4,969	1.2%	3.4%	7.0	31,210	-4.4%
3362	Motor Vehicle Body and Trailer Mfg.	\$ 2,413	1.1%	2.6%	10.9	10,600	-6.1%
3369	Other Transportation Equipment Mfg.	\$ 191	-8.4%	-8.1%	2.1	980	-15.5%

Source: Economy.com

State Driver Portfolio Analysis



Source: Economy.com, CSU/Deloitte analysis

The data presented in the preceding tables do not capture the full economic impact of motor vehicle manufacturing in the state. Many of the other driver industries in Ohio, such as rubber, glass, and chemicals, are suppliers to the motor vehicle industry. Motor vehicle manufacturing has the ninth-highest economic multiplier in the state: Every dollar of direct export expenditure results in an additional \$2.67 worth of purchases within the state's borders. The auto supply chain also generates multipliers due to exports of parts from the state to assemblers elsewhere, but the impact is not as deep or as broad as the impact of the state's OEMs. Plastic products manufacturing has a total multiplier of \$1.92, meaning that \$1 of direct demand generates another 92 cents of economic activity in the state. The parts industry has a similar impact.

Multipliers for Motor Vehicle and Related Industries

NAICS	Industry Name	Multiplier		Rank
		Direct & Indirect	Direct, Indirect & Induced	
3361	Motor Vehicle Manufacturing	2.89	3.67	9
3261	Plastics Product Manufacturing	1.51	1.92	71
3363	Motor Vehicle Parts Manufacturing	1.50	1.90	74
3369	Other Transportation Equipment Manufacturing	1.44	1.83	93
3364	Aerospace Product and Parts Manufacturing	1.43	1.81	99
3362	Motor Vehicle Body and Trailer Manufacturing	1.42	1.80	105
3312	Steel Product Manufacturing from Purchased Steel	1.39	1.76	108
3329	Other Fabricated Metal Product Manufacturing	1.26	1.59	173

Source: IMPLAN Input-Output Model, April 2005; CSU/Deloitte Analysis

Note: Ranked by total multiplier out of 271 industries

The cluster analysis indicates that most of the industries in the supply chain for motor vehicle manufacturing are in Ohio. Ohio is home to both parts suppliers and their OEM customers. Ohio also has strong steel and steel products, engine, plastics, rubber, glass, and chemicals industries, all of which supply the motor vehicle industry. Proximity to suppliers and customers is a major location investment factor for this industry. Thus, Ohio's industry is positioned well.

One potential drawback to the significance and impact of the industry to Ohio's economy is the economic risk to the state associated with downturns or significant changes within OEMs. The two largest risks lie with the old domestic OEMs: declining market shares and a structural cost disadvantage compared to the new domestics. The automobile industry has surplus capacity in the United States, and the new domestics are adding North American capacity in the southeastern United States and in Ontario. The Southeast is attractive to the new domestics because of lower labor costs and a lower likelihood that the plants will be organized by labor unions. Canada is attractive to both new and old domestics because health care costs are not picked up by the company but are financed through the Canadian income tax system. At the same time, the market share and financial condition of the old domestic companies have deteriorated. They are dependent on large sport utility vehicles and full-size pickup trucks for their profits, and sales have been depressed with the recent upswing in gasoline prices. The old domestic firms are also saddled with legacy costs of supporting retirees' defined benefit pension plans and medical insurance coverage. These legacy costs give the old domestic companies between a \$3,000 and \$3,500 per unit cost disadvantage when compared to the new domestics. The same problem exists with Visteon and Delphi, automotive parts supply companies that were spun from Ford and General Motors. Anticipating these market forces and helping companies react to them successfully are critical considerations for economic development policy.

Industry Location/Investment Factors

Motor vehicle parts manufacturers tend to locate near motor vehicle assemblers (OEMs). Proximity allows them to fulfill just-in-time demands and integrate the OEMs' R&D and engineering efforts. Ohio's industry remains defined, in large part, at a regional level by the major players: Honda, GM, DaimlerChrysler, and Ford. The legacy of the Detroit Three remains strong, with significant reinvestments in Ohio in recent years (DaimlerChrysler in Toledo and GM in Lordstown). Foreign OEMs are continuing to grow presence in the South – Hyundai in Alabama, Honda in Georgia, and Toyota in Texas.

Location factors for new OEM plants include the absence of strong union activity, availability of skilled labor, and access to major highways. Governmental economic incentives also play a critical role in determining facility retention, expansion, and location, but this environment may be subject to change. A September 2004 Cincinnati federal appeals court ruling on incentives deemed Ohio's state corporate franchise tax credit to DaimlerChrysler for a Jeep plant in Toledo unconstitutional; \$70 million of the \$280 million incentive package awarded in 1998 is at risk.

Many auto parts activities, especially production of such major components as engines and transmissions, are capital-intensive. This makes manufacturers more likely to focus their investment in a single location. Reinvestment levels represent the best indicator of whether a company plans to extend the life of a plant or allow it to decline in favor of new construction.

The following table lists some critical location factors, and their associated weights, typical among motor vehicle parts manufacturing companies. The weights attributed to the factors are somewhat subjective and may vary based on the particular company, its operating constraints, and its preferences.

<i>Factor</i>	<i>Weight</i>	<i>Preferences</i>
<i>Labor Quality & Availability</i>	High	<ul style="list-style-type: none"> • Highly skilled machine operators, mechanics, and electricians • Low union presence or low incidence of union activity • Precedence for successful manufacturing with similar processes (moderate industry concentration) • Educational attainment: high school degrees and technical school availability with specialized, relevant programs • Strong community growth and moderate unemployment to allow for scalability and avoid competitive pressures
<i>Real Estate</i>	Moderate	<ul style="list-style-type: none"> • Existing manufacturing buildings (Some will require specialization.) • Availability of land or prepared sites • Access to redundant utilities and ease of permitting • Expansion capability (for existing operations) and ease of the construction process
<i>Access/ Infrastructure</i>	High	<ul style="list-style-type: none"> • Immediate (fewer than 10 miles) access to a quality four-lane highway or major interstate • Relative proximity to the customer to allow for just-in-time delivery of product • Large electricity and gas consumers, often requiring redundancy • Access to ports may be important for importing parts and components
<i>Costs</i>	High	<ul style="list-style-type: none"> • Low to moderate semiskilled and skilled labor costs • Low land and construction costs • Low freight costs
<i>Quality of Life</i>	Low to Moderate	<ul style="list-style-type: none"> • Reasonable quality of life to retain and attract talent

Factor	Weight	Preferences
<i>Business Climate & Regulatory Issues</i>	Low to Moderate	<ul style="list-style-type: none"> • Emissions and discharge permitting • Corporate taxation (burden and transparency) • Labor regulations • Economic development community aggressiveness and familiarity with industry forces

Incentives of potential value to this industry typically include:

- Training
- Tax minimization (income, sales & use, property)
- Site preparation and construction assistance
- Discretionary grants

Current Industry Trends and Key Issues

Motor vehicle manufacturing is in a challenging time right now because it faces supply and demand constraints. Increasing costs of raw materials, coupled with chronic overcapacity, are drastically shrinking margins for motor vehicle manufacturers. Automakers have increased pressure on suppliers to reduce their prices and have offered price incentives to consumers to stimulate demand. However, there is less loyalty between suppliers and OEMs, and OEMs have become engaged in a price incentive war amongst themselves. Given the challenging competitive and market environment, OEMs continue to seek opportunities to reduce costs throughout their supply chains and improve financial performance. In addition, there is continual pressure to innovate and comply with new regulations – both activities requiring large capital commitments. As industry globalization increases, manufacturers face heightening competition (at home and internationally) but also growing market opportunities.

Motor Vehicle Manufacturing

There are distinct differences between domestic and foreign OEMs. The Detroit Three continue to scale back production capacity while the foreign OEMs have been growing their U.S. manufacturing base. The new domestics have different philosophies regarding their relationships with suppliers. Honda and Toyota work with their suppliers to better their products. They focus on making suppliers more competitive because this translates into better quality for the OEM. They work to improve suppliers' processes and human resources, motivate suppliers' employees, and demand sensitive information from suppliers to facilitate better collaboration.

Historically, the OEM industry was centered in Michigan and Ohio. In recent years, there has been a shift in production location as the geographic cluster has moved north to Ontario to reduce health care costs and south to North Carolina, Alabama, Mississippi, Texas, and northern Mexico. These southern locations provide cheaper labor, plentiful greenfield sites, and little union presence. There is also a "new domestic" cluster in Ohio, Kentucky, and Tennessee. Each of these geographic clusters has its own just-in-time network of suppliers. This geographic dispersion can be a threat to Ohio's established suppliers. However, there is also an opportunity for global expansion of Ohio's parts suppliers.

Motor Vehicle Parts Manufacturing

Growth of the motor vehicle parts manufacturing industry reflects that of the motor vehicle manufacturing industry. The mature auto industry faces slowing growth with

pricing and margin pressures. As production has slowed at the Detroit Three and underperforming U.S. vehicle production facilities have closed, suppliers to the Detroit Three have been drastically affected. In contrast, expansion of foreign automakers' U.S. presence has and will continue to boost their suppliers, including Asian suppliers that have relocated to the United States. However, the aging of vehicles is expected to drive a steady growth for parts within the U.S. aftermarket.

Parts suppliers had varying experiences in the most recent recession, depending on whom they served. Those supplying Ford and General Motors had difficulty bouncing back from the recession, were under tremendous pressure to reduce costs, and saw their receivables age as the OEMs delayed paying their bills. Those supplying the new domestics, while still experiencing pricing pressures, weathered the recession much more successfully.

There has been a general trend away from high-volume, single-line "push" assembly systems toward flexible "pull" systems that use modular design. For example, GM's C-Flex body-building system can handle 24 variations and may lower product introduction cost by as much as \$100 million. To improve quality of parts and increase the flexibility of suppliers, OEMs are building relationships with key suppliers. Suppliers are locating production facilities near OEM assembly plants to satisfy just-in-time production demands, and Tier I and II suppliers are locating research and product development facilities near OEM product development and engineering facilities to coordinate their product development efforts. The new domestics are more active in building these relationships than the Detroit Three.

As OEMs try to improve financial performance and flexibility, Tier 1 suppliers are taking over roles once reserved for auto assemblers. They are investing in research and development and engineering, including increased responsibility for subassembly engineering and design. Tier I and II suppliers are involved with the production of modules, quality-control of these assemblies, in addition to parts production. Suppliers are increasingly asked to make upfront, capital investment with the OEMs. OEMs have been reducing the number of suppliers used as a way to reduce costs and increase efficiency - making supply chain linkages from the OEM down through the supplier tiers ever stronger. This strong tie influences motor vehicle parts manufacturers' decisions, from location to investment.

OEMs hold significant negotiating and pricing power over their suppliers. Suppliers may depend on a single OEM for most, if not all, of their business. Both industries are in a mature market, which implies low growth, low profit margins, and high labor costs. When growth does occur in these industries, it is incremental, rather than explosive. Market share is the battleground for both OEMs and parts suppliers.

For parts manufacturers, competition based on noncost elements is difficult. Differentiation through performance and service is key to building margins. Companies need to shift away from simple, commodity products that can be purchased from a variety of suppliers toward sophisticated, technology-dependent products. Parts manufacturers also should focus on service, performance, product innovation, and added value. OEM suppliers have an opportunity to expand their share of the value chain by providing preassembled modules. The number of motor vehicle parts manufacturers continues to contract as companies try to increase their scale and negotiating power via mergers and acquisitions and attempt to better serve their

customers that are expanding globally. The Detroit Three auto manufacturers are trying to cut the number of parts used in each component and vehicle to lower production costs and reduce the likelihood of errors.

Emerging/Growth Opportunities and Areas of Investment

Many of the emerging or investment sectors in the motor vehicle manufacturing industry are driven by regulation to reduce emissions or efforts to reduce fossil fuel use. Such areas of investment include developing:

- Zero-emission engines
- Fuel cell technology and other alternate power sources
- Hybrid vehicles and diesel engines

Other areas of investment are motivated by the desire to reduce costs and improve the production process. These primarily involve:

- Investigating alternative raw materials
- Reducing weight of motor vehicles to decrease production costs
- Implementing clean manufacturing processes
- Recycling waste and scrap materials
- Using RFID technology or tracking production status of parts
- Adding factory flexibility
- Applying drive-by-wire and brake-by-wire technology

Additional areas of investment are centered on improving safety, entering new customer markets, and enhancing customers' experiences with their vehicles. These include:

- Safety parts (e.g., head-protecting side airbags and electronic stability)
- Direct tire-pressure monitors
- Entrance into emerging geographic markets
- Wireless fleet monitoring
- In-vehicle consumer electronics (e.g., DVD players)

Competitiveness Assessment of the Automotive Industry

By use of a perception survey, site selectors' survey, competitiveness analysis, and benchmarking, the study team has identified some of Ohio's key strengths and weaknesses related to the motor vehicles industry. The size and history of the industry, along with Ohio's location, all play a significant role in the state's perceived key strengths, which include its concentration of quality, skilled labor; central location; transportation infrastructure and access; proximity and access to customers and suppliers; and quality of life for workers. Perceived weaknesses within the state include a high union presence, high labor costs, utility costs, climate, taxes, and volatility with respect to the state's economic stability. Interestingly, state incentives were rated positively in the perception survey and as a weakness in site selectors' minds. Ohio's airports, real estate, and municipal incentives received mixed reviews, possibly because they vary by MSA or region. Nearly all companies that plan to make investment decisions within the next few years said they are likely to consider Ohio for their next site.

The study team benchmarked the automotive parts industry by modeling high-level cost and operating condition indicators, specifically for the manufacturing business function,

to understand how select Ohio MSAs (Cleveland, Dayton, Columbus, and Cincinnati) compared to other regional and national MSAs with significant motor vehicle parts manufacturing presence. Overall, Ohio locations are of moderate cost when considering only regional competitors. Ohio locations also generally received moderate operating conditions scores, with Cincinnati offering the most attractive conditions. Locations in the Southeast U.S. appear to offer compelling operating conditions and relatively lower costs, which are key reasons automotive companies are locating there. A lower operating conditions score for Toledo was driven largely by negative projected population growth in the MSA (regional growth may, in fact, be positive) and reported union activity.

Ohio's Key Strengths

- Industry concentration and precedence for successful manufacturing
- Proximity to suppliers and customers (OEMs)
- Access to major highways and transportation corridors
- Presence and quality of experienced, skilled labor
- Moderate regional operating costs
- Good quality of life
- Perception of moderate to high productivity (Cincinnati, in particular)
- Educational attainment of workforce (Columbus, in particular)
- State and local commitment to the industry and willingness to work with companies on incentive packages

Ohio's Key Weaknesses

- Perception of union environment and high-cost labor (especially in Northern Ohio)
- Perception of high utility costs
- Taxes
- Low population growth
- Higher cost location than the Southeast, in particular
- Availability and work ethic of next generation of labor (This, however, is likely not just an Ohio issue)
- Economic development incentives:
 - Affect of the recent appeals court ruling on the use of the Investment Tax Credit
 - Transparency and speed for accessing incentives

The following table summarizes some of the key opportunities and issues for the motor vehicles industry in Ohio.

	OPPORTUNITIES	ISSUES
Labor Quality & Availability	<ul style="list-style-type: none"> Large concentration of automotive parts plants provides supply of required skill-sets <i>Perception Survey: Strong availability of skilled and semi-skilled talent</i> <i>Site Selector's Survey: Strong availability of skilled and semi-skilled talent</i> 	<ul style="list-style-type: none"> Ohio is not a Right-to-Work state History of unionized plants <i>Perception Survey: Strong union tradition</i> <i>Site Selector's Survey: Strong union tradition</i>
Real Estate	<ul style="list-style-type: none"> Large number of plants creates platform for expansions to serve new and existing customers in the area 	<ul style="list-style-type: none"> Hurdles to expansion are site-specific, including permitting, infrastructure development/improvements, development timing, and tax policy transparency
Infrastructure / Proximity to Suppliers and Customers	<ul style="list-style-type: none"> Central location in the Midwest allows for advantageous access to markets and key customers in nation's traditional automotive region Multiple ports in the North and the South offer access to Ohio's largest cities, and create Midwest point-of-entry <i>Perception Survey: Strong access to markets and good infrastructure (air cargo, port, and highways)</i> <i>Site Selector's Survey: Strong access to markets and good infrastructure (air cargo, port, and highways)</i> 	<ul style="list-style-type: none"> Other regional competitors will also benefit from general location/access to markets
Costs	<ul style="list-style-type: none"> Ohio appears to offer regionally moderate costs with respect to salaries and wage estimates 	<ul style="list-style-type: none"> Ohio is generally higher cost than most benchmarked locations (when comparing similar size cities) in the Southeast <i>Perception Survey: Ohio is a high cost location (i.e. labor, business taxes)</i> <i>Site Selector's Survey: Ohio is a high cost location (i.e. labor)</i>
Quality of Life	<ul style="list-style-type: none"> Ohio's cities offer a moderately ranked quality of life <i>Perception Survey: Moderate to high quality of life</i> 	<ul style="list-style-type: none"> Some Ohio MSAs exhibit declining populations creating concern for quality of life
Incentives	<ul style="list-style-type: none"> Current manufacturing-oriented incentives policies will likely continue to benefit major expansions 	<ul style="list-style-type: none"> Ohio is <u>not</u> known as an incentives rich state Competing states (i.e. Kentucky, Pennsylvania, Alabama, Georgia) present a significant competitive force inside and outside the region

Options to Improve Competitiveness

Because OEMs have excess capacity and are now making investments in other areas of the country, such as the Southeast, it is not likely that Ohio will attract a new OEM facility. Ohio's OEM focus should be on retention and expansion. The state does have the potential to attract new auto parts suppliers, especially foreign-owned suppliers that serve the new domestics. However, the state should also focus on helping Ohio's existing companies remain competitive and grow, even those attempting to establish global plants so they can be a consistent part of their customers' supply chains. One advantage that Ohio has over many other states is that it is home to the entire supply chain for motor vehicles. Ohio can capitalize on that presence and on the trend toward collaboration throughout the supply chain to strengthen each company that supports the motor vehicles industry. The state can help supplier industries capture more value-added activities, find opportunities to expand globally, and move toward the future with new technologies that hold the potential to transform the industry. Ohio can also leverage its expertise in propulsion technologies and research and development by encouraging knowledge crossover between the motor vehicle and aerospace industries. Finally, the state can begin today to establish and grow fuel cell technologies with grid and off-grid applications to position Ohio as an industry leader and facilitator of transition within the motor vehicle industry.

The study team has identified specific recommendations for how the state can support the automotive industry:

- Position Ohio as an attractive business environment for OEM retention and expansion. Develop business strategies for keeping OEM plants and their suppliers in Ohio. The best opportunities may be in the area of just-in-time

delivery and R&D built around facility changes in model design and production processes. Monitoring the level of OEMs' reinvestment in manufacturing plants is a distinct indicator of their future plans to stay or leave.

- Facilitate relationship-building among Ohio's OEMs and Ohio-based suppliers. Support collaboration among OEMs and parts manufacturers to forge joint ventures or share capital investment as OEMs move to more tightly integrate suppliers into their process
- Help motor vehicle manufacturers gain access to capital
- Support technological investment in safety, regulatory compliance, and alternative fuel sources
- Leverage technological innovations in the automotive industry for use in Ohio's aerospace companies
- Provide or enable services to help companies identify and adopt strategies for long-term survival
- Help Ohio companies expand by taking advantage of global opportunities. Support manufacturers, especially small and midsize enterprises, that want to expand into international markets.
- Aggressively recruit local headquarters and R&D functions of foreign-based auto parts suppliers
- Work to maintain state tax incentives or change the business tax code, especially given the September 2004 court ruling challenging the legality of certain tax breaks awarded to corporations by states
- Nurture and facilitate innovation, which has been and continues to be vital to the success of individual businesses and Ohio's economy overall. State programs could be designed to help promote and sustain process improvement, new product development, business strategies, and operation philosophies.
 - Provide or enable services to help companies find opportunities to expand their share of the value chain product innovation
 - Align academic and applied technology resources.
 - Encourage economic policy to benefit startups that have a high likelihood of commercial application. Recognize that venture capitalists want to continue investing in productivity enhancements through leveraged buyouts.

Implementation Strategies

To best serve the motor vehicle industry and implement specific recommendations, the study team recommends the following actions:

- Hire industry experts or have people who really know the "guts" of the automotive industry (issues, supply chain, critical location factors, etc.) for the state or at least multiple regions. These experts would serve at the state and regional levels, supporting the industry across regions and proactively calling on companies within the industry.
- Build a task force that includes these industry experts and key industry players to understand more deeply Ohio's specific strengths, weaknesses, opportunities, and threats and to develop specific economic development strategies.
- Take a state-led approach to drive economic development strategy, setting guidelines and best practices. Build regional alliances that align with the state strategy and support each region's area of expertise and mix of companies.

Summary

The motor vehicle industry is critical to Ohio's economy. In addition to the industry's direct contribution to the state's economy, its multiplier effect is very large. Most of Ohio's driver industries are tied to the motor vehicle industry, usually as part of its supply chain. The industry is facing challenging times, with slow demand, excess capacity, cost increases, and pricing pressures. There are a number of opportunities to improve processes and transform the industry in the 21st century. Ohio's motor vehicle industry is competitively strong, with significant presence, skilled labor, and access to transportation. Industry costs are about average for the region. The state can help this industry by helping build connections between OEMs and their suppliers; building innovation resources and linking them to companies that commercialize the ideas; and improving speed, transparency, and packaging of incentive packages. Because the motor vehicle industry affects all regions of the state, the study team recommends that ODOD designate an industry expert who can work closely to understand industry needs, a task force that can keep its finger on the pulse of the industry, and regional partnerships that help align state and regional strategies.

Ohio's Value Proposition

- Entire supply chain represented within the state
- Business opportunities across geographies
- Moderate regional costs and a variety of operating conditions (Ohio's regions offer multiple "products")
- A web of related industries (offers opportunities during downturns)

CHEMICALS/POLYMERS

Overview of the Industry in Ohio

Ohio's strength in chemicals echoes the overall state theme of "practical innovation." The state's strength is in using polymers and chemicals to produce innovative products; Ohio is not known as a production location for basic chemicals. The catalyst for the chemical industry in Ohio, and the United States in general, was World War I, when blockades prevented U.S. companies from importing needed chemicals from German manufacturers. However, Ohio's dominance in the soaps and toiletries industry began decades earlier when, in the mid 1800s, Procter & Gamble created a dynasty out of Cincinnati's hog-slaughtering industry. By the turn of the 20th century, Akron had ballooned as the fastest-growing city in the nation, as B.F. Goodrich, Company, Goodyear Tire & Rubber Company, and Firestone Tire and Rubber Company rode the burgeoning auto industry to become the "Rubber Capital of the World." The state's plastics industry grew partly out of the knowledge base of the rubber industry but saw a major increase in demand when World War II created shortages for rubber and other natural materials. Ohio's proximity to raw energy sources of coal and natural gas and its involvement in automotive and agricultural activities, key consumers of rubber and plastics, helped mold the state into a national leader in the chemicals industry.

Chemicals or Polymers?

For the remainder of this section, this industry will be referred to as the more broadly encompassing "chemicals." The chemicals sector defined in this analysis is slightly broader (i.e., encompasses more four-digit NAICs industries) than polymers. Polymers are a subset – granted, a substantial subset – of the chemicals industry as defined in this study.

Ohio's Polymer Strategy Council is taking a strong leadership role in pulling together state and regional resources to promote the sector and encourage economic development. Because its resources are devoted solely to this sector, the council's research has depth beyond the scope of this study, which surveys numerous Ohio industries.

Role of the Industry in Ohio's Economy

Although the objective economic data analysis did not identify chemicals as a state-level driver, the chemicals industry has significant impact in Ohio because it is an important driver in each of the state's six regions. Each region has its own area of subspecialization in this industry. In fact, there are 10 different four-digit NAICS industries in the chemicals sector that are drivers in at least one region of the state. This diversity of regional specializations may be why chemicals did not make the list of drivers for the entire state: With all 10 industries combined, the chemicals industry is a giant at the state level, but the individual regional subspecialties may have cancelled each other out.

Chemicals and polymers contribute \$11.6 billion in output to Ohio's economy, as shown in the following table. However, both output and employment have fallen in most subsectors of this industry. In several subindustries, output declines have not been as deep as employment declines, indicating that productivity is increasing. However, for a handful of large sub-industries – plastics; soaps; basic chemicals; rubber products; and

paints, coatings, and adhesives – output declines have outpaced employment declines, indicating productivity declines and strategic challenges. State output location quotients for chemicals are in the 1.0 to 3.6 range, indicating modest to intense industrial specialization. An output location quotient of 1.0 indicates that the industry's share of state gross product is proportionate to the industry's share of GDP nationally. If the ratio is greater than 1.0, the state's share of gross product is greater than the national average, and if less than 1.0, the state is less specialized in the industry than is the nation as a whole.

Economic Overview of the Chemicals/Polymers Industry in Ohio

NAICS	Industry	2003 Output (\$MM) in 1996 Dollars	1998-2003 Output CAGR	1993-2003 Output CAGR	2003 Output Location Quotient (LQ)	2003 Employment	1998-2003 Employment CAGR
Chemicals/Polymers		\$ 11,619					
3261	Plastics Product Manufacturing	\$ 2,648	-2.6%	2.6%	1.6	53,050	-2.3%
3256	Soap, Cleaning Compound, and Toiletries Mfg.	\$ 1,683	-2.4%	2.1%	2.8	13,970	-0.5%
3251	Basic Chemical Manufacturing	\$ 1,594	-4.1%	0.4%	1.1	10,850	-3.0%
3262	Rubber Product Manufacturing	\$ 1,388	-4.4%	0.2%	3.2	21,970	-5.7%
4246	Chemical and Allied Products Merchant Wholesalers	\$ 1,247	6.6%	8.1%	1.9	8,810	1.9%
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers & Filaments Mfg.	\$ 861	-6.8%	-1.1%	1.4	5,050	-6.1%
3255	Paint, Coating, and Adhesive Manufacturing	\$ 773	-2.8%	-0.7%	2.0	7,960	-2.0%
3279	Other Nonmetallic Mineral Product Manufacturing	\$ 690	-0.4%	2.9%	3.1	8,050	-2.7%
3271	Clay Product and Refractory Manufacturing	\$ 541	-0.8%	1.3%	3.6	8,380	-3.1%
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Mfg.	\$ 195	6.9%	4.5%	1.0	1,520	5.9%

Source: Economy.com

Ohio's share of gross state product that is derived from the most commodity-like portions of the chemical industry is approximately proportional to the national average. The LQ for pesticides and fertilizers is 1.0, and the LQ for basic chemical manufacturing is 1.1. The LQs for the parts of the chemical industry associated with polymer chemistry range from 1.4 and 1.6 in the resin and plastics industries to 3.2 in rubber products and 3.6 in clay products and refractory manufacturing.

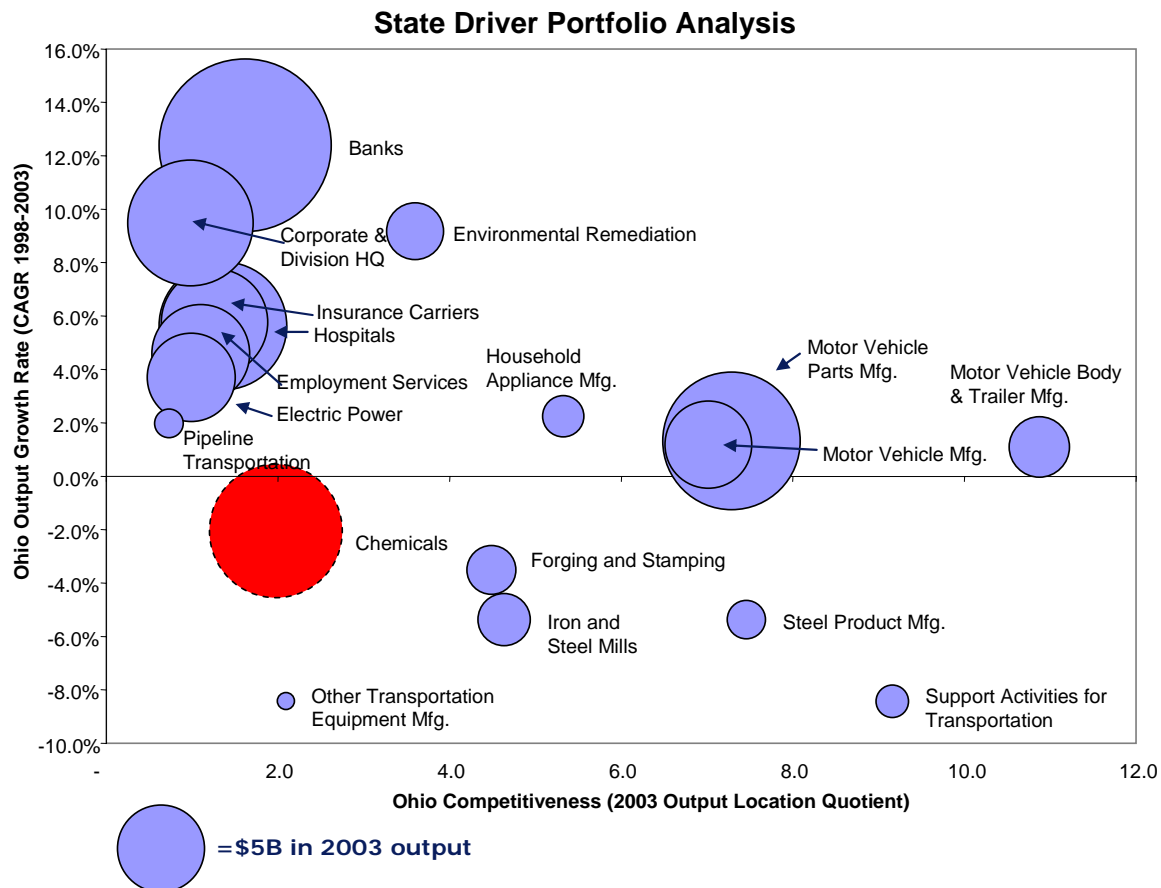
As mentioned earlier, the industry is a driver in all six of Ohio's regions, but regional specializations vary. The following table shows which subsectors the economic data analysis identified as drivers for each region.

Chemicals Driver Industries by Region

NAICS	Description	State	NW	NE	WC	Central	SE	SW	Total
Chemicals									
3251	Basic Chemical Manufacturing						x		1
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers & Filaments Mfg.							x	1
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Mfg.					x		x	2
3255	Paint, Coating, and Adhesive Manufacturing			x	x	x			3
3256	Soap, Cleaning Compound, and Toilet Preparation Mfg.		x	x	x			x	4
4246	Chemical and Allied Products Merchant Wholesalers				x	x		x	3
3261	Plastics Product Manufacturing		x						1
3262	Rubber Product Manufacturing		x	x		x			3
3279	Other Nonmetallic Mineral Product Manufacturing		x	x		x			3
3271	Clay Product and Refractory Manufacturing		x	x		x	x		4

Source: Economy.com

Although chemicals is not a state driver, the following chart shows a bubble for the combined chemicals and polymers industry to represent where it would fall within the state's portfolio of driver industries. Overall, the industry is large. Its output location quotient is 1.9, and its average annual growth rate fell by 2.3% between 1998 and 2003. The data place the chemicals industry in the lower-left section of the portfolio figure: The industry is an important supply base for Ohio but its negative employment and output growth indicate strategic challenges.



Source: Economy.com, CSU/Deloitte analysis

The data presented in these tables do not capture the full economic impact of the chemicals industry in Ohio. The chemicals industry also affects the state's economy indirectly through its supply and customer chains. The polymer portion of the industry is widely recognized as a driving technical force in the economy, and there is interest in understanding how nanotechnologies will reformulate basic chemistry and re-engineer entire classes of chemical products. Yet, the chemicals industry is not solely polymers; it is also tightly connected to automobile manufacturing through parts and materials such as plastic moldings, as well as through paints and coatings. Soaps and lubricants are major export products, and rubber products could become fundamentally refashioned, thanks to chemistry research. What is less widely recognized about this industry are the number of prominent private-sector research and development facilities in the state – studying everything from flavors to paints – and the vibrancy of the research labor market these laboratories support. In expert panels held throughout the state, this

industry was often referred to as a “hidden gem” – an industry thought of as world-class in Ohio but not marketed effectively to industry players outside the state.

All of the chemical industries that were identified as economic drivers had relatively high total multipliers. Total multipliers add up the impact on Ohio’s economy of the direct sale of products from the industry; the rounds of spending that are then created in the industry’s supply chain; and the impact of spending that is attributable to wages, salaries, and proprietor’s incomes of those working in the industry, the supply chain, and in local services businesses that satisfy consumer demand. Within the chemicals industry, basic chemicals had the largest total multiplier among this group of regional drivers at 3.47, indicating its long supply chain. Every dollar of direct export expenditure results in an additional \$2.47 cents worth of purchases within the state’s borders. This is a partial reason why the industry is so important to the southeastern portion of the state. The resin industry had the 23rd largest total multiplier in the state, 2.41, and the soap industry had a multiplier of 2.38. Compared to the other chemical industries, the multiplier of rubber products manufacturing looks modest at 1.64; every dollar of direct demand on the industry generates another 64 cents of economic activity. This is because rubber products manufacturing is a “sandwich” industry: It is principally part of the supply chain of other industries, and modest amounts of its raw materials and work-in-process inventory comes from out-of-state establishments.

Multipliers for the Chemical Industries

NAICS	Industry Name	Multiplier		Rank
		Direct & Indirect	Direct, Indirect & Induced	
3251	Basic Chemical Manufacturing	2.73	3.47	11
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing	1.90	2.41	23
3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	1.87	2.38	25
3255	Paint, Coating, and Adhesive Manufacturing	1.66	2.11	44
3259	Other Chemical Product and Preparation Manufacturing	1.63	2.06	48
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	1.55	1.97	62
3262	Rubber Product Manufacturing	1.29	1.64	150
4246	Chemical and Allied Products Merchant Wholesalers	1.25	1.59	190*

Source: IMPLAN Input-Output Model, April 2005; CSU/Deloitte Analysis

Note: Ranked by total multiplier out of 271 industries.

* All wholesale industries have the same multiplier due to the structure of the IMPLAN model.

The cluster analysis indicates that many suppliers and customers for this industry are also located in Ohio. Proximity to suppliers and customers is an important location factor for this industry, and Ohio’s industry is positioned well. Ohio’s chemicals industry is a leading supplier of parts and products to the motor vehicle industry. This is also a potential drawback because of the economic risk associated with either a downturn in the industry or significant changes in market share among products from Ohio’s assembly plants.

A list of supply chain industries for chemicals follows. Although many of them are located in the state, Ohio also imports most of the raw materials for chemicals. It may be an economic advantage for Ohio’s companies to import these products because many of the inputs are low-profit commodity products. Ohio’s companies are more focused on value-added products and applications. Two value-added supply chain industries that Ohio should consider leveraging from the chemical industry are logistics and scientific research and development.

Industries from which chemicals companies purchase supplies and materials include:

- Petroleum and coal products manufacturing
- Merchant wholesalers, durable goods

- Lessors of nonfinancial intangible assets (except copyrighted works)
- Oil and gas extraction
- Basic chemicals manufacturing (supplier for specialty chemicals industry)
- Management of companies and enterprises
- Truck transportation
- Electric power generation, transmission, and distribution
- Architectural, engineering, and related services
- Metal ore mining
- Nonmetallic mineral mining and quarrying
- Natural gas distribution
- Converted paper product manufacturing
- Real estate, rental and leasing
- Pulp, paper, and paperboard mills
- Scientific research and development services

Industry Location/Investment Factors

Given the commodity nature of the chemicals industry, Ohio would likely benefit from high value-added activities. One area of significant opportunity is research and development to support the innovation of new products to serve industries in Ohio and elsewhere.

The following table lists some typical critical location factors, and their associated weights, specifically for research and development operations. The weights attributed to the factors are somewhat subjective and may vary based on the particular company, its operating constraints, and its preferences.

<i>Factor</i>	<i>Weight</i>	<i>Preferences</i>
<i>Labor Quality & Availability</i>	High	<ul style="list-style-type: none"> • Technical professionals, including researchers and engineers • Educational attainment: four-year degrees, advanced science or engineering degrees • Local and regional availability of science and engineering degree-granting institutions • Strong local and regional industry clustering • Large community capable of providing necessary talent and educational infrastructure
<i>Real Estate</i>	Moderate	<ul style="list-style-type: none"> • Access to R&D facilities at a reasonable cost and with adequate flexibility (i.e., incubators, university space, etc.)
<i>Access/ Infrastructure</i>	High	<ul style="list-style-type: none"> • Strong local and regional industry clustering
<i>Costs</i>	High	<ul style="list-style-type: none"> • Low real estate and operating costs • Moderate labor costs although many salaried workers will be on a “national” scale •
<i>Quality of Life</i>	Moderate to High	<ul style="list-style-type: none"> • High quality of life to retain and attract research and engineering talent

<i>Factor</i>	<i>Weight</i>	<i>Preferences</i>
<i>Business Climate & Regulatory Issues</i>	Low to Moderate	<ul style="list-style-type: none"> • Corporate taxation • Economic development community aggressiveness • Community image and vibrancy

Incentives of potential value for this industry typically include:

- Financing (venture capital)
- Training
- R&D or small business assistance

Current Industry Trends and Key Issues

One of the biggest challenges facing the chemicals industry today is the maturity of the industry and commoditization of many of its products. The industry continues to consolidate. In an industry in which price is often the main distinction between competitors, it is critical for chemicals manufacturers to differentiate themselves by focusing on product innovation and customization to move up the value chain and improve profitability. It is not clear whether companies, faced with managing day-to-day operations and survival, have the capability to define new product or market opportunities.

Other challenges stem from increasing costs and the need for productivity improvement. Energy prices and raw material (resin) prices are driving production costs upward, but there is limited ability to pass cost increases on to customers, especially in the face of global competition. To mitigate high input costs, companies need to look into process and supply chain improvements to obtain cost-saving efficiencies. This is particularly true for basic chemicals, which are commodity products that compete primarily on cost. Unfortunately, at least in the short term, cost savings initiatives may continue to drive employment declines.

Globalization is having both positive and negative impact on the U.S. chemicals industry. On the positive side, U.S. chemical companies have the opportunity to invest in foreign companies to take advantage of increased local demand and reduced labor costs in areas such as Asia, Eastern Europe, and Latin America. However, cheaper products imports from China are challenging U.S. manufacturers, and overseas markets are increasingly sourcing from other countries, such as Russia, because costs, of which labor is a significant component, are lower. U.S. firms need to either drive down costs of production or create new products to be more competitive in the global marketplace.

Compliance with environmental concerns and regulations is another key problem the industry is facing. Companies have had to make costly improvements. Examples include the need to develop and implement new processes for waste reduction and recovery in manufacturing and the need for plastics products manufacturers to develop new containers that comply with state-specified mandates concerning the use of recycled plastic. Another concern among chemicals companies is asbestos removal and remediation. Many companies are still financially exposed to liabilities stemming from continued asbestos litigation.

Emerging/Growth Opportunities and Areas of Investment

Although chemicals is largely a mature or commodity-like business, there are still many growth areas within the industry, along with opportunities to develop more value-added products. Many of these products are linked closely to Ohio's strengths and customer industries, such as motor vehicles, agriculture, and toiletries.

Some of the emerging or investment sectors in the chemicals industry are driven by suppliers' efforts to work more closely with their customers. These areas include:

- Customized chemicals. Companies are anticipating specific customer needs and are developing products in tandem with customers.
- Interactive design software. Databases of formulas, processes to help in product development, and software that tracks product development may help chemicals companies form a closer relationship with customers and shorten time-to-market of new products.

Other growth opportunities are being driven by demographic changes, most notably the general aging of the population:

- "Beauty in a bottle." Aging demographics and increasing global personal income levels are likely to drive demand for cosmetics and toiletries.
- Fine chemicals that are active ingredients in pharmaceuticals

Geographically, many companies are investing in development of offshore capacity in areas such as Asia, Eastern Europe, and Latin America. This investment is largely being driven by increased demand for basic chemicals and reduced labor costs. Because of industry globalization and the complexity of distribution, logistics software to analyze patterns in distribution practices and design a better network to save shipping costs is becoming more valuable for the chemicals industry.

Other areas of R&D and investment leverage scientific development to create "next generation" chemical products, such as:

- Electronic materials for use in semiconductors
- Agrichemicals and pesticides
- Genetically engineered seeds that are disease- and pest-resistant
- Flame retardants
- Innovative inks
- Germicides and disinfectants
- Highly specialized innovations based on nanochemistry

Long-term development opportunities in alternate fuels and more environmentally friendly products are being driven by increasing oil prices and more stringent regulations. These include:

- Agriculture-based synthetic alternatives to carbon-based raw materials and fuels
- Vegetable-based lubricants that lengthen the life of transformers, are environmentally friendly, and are safer than oil-based lubricants
- Vegetable-based polymers used to make packaging more environmentally friendly
- Powder coatings that are UV curable and environmentally friendly

Competitiveness Assessment of Ohio's Chemicals Industry

Using the perception survey, site selectors' survey, competitiveness analysis, and benchmarking, the study team has identified some of Ohio's strengths and weaknesses related to the chemicals industry. Key strengths include Ohio's central location, its labor quality, educational system, quality of life, and strong manufacturing base. Its weaknesses are centered on the perceived high union presence, high labor costs, high taxes, and rigid regulations. Specific comments noted the state's "tax system complexity," "Ohio inventory tax," and "lack of investment/tax breaks." Sixty-five percent of the surveyed chemicals companies that planned to make investment decisions within the next few years said they are likely to consider Ohio for their next site. Those saying they would not consider Ohio as an investment location cited such reasons as the state's distance from customers and suppliers and its seemingly burdensome business climate, stemming from a perception of high operating costs, an ungainly business tax system and union activity.

The study team benchmarked the chemicals industry by modeling high-level cost and operating condition indicators, specifically for the R&D business function, to understand how select Ohio MSAs (Cleveland, Columbus, and Cincinnati) compare to other regional and national MSAs with significant chemicals industry presence. Observations from the competitiveness benchmarking indicate that Cleveland, in particular, exhibits many of the key criteria necessary for R&D activity, including the presence of major universities with research capabilities, and a strong foundation in chemicals and related industries that may offer an advantage in fostering research and development activities. These findings also apply to the Akron metropolitan area. Other Ohio MSAs had low to moderate costs relative to competitive MSAs, but their operating conditions were not ranked as highly as Cleveland's. Conversely, although some regions scored well from an overall growth and educational attainment perspective, they had a comparatively low concentration of chemical industry activity.

Ohio's Key Strengths

- Industry concentration and precedent for successful manufacturing
- Proximity to customers in specific industries (motor vehicles, agriculture)
- Presence and quality of experienced, skilled labor, including a strong pool of doctorate-level chemists
- Moderate labor and business costs
- Good quality of life
- Strong educational and research institutions

Ohio's Key Weaknesses

- "Hidden gem." The scale and sophistication of Ohio's chemicals industry is not well-known outside the state
- Challenge in defining a statewide message of expertise given the many different subindustries of specialization in each region
- Declining output and profitability during the 2001 recession and slow recovery
- Perceived union presence and high labor costs
- Perceived burdensome tax system
- Perceived complex regulatory system

Options to Improve Competitiveness

Study findings suggest specific recommendations for how the state can support the chemicals industry:

- Follow up on company leads generated in the perception survey.
- Focus technology and attraction investments on industry segments and applications in which Ohio can be most competitive: automotive, polymers, agriculture, and soaps and toiletries.
- Develop a statewide marketing message that communicates Ohio's world-class industry and regional specialties.
- Provide strategy and innovation support – in the form of services, incentives, or funding – to help companies identify new products, applications, and market opportunities.
- Link manufacturers to research facilities and universities, including biomedical entities, to encourage collaboration in developing and commercializing new products.
- Help manufacturers work together to create joint ventures for new product or application development.
- Develop strategies for retaining chemicals companies that may be merger or acquisition targets.
- Provide assistance and support for local chemicals manufacturers interested in developing a global presence.
- Provide “business matchmaking” services, linking manufacturers with customers.
- Support MEPs or other organizations that can help small and mid-sized firms improve their processes, streamline their supply chains, and identify growth opportunities.
- Develop a state road map to become world-class in chemicals, research, and education. Encourage universities to strengthen their chemistry courses and related programming so that they become leaders in chemicals research and education. Go beyond investing in academic stars and grow a constellation of excellence in basic, or pure, chemistry science. This should be benchmarked against the best academic chemistry departments in the nation.

Implementation Strategies

To best serve the chemicals industry and implement specific recommendations, the study team recommends that the state:

- Hire industry experts or have people who really know the “guts” of the chemicals industry (issues, supply chain, critical location factors, etc.) for the state or at least multiple regions. These experts would support the industry across regions and proactively call on companies. This is under way in the polymer sector.
- Build a task force that includes the chemicals expert and key industry players to understand more deeply Ohio's specific strengths, weaknesses, opportunities, and threats and to develop specific economic development strategies. This task force could leverage the personnel and research already available through the Ohio Polymer Strategy Council but would cover the broader industry statewide.
- Create a statewide economic development approach and marketing message for the chemicals industry that can be tailored to each region's area of specialization. It might also make sense to develop marketing messages tailored to specific customer industries. For example, marketing Ohio's strength in chemicals applications for the motor vehicle industry could be used as a message to attract

new companies catering to the motor vehicles industry. Marketing messages could also leverage Ohio's intellectual development and R&D capabilities for business attraction.

- Take a region-state approach to economic development for the industry. The state could set guidelines and craft an overall strategy, but each region should understand its areas of specialization and drive targeted programs to help their companies. Build regional partnerships by giving them incentives (regional development action grants) to drive regional strategy, set best practices, and help grow the recommended five- or six-digit NAICS industries (the state focuses on the four-digit NAICS level). Regional strategies would need to align with the state strategy, which, in turn, would support regional expertise.

Summary

Ohio's chemicals industry is large and competitive. Output has been declining in recent years, and many products have become commoditized. Many companies do not have the resources or knowledge to identify value-added growth opportunities. Ohio's chemicals industry is perceived as a "hidden gem," but different regional specialties and fragmented resources have resulted in a lack of clear message to communicate its strengths to industry leaders outside the state. The chemicals industry is highly capital-intensive and, to some extent, is suffering from overcapacity. For these reasons, it is unlikely that a new *basic* chemicals plant will be built in Ohio in the near future. Instead, Ohio's focus needs to be on retaining and expanding existing manufacturers. However, there is an opportunity for the state to attract specific industry players in *applied* or *specialized* chemicals or business functions such as R&D. Of the out-of-state business leaders contacted in the perception survey who expressed interest in considering Ohio as a location for their company's next investment, half were in the chemicals industry, with many in automotive-related fields.

Ohio's Value Proposition

- Industry clustering, particularly in Northeast Ohio
- A web of related industries
- Ohio's history of pragmatic innovation
- Availability of resources to support R&D

CLINICAL MEDICINE AND RELATED INDUSTRIES

Overview of the Industry in Ohio

Ohio, particularly the northeastern region of the state, is known nationally and globally for its strength in clinical medicine. The Cleveland Clinic has consistently placed among the nation's top hospitals for heart care and surgery. In 2004, not only did *U.S. News & World Report* rank Cleveland Clinic No. 4 in the nation, the magazine also rated the hospital among the top 15 treatment centers in the nation for 12 areas of specialty medicine: digestive disorders; urology; kidney disease; rheumatology; orthopedics; neurology and neurosurgery; ear, nose, and throat; gynecology; hormonal disorders; respiratory disorders; geriatrics, and ophthalmology. The state has two hospitals that are among the nation's best in pediatrics: Rainbow Babies and Children's Hospital in Cleveland and Cincinnati Children's Hospital. In addition to pediatrics, University Hospitals Health System, of which Rainbow Babies is part, is among the nation's top 25 treatment centers for geriatrics, neurology and neurosurgery, respiratory disorders, cancer, psychiatry, orthopedics, and digestive disorders. Other Ohio hospitals, such as Christ Hospital and University Hospital, both in Cincinnati; Miami Valley Hospital in Dayton; Ohio State University Medical Center in Columbus; Summa Health System in Akron; and St. Vincent Medical Center in Toledo, contribute to the state's high quality health care.

A recent Battelle study documented Ohio's strength in biosciences:

- Ohio ranks No. 1 in per capita clinical trials.
- Three of the nation's top 20 pediatric medical clinics are in Ohio.
- Ohio placed 10th in total National Institutes of Health funding.
- Ohio has had twice the national average growth in research funding (100% vs. 41%).
- The Cleveland Clinic has been rated the nation's No. 4 hospital and No. 1 in cardiology.
- Case Western Reserve University's bioengineering program is ranked fifth in the country, and three medical schools (Ohio State University, Case Western Reserve University, and the University of Cincinnati) are ranked in the top 50.
- Two Fortune 35 companies involved in biosciences, (Procter & Gamble and Cardinal Health) are headquartered in Ohio. The state is also home to commercial sectors of four leading bioscience companies (Ethicon, STERIS, Invacare, and Ross Laboratories) and such research facilities as the National Institute for Occupational Safety and Health and the Food and Drug Administration's National Forensic Chemistry Lab.)

Given Ohio's strengths in clinical medicine, leveraging this strength to develop medical instruments may be an emerging opportunity for growth in the state. Medical instruments usually develop out of clinical needs, and the intersection of clinical excellence and scientific research and expertise in manufacturing products using advanced materials should offer potential for a broader medical instruments industry. This opportunity is supported by responses to a survey of venture capitalists, who identified medical equipment and instruments as potential areas of investment for Ohio.

Current State of the Industry

There are more than 5,000 hospitals in the United States, most of them operating on a not-for-profit business structure. Most hospitals offer a broad range of inpatient and outpatient services. Hospitals are paid for services by insurance companies, managed care organizations, government programs such as Medicare and Medicaid, and patients themselves. The industry has been consolidating as financially healthy chains have acquired smaller players. Although growth rates are expected to be strong for the near future, driven by favorable demographics and price increases, hospitals are struggling with higher costs of supplies and labor shortages that are driving wage increases. Therefore, hospitals are focusing on cost-cutting measures to improve efficiency and business performance.

Role of the Industry in Ohio's Economy

The clinical medicine industry has a significant impact in Ohio. Hospitals directly contribute \$20 billion to the state's economy, as shown in the following table. Both employment and output are increasing in this sector. Hospitals are a driver industry for the state and for the Northeast, Northwest, Central, and Southwest regions.

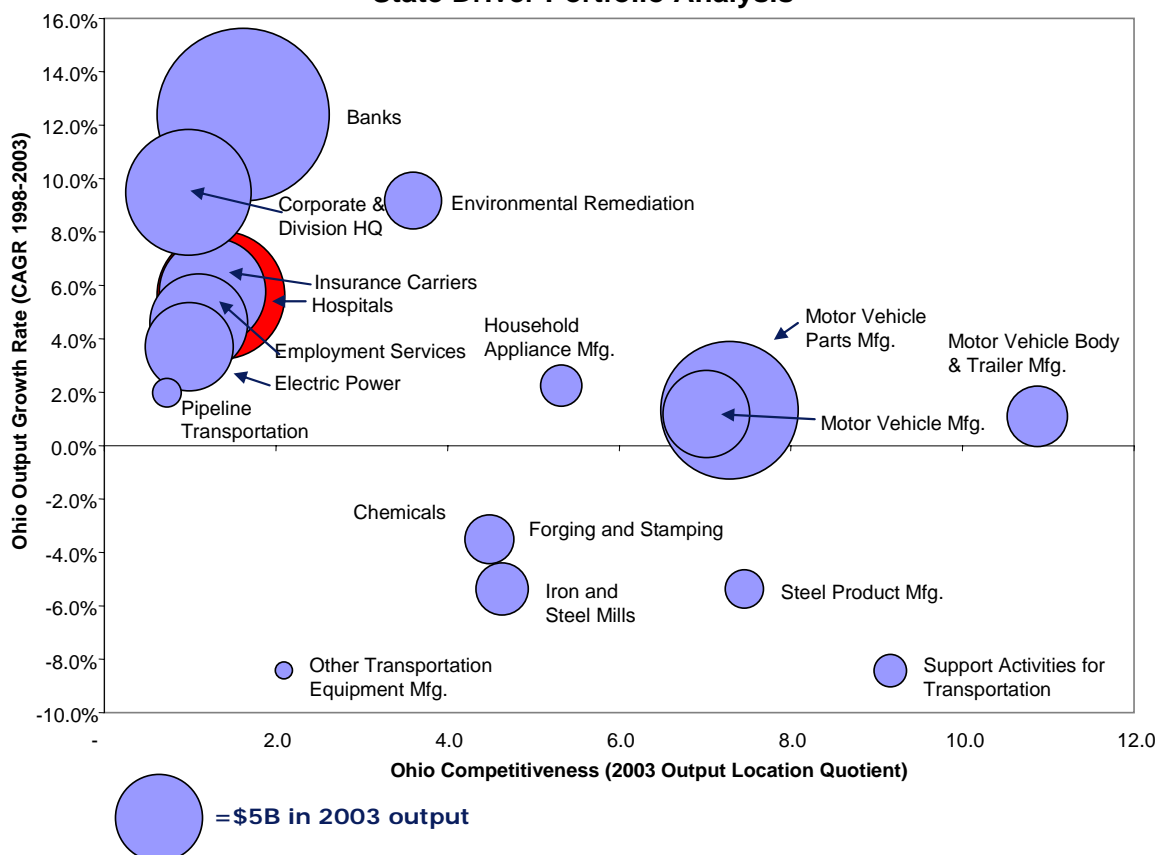
Economic Overview of the Hospitals Industry in Ohio

NAICS	Industry	2003 Output (\$MM)	1998-2003 Output CAGR	1993-2003 Output CAGR	2003 Output Location Quotient (LQ)	2003 Employment	1998-2003 Employment CAGR
6221	General Medical and Surgical Hospitals	\$10,793	5.6%	3.8%	1.4	200,040	1.6%

Source: Economy.com

The following chart shows where hospitals fit within the economic portfolio of Ohio's driver industries. The hospitals industry is large, with a moderately high output location quotient and strong output growth rate. The data place the hospitals industry in the upper-left section of the portfolio figure. Normally, this is interpreted as an important growth opportunity base on which Ohio can build. However, growth in the hospitals industry is limited by population and income growth (even though an aging population will drive up demand). The business case for targeting hospitals for economic development is to use the clinical excellence of Ohio's hospitals to aggressively enter the medical equipment and instruments business, support outsourced hospital back-office opportunities, and attract clinically based research. Another area of opportunity lies in the state's industrial background in organic chemistry and its emerging strengths in biopolymers and nanotechnologies to support the medical instrument markets.

State Driver Portfolio Analysis



Source: Economy.com, CSU/Deloitte analysis

The data presented here do not capture the full economic impact of the medical industry in Ohio. Other industries, such as administrative services and employment services, are suppliers to the hospitals industry. The insurance industry is a primary customer of the hospitals industry. Clinical medicine is also tied to medical equipment and supplies and, through biosciences, to research, information technology, chemistry, nanotechnology, and MEMS. However, the economic data suggest that Ohio is not effectively leveraging its competitive advantage in clinical medicine by connecting all of these industries. Efforts in this area may be too new to yield dramatic results.

Multipliers for Biomedical Industries

NAICS	Industry Name	Multiplier		Rank
		Direct & Indirect	Direct, Indirect & Induced	
3254	Pharmaceutical and Medicine Manufacturing	1.53	1.94	67
6221	General Medical and Surgical Hospitals	1.44	1.83	89
3391	Medical Equipment and Supplies Manufacturing	1.44	1.82	95

Source: IMPLAN Input-Output Model, April 2005; CSU/Deloitte Analysis

Note: Ranked by total multiplier out of 271 industries.

The hospital industry was identified as a driver of the state's economy and its regional economies due to its clinical excellence, not due to its measurable economic impact. The total multipliers of the components of the biomedical industry reinforce this finding. Every dollar of final demand in these three identifiable components of this industry

generate between an additional 82 cents and 94 cents of economic activity. This activity is mainly due to the consumer spending of employees of the component industries. The general medical and surgical hospitals industry has a low multiplier because a large portion of its supply chain, with the exception of labor, comes from out-of-state suppliers. There are two reasons why the medical equipment and supplies industry also has a low multiplier. First, medical products are a national industry and most of the in-state activity comes from wholesalers. The second reason is that the in-state medical equipment industry is a combination of emerging technologies and is a growth opportunity in the state. Its constituent firms are young; they have not had a chance to develop cluster economies and have relatively short in-state supply chains.

Industries that form part of the supply chain for hospitals include:

- Psychiatric and substance abuse hospitals
- Specialty (except psychiatric and substance abuse) hospitals
- Real estate, rental and leasing
- Merchant wholesalers, durable goods
- Securities and commodity contracts intermediation and brokerage (and investments)
- Employment services
- Legal services
- Management of companies and enterprises
- Management, scientific, and technical consulting services

The quantitative growth opportunities analysis in the next section identifies several other industries that are related to hospitals. The first is office administrative services. Many hospitals are outsourcing administrative functions to separate Ohio companies. Another emerging industry in Ohio is computer systems design and related services. At least one of Ohio's top computer systems companies focuses on the health care industry. Other related industries are scientific research and design, which is also a growth opportunity, and medical equipment, which is an underdeveloped industry in Ohio. All of these industries present economic development opportunities for Ohio to leverage its strength in clinical medicine and to build competitive advantage in a broader range of industries.

A deeper look into the list of industries that are suppliers to the medical equipment and supplies industry indicates that Ohio could be well-positioned to leverage its medical research expertise and its existing driver industries, such as chemicals, metals, and glass manufacturing, to build a true center of excellence in medical equipment, especially in the research and development function.

Industry Location/Investment Factors

Hospitals make investment location decisions based primarily on local population levels, population growth, and demographic indicators, such as the percentage of residents over age 65, birth rates, and household incomes. Elderly patients and women of child-bearing age tend to use a disproportionately high level of hospital services. Another critical factor in location investment decisions is the geographic size of the region. Accessibility and the number of competing facilities in the region are also important location factors.

Ohio has the opportunity to leverage its strengths in clinical medicine and clinical trials to build or attract related industries, such as medical instruments manufacturing. Typical

critical location factors, and associated weights, important to high-tech and high-value manufacturing operations, such as medical instruments manufacturing, may include (but are not limited to) the following:

<i>Factor</i>	<i>Weight</i>	<i>Preferences</i>
<i>Labor Quality & Availability</i>	High	<ul style="list-style-type: none"> • Skilled production technicians and quality assurance professionals for manufacturing • Skilled engineers and research professionals for product development and testing • Industry clustering, including a large concentration of health care expertise (hospitals, medical campuses, etc.) • Educational attainment: some college and local technical training for manufacturing; four-year (or more) science and engineering degrees for professional fields • Strong concentration of similar processes (e.g., precision manufacturing, plastics, etc.) • Low union presence or low incidence of union activity • Strong community growth with moderate unemployment
<i>Real Estate</i>	Moderate	<ul style="list-style-type: none"> • Specialized space with R&D and manufacturing capabilities • May require clean rooms and extensive build-out • Important considerations include fiber optics and utility redundancy
<i>Access/ Infrastructure</i>	Moderate	<ul style="list-style-type: none"> • Increasing need to allow for expedited product delivery (air cargo capabilities, especially for high-value products) • Tightly clustered R&D/innovation facilities ,although manufacturing locations may be regional or extra-regional
<i>Costs</i>	Moderate to High	<ul style="list-style-type: none"> • Low to moderate semiskilled and skilled labor costs, without sacrificing talent availability • Low real estate construction and operating costs
<i>Quality of Life</i>	Moderate to High	<ul style="list-style-type: none"> • Moderate to high quality of life requirements to retain and attract talent
<i>Business Climate & Regulatory Issues</i>	Moderate	<ul style="list-style-type: none"> • Corporate and product taxation • Labor regulations • Other permitting (i.e., real estate design and construction) • May be subject to significant FDA regulation • Economic development community aggressiveness and familiarity with industry forces

Incentives of potential value for this industry include:

- Financing (especially with respect to startups and R&D)
- Training
- Tax (income, sales & use, property)
- Site preparation, construction, and discretionary grants

Current Industry Trends and Key Issues

Hospitals

Cost management is becoming increasingly important for hospitals. Continued pricing pressures and rising costs of supplies and labor have driven hospitals to seek cost-

structure improvements to maintain profitability. Many independent hospitals are forming alliances to leverage their purchasing power.

Driven by the desire to lower administrative costs, hospitals are increasingly relying on outside contractors to manage many of their departments, such as food service, housekeeping, and equipment maintenance. In addition, hospitals are turning to technology to automate processes to reduce costs and medical errors.

Labor supply continues to be a concern for hospitals. The shortage of medical staff in hospitals is expected to continue into the foreseeable future. The biggest supply problem is for nurses, especially in highly skilled specialties and urban areas.

Consolidation in the hospital industry continues. Many smaller hospitals and chains are struggling financially and are likely acquisition targets for larger, more profitable organizations.

Medical Equipment and Instruments

Industry growth is driven by innovation and new products. Companies need access to capital to support the significant R&D spending necessary to develop new products, especially as health care inflation and budget challenges affect government reimbursement rates. Larger companies have a significant advantage over smaller ones because they have the scale of resources required to take an idea through multiple years of development.

The brightest prospects for industry growth and profitability are in advanced technology products. Companies need scientists with knowledge of cutting-edge disease management and technology skills to help support product development. Smaller companies or startups may also need entrepreneurial talent who can manage a new and growing business.

Although capital and labor are both essential for innovation in this industry, equally important is the need to link companies that have the ability to commercialize products to institutions that generate cutting-edge thinking and ideas. Smaller companies may also need assistance with managing the innovation process and product life cycles. Some of the expert panelists who participated in this study raised concerns about the dearth of experienced managers to lead fast-growth technology firms.

Companies that compete in the commodity-like hospital products market need to be as efficient as possible to offset the financial challenges of price competition. Process improvement may become more important if reimbursement levels for health care payers begin to decline or when products that were once cutting-edge become more mature.

Emerging/Growth Opportunities and Areas of Investment

Hospitals

As mentioned earlier, hospitals continue to consolidate. Investment in merger and acquisition activity is expected to continue.

Technology is another major investment area. Hospitals have not been on the leading edge for applying technology, but complexity of recordkeeping, increased focus on safety, and the desire to reduce administrative costs have all pushed hospitals toward automation. One expert panelist estimated that every hospital would invest \$10 million over the next few years in technology. Specific areas on which hospitals are focusing include:

- Data-processing equipment
- Technology to automate medical records, reduce costs, and prevent medical errors
 - Computerized physician order entry
 - Procurement and inventory software and services
 - Electronic patient records
- RFID applications for patient tracking and management of pharmaceuticals or other high-value medical supplies.
- Telecommunications

As hospitals try to manage costs and improve processes, they are also investing in infrastructure. Specific areas of investment include:

- Energy-saving equipment, such as ventilation systems
- Construction of new facilities to replace old ones
 - Rebuilding or adding high-profit operations, such as orthopedics, cardiology, oncology, and diagnostic imaging

Medical Equipment and Supplies

In general, the medical equipment industry is investing in the development of products that increase benefits to patients, improve medical labor productivity, reduce patient hospital stays, and facilitate hospital care in less expensive settings.

Specific new product opportunities are increasingly technological. Many of the growth sectors expected to play a significant role in the future are those that address the needs of an aging population, especially in the areas of cardiology, diabetes management, and orthopedics. Some specific products in which the industry is currently investing research and development dollars include:

- Orthobiologics
- Deep brain stimulation
- Drug-coated coronary and peripheral vascular stents
- Implantable defibrillators
- Ablation catheters
- Congestive heart failure treatments
- Diabetes testing and management
- Minimally invasive and robotic surgery
- Prosthetic equipment that allows bone to grow directly into implants
- Devices used in spinal fusion procedures, including electrical stimulators that treat fractures and devices that can stimulate bone growth
- DNA tests
- Lasers

The medical equipment industry is also evaluating China as a geographic area for investment because it is an attractive market. There are tariff and regulatory challenges

to selling in China that must be overcome, but long-term prospects are promising, especially for advanced technology products

Competitiveness Assessment of Ohio's Medical Industry

Through the competitiveness analysis and benchmarking, the study team was able to identify some of Ohio's strengths and weaknesses for the medical industry. The study team benchmarked the medical devices industry by modeling high-level cost and operating condition indicators, specifically for the manufacturing business function, to understand how Ohio's MSAs compare to other national and regional MSAs with a significant medical industry presence,

Cities that have traditionally had strong clusters in biotech and medical device technology continue to offer strong operating conditions although at likely higher relative costs. Minneapolis appears to be a clear leader with respect to medical device manufacturing, based largely on industry clustering in the region. The Research Triangle area in North Carolina, however, appears to offer lower costs than other established markets. From an operating conditions perspective, Ohio locations appear to be on par with several regional and national competitors in the medical devices arena, including northern New Jersey, Pittsburgh, and San Diego.

Regionally, Ohio locations are moderate to low cost compared to national competitors and offer moderate operating conditions. The other regional competitor, Pittsburgh, slightly trailed Ohio locations with respect to both operating conditions and costs. All Ohio locations appear to be significantly less expensive than some of the more established biotech centers of excellence, such as Boston, northern New Jersey, Washington, D.C., and San Diego.

Ohio's Key Strengths

- Recognized world-class adult and pediatric clinical medicine
- Nationally ranked hospitals, with particular expertise in cardiology, geriatrics, and nearly a dozen other specialties
- Clinical trials pre-eminence
- Research funding growth
- R&D facilities and biosciences entities
- Moderate to low costs compared to national competitors
- Moderate operating conditions for medical products manufacturing
- Moderate to high quality of life
- Moderate to high educational attainment
- Low to moderate cost of living compared to national competitors

Ohio's Key Weaknesses

- Little link between clinical research and product development and commercialization
- Lack of transparency of economic development incentives
- Lack of entrepreneurial culture and management talent to commercialize products or technologies
- Lack of marketing to attract companies and create visibility for investors
- Low population growth (with the exception of Columbus)
- Less industry depth and presence compared to national competitor locations

Options to Improve Competitiveness

Ohio already has world-class clinical medicine. The opportunity for future economic development is to support the current industry and leverage it to build a stronger bioscience, information technology, and medical devices cluster within the state. The first step is to build connections between research, technology, commercialization, and production. The next step is to foster product development investment and an entrepreneurial, innovation-focused business culture. Overarching all of these activities should be marketing efforts to attract new, related businesses to Ohio by communicating the state's clinical medicine excellence and leadership in clinical trials.

Study findings suggest specific recommendations for how the state can support the medical industry:

Hospitals

- Provide or enable process improvement services to help hospitals improve operating efficiencies.
- Facilitate purchasing alliances between Ohio hospitals.
- Help struggling hospitals access capital or facilitate consolidation of hospital companies.
- Work with universities to offer nursing scholarships that require recipients to work in Ohio for a contracted amount of time after graduation.
- Encourage investment in technology by offering tax credits or helping hospitals access capital and resources for technology purchases, implementation, and training.
- Leverage Ohio's strength in clinical medicine and medical delivery to expand and attract companies in related industries, such as medical devices and back-office software development or implementation services.
- Position Ohio as an attractive location for a facility or headquarters of a hospital company.
- Create and support an industry-led task force to evaluate opportunities for RFID applications to track inventory or patient treatment records.

Medical Equipment

- Leverage Ohio's strength in clinical medicine and manufacturing to develop a center of expertise in this growing industry and attract new companies.
- Facilitate relationships among Ohio's education, research, intermediary facilities, and companies that can commercialize ideas into products.
- Encourage educational institutions to support degree programs in life sciences.
- Position Ohio as an attractive location for a manufacturing or R&D facility for a larger company or headquarters of a smaller firm.
- Consider programs to help smaller firms in Ohio partner to share product development risks and resources and achieve economies of scale.
- Consider government incentives to offset the cost of technology, R&D, or production.
- Help Ohio companies access National Institutes of Health funding.
- Provide or help companies access process improvement services, such as product development, process management, product life-cycle management, and lean manufacturing.
- Nurture and facilitate innovation, which has been and continues to be vital to the success of individual businesses and Ohio's economy overall. State programs

could be designed to help promote and sustain process improvement, new product development, business strategies, and operation philosophies.

- Provide or enable services to help companies find opportunities to expand their share of the product innovation value chain.
- Align academic and applied technology resources.
- Encourage economic policies to benefit startups that have high likelihood of commercial application. Recognize that venture capitalists have a desire to continue productivity-enhancing investment.

Implementation Strategies

To best serve the medical industry and implement specific recommendations, the study team recommends the following actions:

- Take a more regional approach to implementing economic development strategies. This industry is a strong driver in the Northeast, Northwest, Central, and Southwest regions, and each region has its own specialties. The state should set an overall strategy and guidelines, but it should play a support and guidance role. Instead, regions should take the lead in development efforts and focus on their own area of specialization.
- Provide incentives to encourage regional partnerships that would help avoid each region acting independently and potentially competing with other regions for limited resources. The state should offer incentives (regional development action grants) to drive regional strategy, set best practices, and help grow the recommended five- or six-digit NAICS industries. (The state focuses on the four-digit NAICS level.) Regional strategies must align with the state, which, in turn, should support regional expertise.
- Hire industry experts or have people who really know the “guts” of this industry (issues, supply chain, critical location factors, etc.) for the regions in which clinical medicine is a driver. These experts would proactively call on companies within the industry, serve as a central point of contact, and focus on the region’s specialties.
- Build a task force that would include the industry expert and key industry players to understand more deeply Ohio’s specific strengths, weaknesses, opportunities, and threats and to develop specific economic development strategies.

Summary

The clinical medicine industry is critical to Ohio’s economy. In addition to its direct contribution, the industry’s multiplier effect is large. There is an opportunity to build a bioscience, technology, and product cluster of companies and industries that draw on Ohio’s research and clinical strengths to develop and commercialize products and supporting technologies. The state can help this industry by facilitating connections between companies and research institutions; building innovation resources and linking them to companies that commercialize ideas; and improving speed, transparency, and packaging of incentive packages. Because the medical industry is a driver in several regions of the state, ODOD should develop regional partnerships that help align state and regional strategies.

Ohio’s Value Proposition

- Industry clustering, particularly in Northeast Ohio

- A web of related industries
- Ohio's history of pragmatic innovation
- Availability of resources to support R&D

LOGISTICS, WAREHOUSING, AND DISTRIBUTION

Overview of the Industry in Ohio

Location is an extremely important factor for distribution and warehousing providers because it can make or break a company where the primary objective is to meet customers' demands to ship products correctly and on time. Ohio offers numerous resources to help businesses succeed in today's intensely competitive marketplace. The state is strategically located in the nation's industrial heartland, within 500 miles of half the U.S. population and within a day's drive of many major markets. Additionally, Ohio provides convenient access to domestic and global markets via its multimodal transportation network. The region is one of the country's leading trucking centers, with an efficient highway system that includes several major interstates and the Ohio Turnpike. Shipping by rail is a viable and attractive option, with hundreds of miles of track operated by three Class 1 railroads and several regional railroads. Lake Erie ports and inland ports along the Ohio River provide low-cost water transportation options, and several major commercial airports connect Ohio passengers and freight to the global marketplace. Ohio's logistical strengths have resulted in the extensive growth of many successful trucking firms and third-party logistics (3PL) providers that facilitate the region's quick movement of goods to national and international markets.

Ohio is home to a widely recognized operations and logistics management major in the MBA program at the Ohio State University. OSU also contains two research groups: The Supply Chain Research Group, which is collaborating with world-class firms on the evolving standards of practice in this area, and the Center for Excellence in Manufacturing Management, which works with sponsoring companies on issues pertaining to research and education in manufacturing. Logistics is the glue that binds these two research areas together.

Role of the Industry in Ohio's Economy

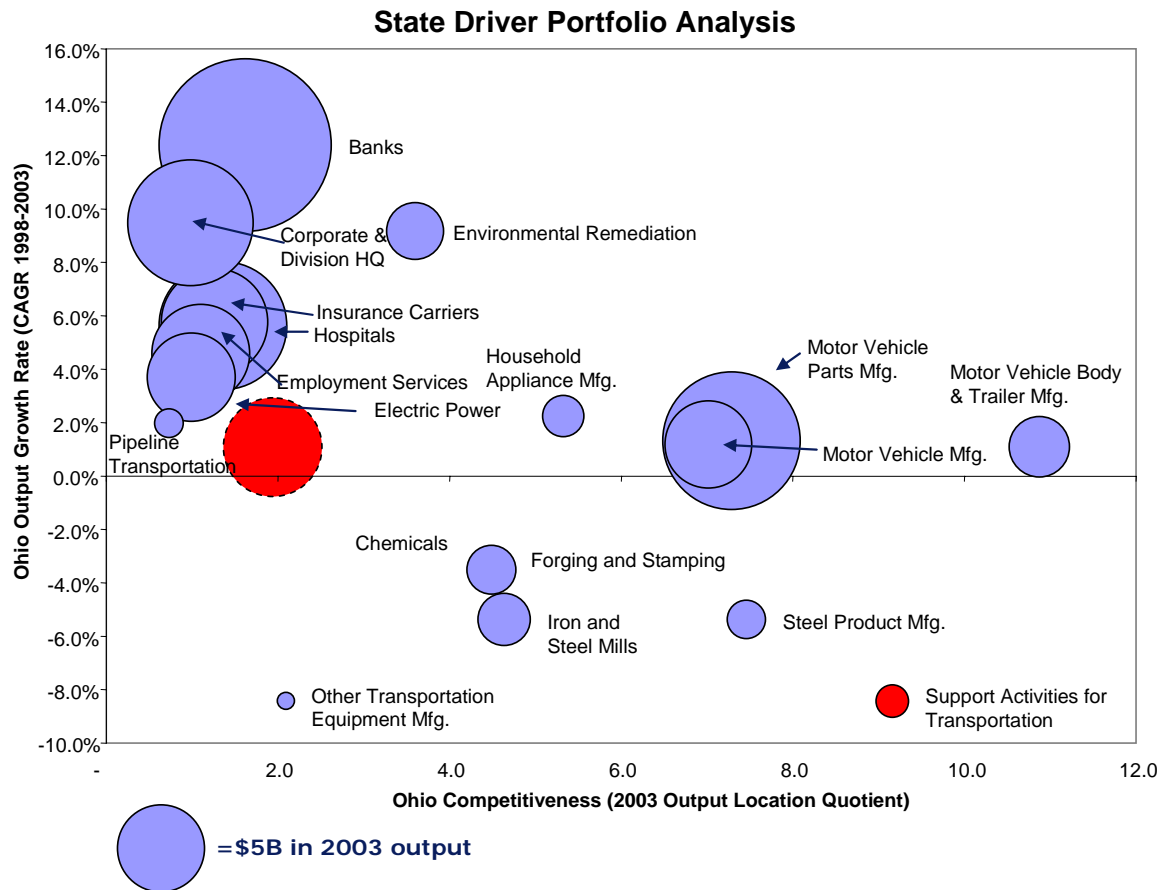
Logistics, distribution, and warehousing have significant impact in Ohio, directly contributing nearly \$6.5 billion to the state's economy. One industry was a statewide driver; three others were identified as drivers in the Northeast, Northwest, and Central regions. As shown in the following table, output and employment growth rates vary by industry segments. Output is growing for every segment except other support activities for transportation. Employment is declining in every segment except warehousing and storage. Ohio's logistics, distribution, and warehousing industry is competitive, with output location quotients of 1.5 for the three segments that were regional drivers and 9.2 for state-level driver other support activities for transportation.

Economic Overview of Logistics, Distribution and Warehousing in Ohio

NAICS	Industry	2003 Output (\$MM) in 1996 Dollars	1998-2003 Output CAGR	1993-2003 Output CAGR	2003 Output Location Quotient (LQ)	2003 Employment	1998-2003 Employment CAGR
Distribution, Warehousing, and Logistics		\$ 6,479					
4841	General Freight Trucking	\$3,327	0.8%	4.1%	1.5	45,200	-0.2%
4931	Warehousing and Storage	\$1,709	8.3%	11.0%	1.5	22,140	1.3%
4885	Freight Transportation Arrangement	\$735	3.3%	7.4%	1.5	7,080	-2.6%
4889	Other Support Activities for Transportation	\$708	-8.4%	-3.5%	9.2	5,500	-6.9%

Source: Economy.com

The following chart shows where logistics, distribution, and warehousing fits in the economic portfolio of Ohio's driver industries. Support activities for transportation, the statewide driver, falls into the lower-left section of the chart. Its very high output location quotient indicates that it is an established driver, but its low growth rate indicates that the industry has struggled in recent years. The red bubble on the left-hand side of the chart represents the combined state and regional driver industries in the logistics, distribution, and warehousing sector. Its location quotient is moderately high and growth rate is modest, indicating that there is an opportunity to grow this industry further in Ohio and increase the state's competitiveness.



Source: Economy.com, CSU/Deloitte analysis

The data presented here do not capture the full economic impact of the logistics, distribution, and warehousing industry in Ohio. This industry is actually a business function within the supply chain of virtually every industry in the state. All manufacturers need to ship and store their raw materials and finished products. Ohio's prominence in retail stores and consumer goods also plays a part: Products must be shipped to stores and consumers, and Ohio's central location means that goods can reach Eastern and Midwestern population centers quickly.

Multipliers for the Logistics, Distribution, and Warehousing Industry

NAICS	Industry Name	Multiplier		Rank
		Direct & Indirect	Direct, Indirect & Induced	
4841	General Freight Trucking	1.49	1.89	76
4885	Freight Transportation Arrangement	1.36	1.73	125
4889	Other Support Activities for Transportation	1.36	1.73	126
4521	Department Stores	1.22	1.55	220
4931	Warehousing and Storage	1.10	1.40	256

Source: IMPLAN Input-Output Model, April 2005; CSU/Deloitte Analysis

Note: Ranked by total multiplier out of 271 industries.

The logistics, distribution, and warehousing industry has surprisingly high multipliers when its statewide presence is considered. The multipliers are generated by the supply chains – the truck drivers, loaders, and companies tied to the distribution centers through the products they ship. Not to be ignored are those employed in the distribution centers of the airfreight component of this industry, which has major facilities in the Northwest, Central, and Southwest portions of Ohio. General freight trucking, forwarding, and related activities have the 76th–highest multiplier in the state’s economy, out of 271 four-digit NAICS industries, adding 89 cents’ worth of purchases within the state’s borders for every dollar of direct export expenditure. Distribution centers and department stores each drive between 40 cents and 55 cents of additional purchases.

The cluster analysis indicates that many of the industries in the supplier and customer chains for this industry are also located in Ohio. Proximity to suppliers and customers is a location investment consideration for this industry, and Ohio’s industry is positioned well.

Supply chain industries for logistics, distribution, and warehousing include:

- Truck transportation
- Automotive repair and maintenance
- Merchant wholesalers, durable goods
- Petroleum and coal products manufacturing
- Scenic and sightseeing transportation
- Other support activities for transportation
- Insurance carriers
- Motor vehicle parts manufacturing
- Oil and gas extraction
- Real estate, rental, and Leasing
- Legal services
- Computer systems design and related services
- Architectural, engineering, and related services
- Electric power generation, transmission, and distribution

The quantitative growth opportunity analysis identified Ohio’s computer systems design and related services as an emerging industry supplying the logistics, distribution, and warehousing industry. This is an area in which Ohio can capture some of the more logistics-oriented opportunity in the future, as companies turn to technology to help optimize fleets and routes and improve efficiency for inventory planning and tracking.

Industry Location/Investment Factors

Two of the most important location criteria for the distribution and warehousing industry are proximity to major markets and access to transportation. As mentioned earlier, Ohio has strength in both of these factors. Because the industry is fairly labor-intensive, labor rates and union penetration are also important considerations. A general perception that Ohio has high union activity and high wages may be a negative factor in investment decisions. Tax abatements are another important consideration, especially for companies planning to build a large facility. Ohio's tangible personal property tax may be a negative factor for companies considering a major facility although many companies would obtain free-trade zone designation to avoid the tax.

The following table lists some typical critical location factors, and their associated weights, specifically for logistics, distribution, and warehousing functions. The weights attributed to the factors are somewhat subjective, and may vary based on the particular company, their operating constraints, and their operating preferences.

<i>Factor</i>	<i>Weight</i>	<i>Preferences</i>
<i>Labor Quality & Availability</i>	High	<ul style="list-style-type: none">• General availability of distribution and light manufacturing skills• Low union presence or low incidence of union activity• Precedence for successful distribution operations (some industry concentration)• Educational attainment: high school degrees and technical school availability with specialized supply chain and distribution programs• Strong community growth with moderate unemployment to allow for scalability and avoid competitive pressures
<i>Real Estate</i>	Moderate	<ul style="list-style-type: none">• Availability of land, prepared sites, and sufficient speculative space (appropriate clear heights, dock layout, etc.)• Immediate access to four-lane quality highway to allow for ingress & egress• Access to utility infrastructure and ease of permitting process
<i>Access/ Infrastructure</i>	High	<ul style="list-style-type: none">• Access to markets and customers – Ohio's position in the network• Overall highway, port, and air cargo access
<i>Costs</i>	High	<ul style="list-style-type: none">• Low unskilled labor costs• Low utility costs• Low land and construction costs• Optimized freight costs
<i>Quality of Life</i>	Low to Moderate	<ul style="list-style-type: none">• Reasonable quality of life to retain and attract talent
<i>Business Climate & Regulatory Issues</i>	Low to Moderate	<ul style="list-style-type: none">• Corporate and product taxation (burden and transparency)• Labor regulations• Economic development community aggressiveness and familiarity with industry forces

Incentives of potential value for this industry include:

- Training
- Tax (income, sales & use, property)
- Site preparation, construction
- Discretionary grants

Current Industry Trends and Key Issues

Globalization is having a major impact on logistics, warehousing, and distribution. Increasing globalization of industries and their supply chains is adding logistics complexity to distribution and warehousing, as components or products are shipped among multiple companies and countries.

The increased pace of global trade, coupled with the outsourcing of manufacturing around the world, has transformed delivery into a multifaceted planning and engineering task. Growing use of technology to meet the demands of this complex global environment has increased the demand for personnel with technical skills in the U.S. logistics industry.

A major technology application the industry is considering adopting is radio frequency identification (RFID) systems to track inventory as it flows through the supply chain. Mainstream adoption of RFID may add cost because it requires the application of computer chip tags to inventory and implementation of tracking software systems. However, RFID has the potential to improve efficiency over the next several years, lowering the overall cost of production. When RFID will be widely adopted mainstream is not yet known.

The new hours-of-service regulations, aimed at decreasing driver fatigue, and post-9/11 security regulations are expected to be costly for companies to comply with.

Substitution can affect specific modes of transportation in the distribution industry. Although using rail on one leg of an intermodal shipment may lower costs, consistent delays affect just-in-time delivery systems. Such delays might lead shippers to other means of transportation if problems continue. For the seventh time in eight years, annual intermodal volume for U.S. railroads hit a new record, rising 6.9% in 2003, but various indicators indicate that railroads are not keeping pace due to growth in freight shipments, lack of equipment, disruptions (e.g., wildfires in Southern California in late 2003), and crew shortages.

Emerging/Growth Opportunities and Areas of Investment

The logistics industry is benefiting as its customer companies outsource their logistics functions. Because these functions are being outsourced, the fields of third-party and fourth-party logistics are growing and provide an opportunity for logistics companies in Ohio to leverage their expertise to provide services to a growing market.

- Companies are outsourcing noncore logistics competencies to third-party logistics providers (3PLs) that offer transportation, warehousing, logistics technology, and order management services. The 3PLs tend to locate in areas that allow them to optimize services to their customers.
- Fourth-party logistics (4PLs) providers are “supply chain integrators”: They assemble and manage the resources, capabilities, and technology of their own organization with those of other service providers to deliver a comprehensive supply chain solution to their customers. The 4PLs manage and direct the activities of multiple 3PLs, and serve as integrators.

Globalization of distribution and supply chains is a continuing force in this industry. Companies are making investments globally, and manufacturers need to be able to track raw materials, components, and finished goods that travel between countries.

Technology is another area of investment within the distribution and warehousing industry. Technology tools help improve efficiency, identify ways to better serve customers, and simplify complex logistics tasks. Specific technologies and applications in which companies in this industry are investing include:

- Sales and operations planning
- New procurement tools, such as electronic data interchanges (EDIs), that link companies to their suppliers via proprietary computer networks
- Transportation and warehouse management systems
- Sophisticated shipment tracking systems
- Inventory management
- GPS systems to track the location, content, and status of trucks, railcars, and shipping containers
- Intermodal freight planning applications, which allow companies to select optimal freight routes and intermodal transport services via the Internet
- Customer relationship management (CRM), which helps wholesalers, manufacturers, and retailers recognize and value customers' specific needs and tailor offers to them
- Enterprise resource planning (ERP) systems
- Client billing systems
- Global synchronization of vendors, customers, and suppliers
- RFID:
 - Smart container technologies that automatically detect intrusions and recognize hazardous materials through the use of security seals
 - Applications for inventory management and distribution, providing hands-off processing to improve order fill rates and accuracy, offer detailed and accurate visibility of inventory, and create significant handling efficiencies
 - Autosensing solutions consulting, implementation, and managed services

Competitiveness Assessment of Ohio's Distribution and Warehousing Industry

Through the competitiveness analysis and benchmarking, the study team identified some of Ohio's strengths and weaknesses related to the logistics, distribution, and warehousing industry.

Key strengths include Ohio's central location, its transportation infrastructure and ease of access, its proximity and access to customers and suppliers, and its quality of labor. Weaknesses include a perception of high union presence (especially in Northern Ohio), high labor costs, and high taxes. Ohio's airports received mixed reviews from perception and site selector survey respondents, possibly because they vary by MSA or region.

The study team benchmarked the distribution industry by modeling high-level cost and operating conditions to understand how Ohio's MSAs compare to other regional and national MSAs with a significant warehousing and distribution presence.

Compared to regional competitors, Cincinnati and Columbus score particularly well with respect to operating conditions although base costs may be moderate to high.

This evaluation does not take into account the importance of Ohio in the context of a company's overall distribution network. Based on a recent study of population centroids, Ohio is particularly strong when a company's overall distribution network consists of six or more distribution centers. The particular configuration of distribution centers that a

company invests in depends on the type of product being shipped and the required level of service, but six or more distribution centers in a network is fairly common. If Ohio can develop other operational efficiencies, such as lower-cost labor, that offset freight penalties, the state may become a more viable candidate for other network configurations. Ohio is particularly strong when a company wants to include two distribution centers across the East North Central Census Region states in its network.

Future modifications to Ohio's tax code may strengthen the state's overall position with respect to distribution.

Ohio's Key Strengths

- Central location
- Proximity to customers and markets
- Access to major highways and transportation corridors
- Quality of labor
- Established industry presence and expertise, especially serving the retail, auto, and consumer packaged goods industries
- Moderate to high quality of life
- Moderate to high educational attainment
- Low incidence of union activity compared to proxy regional competitors
- Strong population growth (Columbus)
- Industry depth (Columbus)

Ohio's Key Weaknesses

- Perception of union environment and high-cost labor (especially in Northern Ohio)
- Taxes, especially tangible personal property tax
- Higher cost of living (with the exception of Columbus)
- Moderate to high overall operating costs
- Low population growth (with the exception of Columbus)

Options to Improve Competitiveness

Ohio already has an established presence in logistics, distribution, and warehousing and can further build the industry by attracting new investments by promoting the state's central location and its strong transportation infrastructure as selling points. Further industry development could come from leveraging the state's current distribution and warehousing expertise and its emerging strength in computer systems design and related services to drive such growth areas as 3PL and 4PL services, RFID software development, and logistics applications.

This study has identified specific recommendations for how the state can support the logistics, distribution, and warehousing industry:

- Leverage Ohio's industry expertise by encouraging development of ancillary services, such as RFID consulting and 3PL providers.
- Invest in specialty degrees, such as computer science at the university level and logistics specialists at community colleges, and encourage focused internships at Ohio colleges and universities to make more available knowledge workers with a connection to the logistics industry

- Encourage innovation by offering tax credits or helping small and midsized warehousing, distribution, and logistics companies access capital and resources for technology purchases, implementation, and training.
- Position Ohio as an attractive location for a facility or headquarters using its central location and strong transportation infrastructure and network as a selling points.
- Target a balanced mix of business types within the warehousing and distribution industry. Try not to rely on any one transportation industry (e.g., rail) to spread risk.

Implementation Strategies

To best serve the logistics, distribution, and warehousing industry and implement specific recommendations, the study team recommends the following actions:

- Take a more regional approach to implementing economic development strategies. The state should set overall strategy and guidelines but then play a support and guidance role. Each region, particularly the Northeast, Northwest and Central areas where the industry is a driver, should take the lead in implementing strategies, focusing on its own specific needs and development opportunities.
- Provide incentives to encourage regional partnerships that would help avoid each region acting independently and potentially competing with other regions for limited resources. The state should offer incentives (regional development action grants) to drive regional strategy, set best practices, and help grow the recommended five- or six-digit NAICS industries. (The state focuses on the four-digit NAICS level.) Regional strategies must align with the state, which, in turn, should support regional expertise.
- Hire industry experts or have people who really know the “guts” of this industry (issues, supply chain, critical location factors, etc.) for the regions in which logistics, distribution, and warehousing is a driver. These experts would proactively call on companies within the industry, serve as a central point of contact, and focus on the region’s specialties.
- Build a task force that would include the industry expert and key industry players to understand more deeply Ohio’s specific strengths, weaknesses, opportunities, and threats and to develop specific economic development strategies.
- Build a task force to evaluate Ohio’s potential in developing a world-class cluster of expertise in such areas as 3PL and 4PL services, RFID software development, and logistics applications.

Summary

The logistics, distribution, and warehousing industry is critical to Ohio’s economy. In addition to its direct contribution to Ohio’s economy, the industry’s multiplier effect is very large. There is an opportunity to broaden Ohio’s strengths to build out a cluster of companies and industries that use industry expertise to develop additional services or technology tools. The state can help this industry by encouraging technology investment and innovation in service offerings and by marketing Ohio as an ideal location for industry investment. Because the logistics, distribution, and warehousing is a driver in different regions of the state, ODOD should develop regional partnerships that help align state and regional strategies.

Ohio's Value Proposition

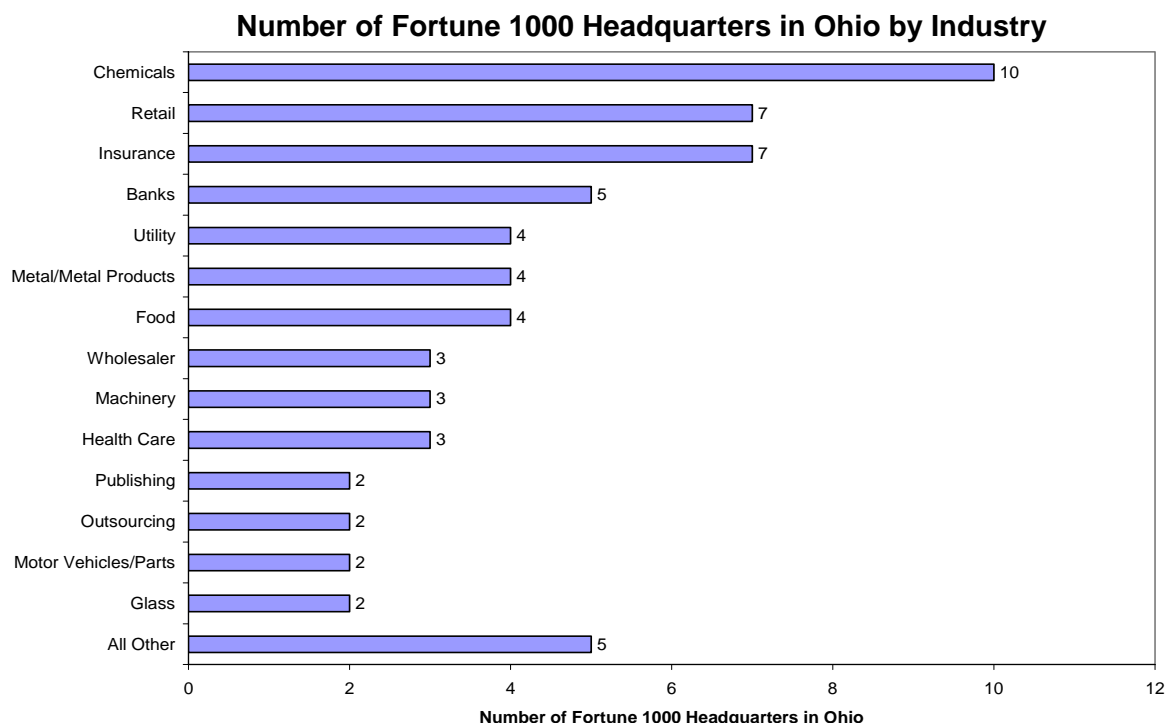
- Ohio's central location and world-class transportation network
- Center of excellence in Columbus, rising from the intersection of several key functions (headquarters, distribution centers, etc.) and facets of the industry, as well as a top-notch educational institution

CORPORATE AND DIVISION HEADQUARTERS, BACK-OFFICE, AND ADMINISTRATIVE FUNCTIONS

Overview of the Industry in Ohio

Ohio is a headquarters state, particularly rich in the number of divisional and regional offices. Although there has been publicity around high-profile headquarters losses in recent years, Ohio's strength in corporate and divisional headquarters operations continues. In its 2004 annual ranking of largest public corporations in America, the Fortune 1000 list included 64 Ohio companies, led by Cardinal Health, Kroger, Procter & Gamble, Nationwide Insurance, American Electric Power, and Goodyear Tire & Rubber. Ohio ranked fifth in the nation for number of headquarters in Fortune's top 500 list.

A review of the Fortune list indicates that many of the headquarters reflect Ohio's strengths; most of these companies represent industries that this study has identified as economic drivers in the state and regions.



Source: Fortune 1000, Deloitte/CSU Analysis

Role of the Industry in Ohio's Economy

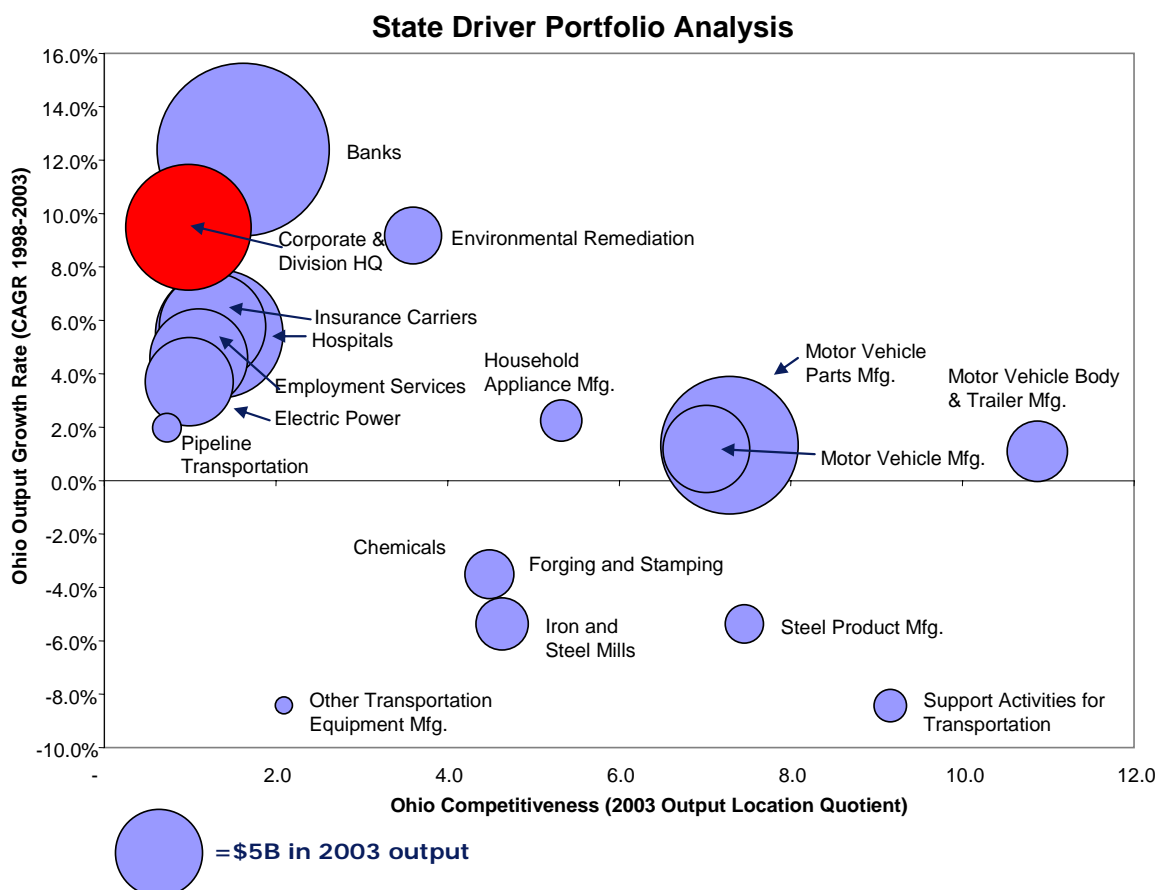
The headquarters and division offices business function has significant impact in Ohio, directly contributing \$10.4 billion to the state's economy. As shown in the following table, employment has grown at an average annual rate of 2.6% since 1998, and output has grown by 9.5% yearly. Ohio's headquarters and division offices business function is competitive, with a modest output location quotient of 1.0. This industry is a driver for five of Ohio's six regions and is an emerging driver in West Central.

Economic Overview of the Headquarters Industry in Ohio

NAICS	Industry	2003 Output (\$MM) in 1996 Dollars	1998-2003 Output CAGR	1993-2003 Output CAGR	2003 Output Location Quotient (LQ)	2003 Employment	1998-2003 Employment CAGR
5511	Headquarters and Division Offices	\$10,411	9.5%	9.4%	1.0	87,800	2.6%

Source: Economy.com

The following chart shows where corporate and division headquarters fit in the economic portfolio of Ohio's driver industries. The headquarters industry's modest output location quotient and strong output growth rate place it in the upper left section of the portfolio figure, indicating that the industry is an important growth opportunity base on which Ohio can build. This industry is growing nationally. Ohio simply capturing its "fair share" of national industry growth will benefit the state.



Source: Economy.com, CSU/Deloitte analysis

The data do not capture the full economic impact of this industry on the state. The headquarters industry encompasses virtually all companies: Every company, no matter its size and no matter its business, has a primary command and control center. In addition, a number of administrative business functions usually take place in headquarters or regional offices. In recent years, many companies have begun outsourcing these functions. Data for this study indicate that office administrative services and computer systems design, both of which are closely related to this industry, are growth opportunities for Ohio.

Multipliers for Headquarters, Back Office, and Shared Services

NAICS	Industry Name	Multiplier		Rank
		Direct & Indirect	Direct, Indirect & Induced	
5611	Office Administrative Services	1.50	1.91	72
5615	Travel Arrangement and Reservation Services	1.43	1.82	98
5619	Other Support Services	1.35	1.71	128
5414	Specialized Design Services	1.31	1.66	146
5419	Other Professional, Scientific, and Technical Services	1.25	1.59	174
5612	Facilities Support Services	1.18	1.50	232
5418	Advertising and Related Services	1.16	1.47	240
5413	Architectural, Engineering, and Related Services	1.15	1.46	241
5411	Legal Services	1.13	1.44	247
5511	Headquarters and Division Offices (Management of Companies)	1.13	1.43	248
5614	Business Support Services	1.13	1.43	249
5416	Management, Scientific, and Technical Consulting Services	1.09	1.39	258
5415	Computer Systems Design and Related Services	1.08	1.38	261
5412	Accounting, Tax Preparation, Bookkeeping, and Payroll Services	1.07	1.35	264
5613	Employment Services	1.05	1.34	267
5417	Scientific Research and Development Services	1.03	1.31	268

Source: IMPLAN Input-Output Model, April 2005; CSU/Deloitte Analysis

Note: Ranked by total multiplier out of 271 industries.

The headquarters and division offices business function was identified as a driver of Ohio's economy. (This is the four-digit NAICS industry 5511 Management of Companies and Enterprises). The multiplier table includes a much longer list of industries than just the headquarters function. It includes the driver industry, its supply chain, and industries identified as growth opportunities, which are discussed later in this report. The total multiplier in the headquarters business function is relatively low at 1.43, and its impact is mainly through the spending of employees. This is not a surprise because of the labor-intensive nature of production. However, the location of corporate and divisional headquarters can support a raft of industries that were identified as growth opportunities in Ohio. These include a number of shared-service or back-office business functions, such as office administrative services (1.91), other support services (1.71), and accounting and payroll services (1.35). Other professional, scientific, and technical services, with a total multiplier of 1.59, and legal services (1.44) are supported by orders that flow out of headquarters operations. Additionally, industries that can revitalize a company's set of products also revolve around headquarters operations; these include specialized design services (1.66), computer systems design (1.38), and scientific research and development (1.31).

The supply chain for headquarters typically involves high-level business services, as reflected in the results of the quantitative cluster analysis. The cluster analysis indicates that many of the services industries that are part of the headquarters supply chain are also located in Ohio.

The headquarters industry supply chain includes:

- Real estate, rental, and leasing
- Advertising and related services
- Legal services

Industry Location/Investment Factors

Headquarters typically employ white-collar managerial workers up through executive levels. Availability of such workers, real estate availability and cost, cost of doing

business, and access to supporting business services such as legal, financial, and advertising, are all important considerations when making a headquarters location decision. Because headquarters functions often control operations in other locations, communications and transportation infrastructures are also critical. Air transportation is a specific need, with access to jet service and private air transportation both important to executives. For many industries, proximity to customers or suppliers is an important consideration.

Because headquarters decisions are typically made by executives who will be working at the chosen location, lifestyle considerations may often be as important as business ones. Cost of living and quality of life both play a role in headquarters decisions. Many of the expert panelists said their companies, small, medium, and large, were located in Ohio because owners wanted to be near family members.

Fortune 500 headquarters relocations are relatively rare. However, small businesses and division headquarters moves are more common. Headquarters decisions tend to favor major metropolitan centers, which often fit more of the aforementioned criteria. Economic and population growth may play into headquarters decisions, as does merger and acquisition activity, which forces newly combined companies to select the location from which they will primarily operate going forward.

The following table lists some typical critical location factors, and their associated weights, specifically for regional administrative offices, including headquarters. The weights attributed to these factors are somewhat subjective and may vary based on the particular company, its operating constraints, and its preferences.

Critical Location Factors: Regional Administrative Offices/Headquarters

<i>Factor</i>	<i>Weight</i>	<i>Preferences</i>
<i>Labor Quality & Availability</i>	High	<ul style="list-style-type: none"> • Professional talent, including senior management • Educational attainment: four-year degrees or advanced business degrees • Availability of local or regional educational institutions (undergraduate and advanced degrees) • Precedence for attracting and supporting regional or national headquarters
<i>Real Estate</i>	Low	<ul style="list-style-type: none"> • Typically a high degree of facility build-out, including executive offices and conference room areas • May prefer Central Business District location or Class A suburban setting • Requires proximity to amenities and perhaps public transportation
<i>Access/ Infrastructure</i>	High	<ul style="list-style-type: none"> • Air access to other key operations • Low climate risk • Low natural disaster risk

Costs	Moderate	<ul style="list-style-type: none"> • Moderate labor costs although many salaried workers will be on a “national” scale • Moderate real estate costs
Quality of Life	High	<ul style="list-style-type: none"> • High quality of life requirements to retain and attract managerial talent
Business Climate & Regulatory Issues	Low to Moderate	<ul style="list-style-type: none"> • Corporate taxation • Labor regulations • Economic development community aggressiveness • Community image and vibrancy

Incentives of potential value for regional administrative offices and headquarters include:

- Tax (income, property, other)
- Relocation assistance
- Discretionary grants

The following table lists some typical critical location factors, and their associated weights, specifically for back-office operations. The weights attributed to these factors are somewhat subjective and may vary based on the particular company, its operating constraints, and its preferences.

Critical Location Factors: Back-Office Operations

Factor	Weight	Preferences
Labor Quality & Availability	High	<ul style="list-style-type: none"> • Professionals with banking, insurance, and other shared-services skill-sets (i.e., accounting, finance, human resources) • Moderate need for management and executive personnel • Industry presence, including other back-office operations • Educational attainment: Generally two- or four-year degrees • Regional language and accent preferences • Strong community growth with moderate unemployment to allow for scalability and avoid competitive pressures
Real Estate	Low	<ul style="list-style-type: none"> • Typical open space requirements to house cubicles • Moderate to low need for designated offices and conference room areas • May prefer to locate in Class A or Class B suburban environments • Important considerations include fiber optics and utility redundancy • Proximity to amenities and perhaps public transportation
Access/ Infrastructure	Moderate	<ul style="list-style-type: none"> • Electricity and telecom are important, especially with respect to mission-critical operations • Customer-facing operations (internal or external) may require specific time-zone to meet required customer service levels • Low climate risk • Low natural disaster risk
Costs	High	<ul style="list-style-type: none"> • Low to moderate professional costs, without sacrificing talent availability • Low real estate rent and operating costs

<i>Factor</i>	<i>Weight</i>	<i>Preferences</i>
<i>Quality of Life</i>	Moderate	<ul style="list-style-type: none"> • Moderate quality of life requirements to retain and attract managerial talent
<i>Business Climate & Regulatory Issues</i>	Low to Moderate	<ul style="list-style-type: none"> • Corporate taxation • Labor regulations • Economic development community aggressiveness and familiarity with industry forces

Incentives of potential value for back-office operations include:

- Training
- Tax (income, property)
- Discretionary grants
- Relocation assistance

Current Industry Trends and Key Issues

- Fortune 500 headquarters moves are rare. Division headquarters or small business startups are more common and are the more likely area of opportunity for Ohio, in addition to expansion of headquarters currently in the state.
- Outsourcing of administrative and back-office functions is increasing.
- Many companies are increasingly using technology to automate administrative and back-office functions.

Emerging/Growth Opportunities and Areas of Investment

- North American headquarters of foreign-owned companies (leverage existing networks within Ohio)
- Headquarters of newly established companies
- Through M&A activity, headquarters and other office functions will consolidate to reduce or eliminate redundancies
- Although many back-office functions may move offshore, some highly regulated operations will need to stay behind.
- Other companies may not be able to afford moving activities offshore because of associated costs or risks.

Competitiveness Assessment of Ohio's Headquarters Industry

Through perception and site selectors' surveys, competitiveness analysis, and benchmarking, the study team has identified some of Ohio's strengths and weaknesses related to the headquarters and administrative offices industry.

The perception and site selectors' surveys indicated a number of positive attributes for Ohio. Key strengths for Ohio are quality of labor, accessibility to major transportation corridors, access to markets and suppliers, communication infrastructure, and quality of life. Factors perceived as weaknesses are labor costs, access to multilingual labor, utilities, climate, state incentives, and taxes.

Perception ratings were mixed for airports, real estate, and municipal incentives, which are factors that vary significantly by MSA within Ohio.

The study team benchmarked the regional administrative offices and headquarters function by modeling high-level cost and operating condition indicators to understand how Ohio MSAs compare to other regional and national MSAs with significant headquarters presence.

Fast-growing cities in the South, such as Charlotte and Tampa, and larger metropolitan areas, such as Chicago, will continue to offer attractive operating conditions for major headquarters projects although cost is a tradeoff for some locations (i.e., Chicago). Ohio locations offer many of the operating conditions necessary to compete regionally and, overall, are considered moderate cost locations among the benchmarked metropolitan areas. Three Ohio locations (Cleveland, Columbus, and Cincinnati) appear to offer similar cost and operating conditions. Akron scored lower based on overall operating conditions although it maintains a relatively low cost structure.

For the back-office benchmarking analysis, the study team evaluated back-office functions for the insurance and banking industries.

Nationally competitive locations such as Denver and Phoenix continue to offer strong operating environments for financial service-related back-office operations. However, such areas tend to have higher costs than other benchmarked metropolitan areas. Ohio locations are moderate cost and are regionally competitive when compared to such locations as Indianapolis and Pittsburgh. All three Ohio locations benchmarked (Cincinnati, Cleveland, and Columbus) appear to offer similar cost and operating conditions.

Ohio's Key Strengths

- Many small to midsized MSAs, all with unique attributes
- Metropolitan areas, such as Cleveland and Toledo, that contain significant cultural institutions
- Central location
- Quality of labor
- Moderate operating costs
- Accessibility to major transportation corridors
- Access to markets and suppliers
- Communication infrastructure
- Accessibility of business services (financial, legal)
- Quality of life
- Presence of Fortune 1000 companies (with the exception of Akron)
- Strong air access (Cincinnati)
- Industry presence (especially strong in insurance and banking back offices)
- Moderate to high educational attainment

Ohio's Key Weaknesses

- Perceived high labor costs
- Low population growth (with the exception of Columbus)
- Moderate executive labor availability
- Low to moderately ranked air access (with the exception of Cincinnati)
- Moderate to higher cost of living (with the exception of Akron)
- Low population growth (with the exception of Columbus)

- Perception that Ohio lacks multilingual labor, especially Spanish-speaking
- Utility costs
- Climate
- Overall perception of state incentives and taxes

Options to Improve Competitiveness

Ohio already has an established presence of headquarters and division offices. Headquarters are an attractive component of the state's overall economy because of their high wages, high multiplier effect, and their association with other business functions that might be located nearby. Ohio could drive economic growth by attracting new investments using the state's strong labor force, transportation network, and good quality of life as selling points. The state could also encourage economic development by leveraging emerging strengths in administrative and computer services to build a cluster of industries around headquarters. Because high-profile, large corporate moves are rare, Ohio should focus on attracting smaller headquarters or regional offices and U.S. divisions of foreign companies. Ohio should also focus on retaining current headquarters and positioning the state as an attractive location for the headquarters of companies that have undergone transitions as part of merger and acquisition activity. Finally, the state should encourage and support entrepreneurial businesses because many of Ohio's largest corporations are "homegrown," which is a dominant retention factor.

This study has identified specific recommendations for how the state can support the headquarters industry:

- Help international companies with U.S. market-entry strategies (sales and marketing offices or establishment of North American headquarters)
- Provide small business development programs
- Encourage policy that keeps cost of living low and quality of life high

FOOD PROCESSING & MANUFACTURING AND AGRICULTURE VALUE-ADDED PRODUCTS

Overview of the Industry in Ohio

Ohio's strong agricultural heritage and central location make it an ideal location for food processing and manufacturing. Although food processing and manufacturing is the industry sector identified as an economic driver, Ohio establishments represent the entire supply chain for the food industry, from farm to the consumer's kitchen table or restaurant.

Ohio is home to major food company headquarters, such as Chiquita Brands and J.M. Smucker. It is also home to a number of regional headquarters and processing plants, including Nestle in Solon, Campbell Soup in Napoleon, and Consolidated Biscuit in McComb. Other notable food-related establishments in Ohio include Kroger's headquarters and manufacturing facilities, Procter & Gamble's food and beverage division, and Wendy's and Bob Evans' headquarters.

Role of the Industry in Ohio's Economy

Food manufacturing has a significant impact on Ohio. The six industries in the agriculture sector that were identified as economic drivers contribute \$5.9 billion to the state's economy, as shown in the following table. Three of the driver industries showed modest declines in employment between 1998 and 2003, and three showed modest employment increases. Over the same period, output for five of the six driver industries increased. Only grain and oilseed milling showed a small output decline. Output growth in conjunction with employment declines indicates that these industry segments have experienced productivity gains. Ohio's food industry is competitive, with output location quotients ranging from 1.4 to 2.9.

Although food processing and manufacturing is not a state driver, segments of the industry are drivers for five of Ohio's six regions. Northeast is the only region for which the economic data did not identify food processing as a driver. Industry growth rates and location quotients vary by region.

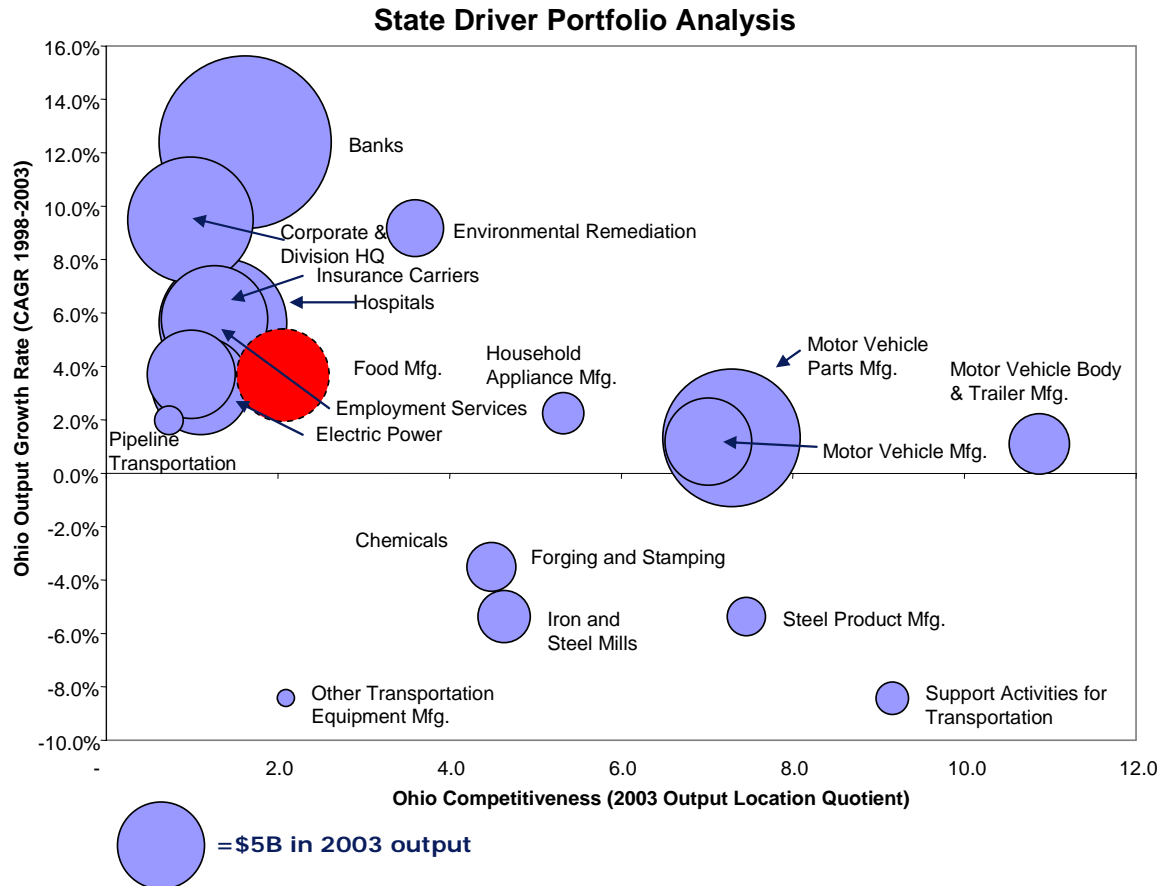
Economic Overview of the Food Industry in Ohio

NAICS	Industry	2003 Output (\$MM) in 1996 Dollars	1998-2003 Output CAGR	1993-2003 Output CAGR	2003 Output Location Quotient (LQ)	2003 Employment	1998-2003 Employment CAGR
Food		\$ 5,926					
3114	Fruit and Vegetable Preserving and Specialty Food Mfg.	\$ 1,444	4.3%	4.4%	2.9	11,740	1.1%
3118	Bakeries and Tortilla Manufacturing	\$ 1,451	4.7%	4.2%	1.8	12,470	-0.7%
3115	Dairy Product Manufacturing	\$ 1,042	3.1%	2.5%	2.4	8,250	0.3%
3121	Beverage Manufacturing	\$ 1,031	6.2%	6.0%	1.4	6,790	-1.0%
3111	Animal Food Manufacturing	\$ 480	4.2%	5.7%	2.9	2,800	1.1%
3112	Grain and Oilseed Milling	\$ 478	-0.1%	2.5%	2.1	2,880	-3.3%

Source: Economy.com

The following chart shows where the food industry fits in the economic portfolio of Ohio's driver industries. The red "bubble" on the left-hand side of the chart represents the

combined regional driver industries in the food sector. The food industry's location quotient is moderately high, and its growth rate is has averaged about 4% between 1998 and 2003. This indicates that there is opportunity to grow this industry further in Ohio and increase the state's competitiveness.



Source: Economy.com, CSU/Deloitte analysis

The data presented here do not capture the food industry's full economic impact in Ohio. Many other large industries in the state are suppliers to and customers of the food processing industry. Large portions of Ohio are dedicated to agriculture, which directly supplies the food processing industry. Supplying agriculture, as well as processing agricultural products, is especially important to the economic base of the Central and Northwestern portions of the state. Customers of the food processing industry, including wholesalers, retailers such as Kroger, and food service companies, also play an important role in Ohio's economy.

Multipliers for Food Industries

NAICS	Industry Name	Multiplier		Rank
		Direct & Indirect	Direct, Indirect & Induced	
3112	Grain and Oilseed Milling	2.92	3.71	7
3115	Dairy Product Manufacturing	2.21	2.80	19
3111	Animal Food Manufacturing	2.08	2.64	20
3119	Other Food Manufacturing	1.90	2.41	24
3121	Beverage Manufacturing	1.75	2.22	33
3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing	1.71	2.17	39
FR	Farms	1.55	1.96	63
3118	Bakeries and Tortilla Manufacturing	1.54	1.96	64

Source: IMPLAN Input-Output Model, April 2005; CSU/Deloitte Analysis

Note: Ranked by total multiplier out of 271 industries.

Grain and oilseed milling has the highest multiplier for this industry in Ohio: Every dollar of direct export expenditure results in an additional \$2.71 in purchases within the state's borders. Dairy products follow, with a multiplier of 2.80, indicating both the size of the supply chain and the manufactured nature of the products derived from the dairy industry. Ohio's food products manufacturing is particularly strong in the production of food for animals, which has a multiplier of 2.64. The state also houses sizable industries that produce food for human consumption: beverages, fruit and vegetables preserving and specialty foods, and bakery products. These uses of food products do not reflect the innovative potential of bioengineered products, fuel, and plant-derived polymers.

The cluster analysis indicates that many of the industries in the supplier and customer chains for this industry are also located in Ohio. In addition to agriculture, other suppliers to food processors and manufacturers that are driver industries in Ohio include logistics, distribution, and warehousing; metal, glass and plastic container manufacturers; wholesalers; and business services such as real estate, administrative, and advertising. Customers located in Ohio include retailers, wholesalers, and food service organizations. From farm to consumer, Ohio contains the entire value chain for this industry.

Industries that supply food processors and manufacturers include:

- Farms
- Merchant wholesalers, durable goods
- Converted paper product manufacturing
- Boiler, tank, and shipping container manufacturing
- Lessors of nonfinancial intangible assets (except copyrighted works)
- Truck transportation
- Real estate, rental, and leasing
- Advertising and related services
- Management of companies and enterprises
- Plastics product manufacturing
- Pulp, paper, and paperboard mills
- Glass and glass product manufacturing
- Sugar and confectionery product manufacturing
- Warehousing and storage
- Printing and related support activities

Industries that buy from food processors and manufacturers include:

- General line grocery wholesalers
- Supermarkets and other grocery (except convenience) stores
- Convenience stores
- Community food services
- Food service contractors
- Mobile food services
- Animal production

Industry Location/Investment Factors

Food processors and manufacturers tend to locate near raw ingredients – that is, the farms that produce their ingredients or the mills and other initial processors that provide inputs.

Companies in this sector also locate near major customers or population centers. Because some food products, such as produce or dairy goods, are perishable, quick delivery is critical. Food products also are often heavy and take up a lot of space so shipping long distances can be costly, especially when considered against the products' modest prices.

Current Industry Trends and Key Issues

These are challenging times for food and beverage companies. In addition to the long-existing pressures of intense competition, rising ingredient prices, minimal pricing power, and low market growth prospects, the industry is being affected by the public's growing unease with certain operating practices and product offerings. Well-publicized concerns from social, governmental, and medical communities regarding obesity, food safety, portion size, and ingredients are prodding some companies to change the way they operate. Increased litigation and legislation are also playing into recent corporate decisions. On top of these pressures, industry participants must effectively manage their relationship with Wal-Mart. That company's determined search for lowest-price suppliers is legendary. Its radio frequency identification (RFID) mandate is revolutionizing numerous processes throughout the industry.

Slow market growth, intense competition from branded and private-label products, rising input costs, and increasingly stronger retail customer (Wal-Mart) power have created a challenging environment with shrinking profit margins for food companies.

Innovating and adding value are critical to this industry. Top-line growth and higher profits are essential to food manufacturing's future in Ohio. Because many products are commoditized, food companies must effectively develop products that meet changing consumer needs. Recent trends in consumer tastes and demographics include interest in eating healthier foods, a growing ethnic diversity, an aging population, and increasingly busy lifestyles with little or no time to cook.

Because revenue growth is low in the food industry, manufacturers are increasingly looking for cost savings to improve their profit. The overall supply chain (plan, source, make, and distribute) and associated costs represent the best opportunity for cost to reduction. Food companies are collaborating through their supply chains to improve performance.

Global expansion presents an opportunity for food companies. More than 80% of the world's population lives outside the United States, Canada, Europe, and Japan. Businesses are turning to fast-growing markets to increase revenue as sales remain relatively flat in the United States. Some food companies are establishing offices or manufacturing plants in China because the nation's huge population base offers potential for strong growth. China's increased purchases of raw materials have benefited U.S. agribusinesses. However, understanding cultural differences is important for product communications.

Increased public policy attention and legislative activity are being focused on the food industry. Some of the topics attracting legislators' attention include obesity, food safety, product ingredients and labeling, trade promotion spending and accounting, and corporate governance. Governments are enacting various complex regulations that are expensive for food manufacturers to comply with.

Technology is another trend influencing the food industry. Wal-Mart's RFID mandate that top suppliers include tracking chips on shipments means that many companies must adopt some level of the technology. Implementing RFID can be costly and complex for manufacturers, who are struggling with mastering the technology, synchronizing the data, and connecting to legacy computer information systems. However, RFID also offers opportunity to better manage production and inventory at all levels of the supply and customer chains.

Two aspects of the way the food distribution industry is organized have increased barriers for small to mid-sized operators to enter the food products industry. Consolidation among wholesalers and grocery stores has made it difficult to grow a brand gradually through a regional distribution strategy. Consolidation has also led to the widespread use of "slotting fees," where grocers charge suppliers for the privilege of stocking products in their stores.

Emerging/Growth Opportunities and Areas of Investment

To drive revenue growth, most food companies are investing in research and development in innovative new foods. Some categories that are growing and present opportunity for higher profit margins include:

- "Better for you" foods (low trans fat, organic)
- Convenience, ready-to-eat foods
- Food products targeted at ethnic or aging populations
- "Functional foods" that provide added nutrients or health benefits

Consolidation in the food industry continues. Many companies are exploring mergers and acquisitions to build manufacturing scale, increase their negotiating power, or add new product lines. For example, many larger food companies have recently acquired small natural or organic food businesses.

Another growth strategy has been to invest in global markets. For the food industry, this investment approach is motivated primarily by companies' desire to sell into new markets, not typically to take advantage of lower overseas production and labor costs. Perishability and high shipping costs make overseas production for shipment to the United States a fairly unattractive proposition for many food products.

Bioresearch in the food industry includes genetically modified seeds that are disease- or pest-resistant and genetic modifications that may produce tastier, healthier, or longer-lasting foods. Related to this is agricultural research that supports Ohio's chemicals industries, such as improved fertilizers and pesticides, alternatives to fossil fuels, and polymers that can be used in environmentally friendly packaging. Biotechnology genetics are another related field of research, and one recent Ohio investment even showed a creative use of food byproducts to produce energy.

The Wal-Mart mandate is driving investment in RFID technology. At a minimum, food processors wanting to stay in Wal-Mart's supply chain will have to buy RFID tags with computer chips to add to product cases or pallets after production. Full investment in RFID involves adapting manufacturing processes to add tags mechanically, acquiring software for inventory tracking, and incorporating RFID into companies' existing technology systems.

Ohio's Key Strengths

- Industry concentration and precedence for successful manufacturing
- Proximity to suppliers (especially agricultural)
- Proximity to customers (large population centers)
- Access to major highways and transportation networks
- Presence and quality of experienced, skilled labor
- Moderate labor and business costs
- Good quality of life
- Large agricultural research and development establishment
- Major test market for chain restaurants and retail food products because of the average demographic makeup of the state

Ohio's Key Weaknesses

- Industrywide struggles with growth and profitability
- Lack of an entrepreneurial business environment in the food industry

Options to Improve Competitiveness

The study has identified specific recommendations for how the state can support this industry:

- Build and support agriculture-based R&D and provide commercialization connections to help food companies improve their current products and develop new ones.
- Use Ohio's vast agricultural resources and its proximity to most U.S. population centers as a marketing point. Create incentives targeted toward drawing additional manufacturing, distribution and warehousing facilities to Ohio or encouraging headquarters or facilities of merged companies to locate in the state.
- Leverage Ohio's expertise in distribution and warehousing to build an RFID center of excellence, exporting RFID consulting and implementation services.
- Help support Ohio-based manufacturers that wish to expand outside the United States.
- Provide services to help small and mid-sized food companies with product development and process improvement services.

- Participate throughout the product development process, from identifying opportunities for products and markets to developing products and testing their performance with consumers.
- Identify and “incubate” new product ideas, especially value-added products (e.g., convenience) that will allow commoditized food categories to differentiate themselves and improve financial performance.
- Continue to identify process improvement and cost-savings ideas. Look beyond functional or single-process opportunities to enterprise opportunities to cut costs and optimize the total supply chain.
- Develop effective go-to-market strategies and sales processes.
- Provide incentives to larger processing companies for using more inputs (ingredients, capital equipment, etc.) from Ohio.
- Nurture and facilitate innovation, which has been and continues to be vital to the success of individual businesses and Ohio’s economy. State programs should be designed to help promote and sustain process improvement, new product development, business strategies, and operation philosophies.
 - Help companies find opportunities to expand their share of the product innovation value chain.
 - Align academic and applied technology resources.
 - Encourage economic policy to benefit startups that have a high likelihood of commercial application. Recognize that venture capitalists are interested in continuing productivity-enhancing investment.

Implementation Strategies

To best serve the food industry and implement specific recommendations, the study team recommends the following actions:

- Hire industry experts or have people who really know the “guts” of food processing and manufacturing (issues, supply chain, critical location factors, etc.) for the state or at least multiple regions. These experts would serve at the state and regional levels, supporting the industry across regions and proactively calling on companies within the industry.
- Build a task force that includes these industry experts and key industry players to understand more deeply Ohio’s specific strengths, weaknesses, opportunities, and threats and to develop specific economic development strategies.
- Create a statewide economic development approach and marketing message for the food manufacturing industry that can be tailored to each region’s area of specialization. It may also make sense to develop marketing messages tailored to specific customer industries. Marketing messages could leverage Ohio’s intellectual and R&D capabilities for business attraction.
- Provide incentives to encourage regional partnerships that would help avoid each region acting independently and potentially competing with other regions for limited resources. The state should offer incentives (regional development action grants) to drive regional strategy, set best practices, and help grow the recommended five- or six-digit NAICS industries. (The state focuses on the four-digit NAICS level.) Regional strategies must align with the state, which, in turn, should support regional expertise.

Summary

Food manufacturing and processing is critical to Ohio’s economy. In addition to its direct contribution, the industry’s multiplier effect is very large. The entire supply and customer

chain for the food industry is present in Ohio. Ohio's food industry is competitively strong, with significant presence and experience; proximity to raw materials; and fast, easy access to customers. However, the industry is facing challenging times, with slow demand growth and pricing pressures and increased barriers to entry. There are a number of opportunities to improve processes, innovate products, apply technology, and leverage agricultural R&D for use in food, chemicals, and health care. The state can help this industry by building innovation resources and linking them to companies that commercialize ideas, helping smaller companies with innovation and process improvements, and leveraging Ohio's strengths into new fields, such as RFID implementation services, logistics consulting, agriculture-based chemicals, and health care.

Ohio's Value Proposition

- Central location
- Moderate costs
- Complete supply chain
- Research potential in end-user products and links to polymers industry and clinical health care industry
- Ultimate test market

ENVIRONMENTAL TECHNOLOGY

Overview of the Industry in Ohio

A look at some of Ohio's largest companies in environmental technology reveals a long history and a broad scope of services. Fluor Fernald, a division of Fluor Corp., was awarded a U.S. Department of Energy (DOE) multiyear, multibillion dollar contract in 1992 to remediate a former nuclear weapons site in Ohio and environmental activities continue at the site. BWXT of Ohio is the remediation contractor for the Miamisburg Environmental Management Project at the DOE Mound site. BWXT's Nuclear Equipment Division (NED), with facilities in Barberton and on the Ohio River in Mount Vernon, Indiana, specializes in the design and manufacture of large, heavy components with close tolerance and high-quality requirements. Both facilities are supported by an experienced staff of engineers capable of performing full-scope prototype work, as well as manufacturing integration on the shop floor.

SOFCo-EFS Holdings LLC, a wholly owned limited liability corporation of BWX Technologies Inc., headquartered in Alliance, is a technology development company for solid oxide fuel cell (SOFC) power systems. This technology applies to stationary and auxiliary power and processors for a number of gaseous and liquid fuels, which are suitable for a broad range of fuel cell and nonfuel cell applications. Precision Environmental Company is a recognized leader in selected demolition requiring highly specialized engineering and environmental expertise, as well as asbestos and lead abatement. In addition, Precision offers indoor air-cleaning services, hazardous waste remediation, and floor and surface preparation. Rumpke Consolidated Companies grew from a coal and junkyard business opened in 1932 in Carthage to become the nation's largest privately owned waste and recycling company, currently employing 2,000 people and owning or operating nine landfills, seven transfer stations and five recycling centers in Ohio, Kentucky, and Indiana.

The environmental technology industry in Ohio is supported and enhanced by a number of nationally known research programs. For example, the National Risk Management Research Laboratory, a division of the U.S. Environmental Protection Agency headquartered in Cincinnati, works to reduce pollution and restore ecosystems. NRMRL scientists and engineers tackle environmental challenges in seven research areas: drinking water protection, air pollution control, pollution prevention, contaminated media remediation, watershed management and protection, environmental technology verification, and technology transfer and technical support. Research efforts at the National Institute of Occupational Safety and Health, which has a facility in Cincinnati, have included identifying industries and occupations with increased risk of respiratory disease and examining noise control technology in the mining industry. The University of Cincinnati's environmental engineering program has been ranked among the top in the nation, and the Ohio State University's Environmental Molecular Science Institute examines how pollutants chemically react to the environment. Established in September 2000, the multidisciplinary institute unites researchers from fields such as mathematics, chemistry, medicine, engineering, and agriculture.

Role of the Industry in Ohio's Economy

Environmental technology has significant impact in Ohio. The industry directly contributed \$3 billion to the state's economy in 2003 (constant 1996 dollars), as shown

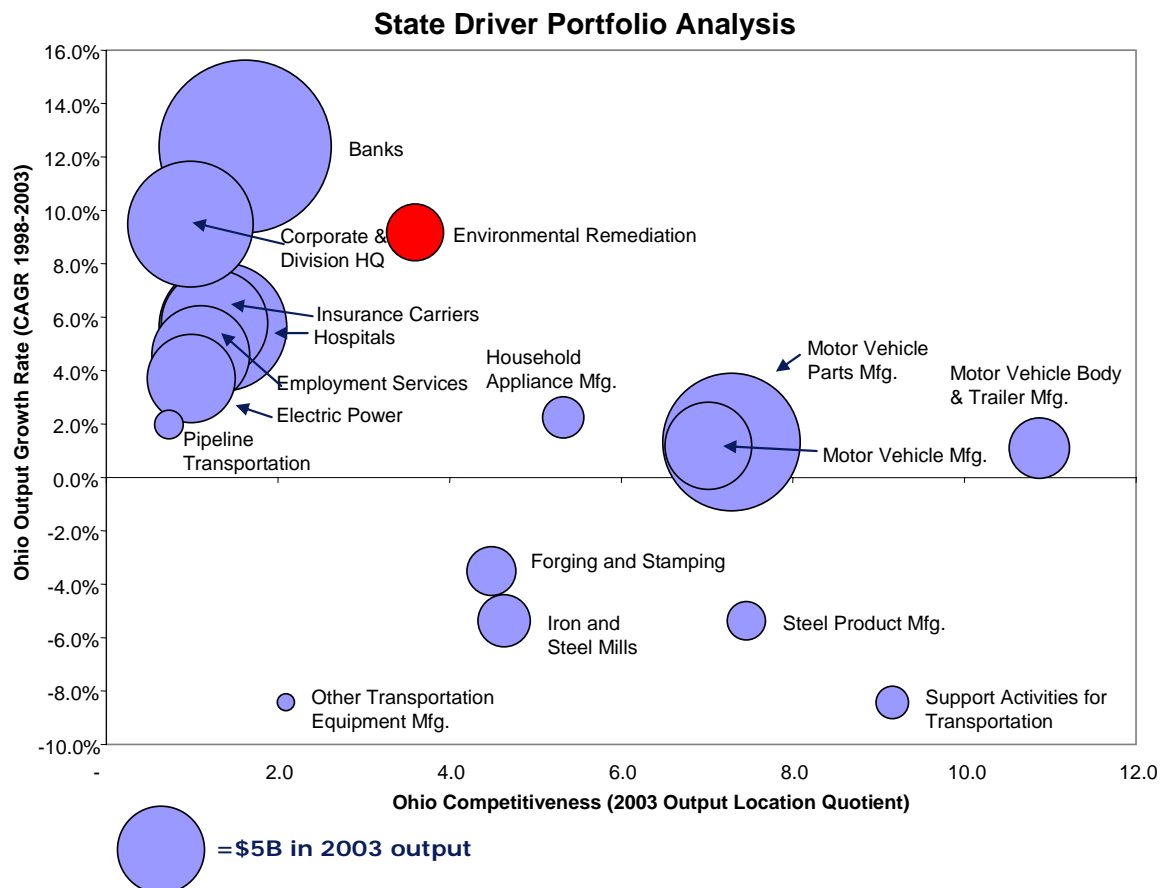
in the following table. Employment has been fairly flat in this sector while output has experienced strong growth. Employment declines in conjunction with output increases indicate that productivity in this industry continues to increase. Ohio's environmental technology industry is competitive, as indicated by its moderately high location quotients. The industry is a driver for the state and for four of the six regions. Industry growth is strong in every region.

Economic Overview of the Environmental Technology Industry in Ohio

NAICS	Industry	2003 Output (\$MM) in 1996 Dollars	1998-2003 Output CAGR	1993-2003 Output CAGR	2003 Output Location Quotient (LQ)	2003 Employment	1998-2003 Employment CAGR
Environmental Remediation		\$ 3,036					
5622	Waste Treatment and Disposal	\$ 2,131	9.2%	9.6%	3.5	5,580	-0.8%
5629	Remediation and Other Waste Management Services	\$ 904	9.5%	8.2%	1.6	4,000	0.0%

Source: Economy.com

The following chart shows where environmental technology fits within the economic portfolio of Ohio's driver industries. The red "bubble" on the left-hand side of the chart represents the state driver industry. Its location quotient is moderately high, and growth rate has averaged about 9% between 1998 and 2003. There is opportunity to grow this industry further in Ohio and increase the state's competitiveness.



Source: Economy.com, CSU/Deloitte analysis

Environmental technology is growing quickly, is rapidly evolving, has relatively high productivity levels, and is capital intensive. In addition to being an important part of the economic base in several regions of Ohio, environmental remediation and technology generates 70 cents in additional purchases within the state for every dollar of final demand.

Multipliers for Environmental Technology

NAICS	Industry Name	Multiplier		Rank
		Direct & Indirect	Direct, Indirect & Induced	
5622	Waste Treatment and Disposal*	1.34	1.70	132
5629	Remediation and Other Waste Management Services*	1.34	1.70	133

Source: IMPLAN Input-Output Model, April 2005; CSU/Deloitte Analysis

Note: Ranked by total multiplier out of 271 industries.

* Industries have the same multiplier due to the structure of the IMPLAN model.

The cluster analysis indicates that some of the industries in the supplier and customer chains for this industry are also located in Ohio. The state is home to a fairly large oil and gas industry and a large automotive industry. These industries supply environmental technology. Energy, chemicals, and the military are the leading industries for which remediation services are typically needed; all three have a presence in Ohio. The U.S. lags Europe when it comes to developing remediation technologies, partly as a result of stricter European regulations. This presents Ohio with a competitive opportunity as a source of technology transfer. Remediation is also an area for possible technology development.

Supplier industries for environmental technology include:

- Waste collection
- Remediation and other waste management services
- Automotive repair and maintenance
- Petroleum and coal products manufacturing
- Merchant wholesalers, durable goods
- Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance
- Oil and gas extraction
- Lessors of nonfinancial intangible assets (except copyrighted works)
- Motor vehicle parts manufacturing

Industry Location/Investment Factors

Industry location and investment factors are not well-known. Ohio is a large market opportunity because many large remediation sites lie within the state's borders. Changes in the business tax code may encourage industry capital investment.

Emerging/Growth Opportunities and Areas of Investment

Some of the emerging or investment sectors in the environmental technology industry are driven by regulation to lower emissions or efforts to reduce use of fossil fuels:

- Alternative fuel technologies, such as hybrid vehicles, fuel cells, alternatives to the internal combustion engine
- Cleaner emission standards in diesel fuel
- Cleaner diesel engines

- Waste-to-energy projects
- Assessment of pollutant contaminant levels
- Development of analytical methods to identify environmental hazards
- Systems to combat toxins in groundwater
- Air-pollution control systems

Investment in process improvements have tended to be focused on consolidating loads and applying new technologies to increase landfill capacity. Examples include:

- Transfer stations for solid waste. These facilities handle functions such as materials segregation, recovery, and composting and reduce the amount of waste that goes to landfills.
- Bioreactor technology adds liquid and air to rapidly break down organic waste, thereby increasing the airspace and life of a landfill and reducing the length and cost of post-closure care.

A growing area in which several Ohio companies have taken the lead is recycling or remanufacturing electronic and other waste, such as computers and cellular telephones.

Competitiveness Assessment of Ohio's Environmental Technology Industry

Ohio's competitiveness for this industry was not benchmarked as part of this study. However, the study team does recommend that a team of industry leaders conduct a competitiveness assessment for the state. It is important to have business leaders making this assessment and subsequent recommendations; environmental and public policy advocates do not bring a business and profitability perspective to the table.

Recommendations

Depth of knowledge in environmental technology is not as strong in the state as for many of Ohio's other driver industries. Although much has been written about the industry, it is often from an environmental or other advocacy viewpoint. Thus, it is difficult to identify specific strengths, weaknesses, and recommendations for Ohio.

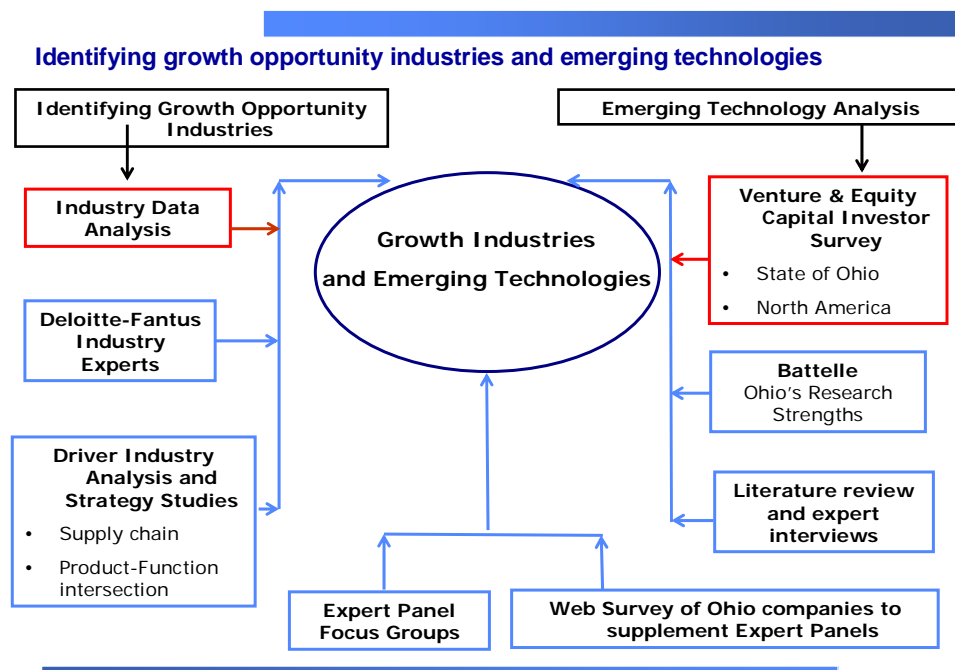
Environmental technology is large, competitive, and growing in Ohio. It is capital- and technology-intensive. Major research facilities exist in the state, and manufacturing expertise exists that can produce environmental capital products, such as plasma furnaces. There appears to be opportunity for expansion in the state. ODOD should develop a statewide task force to better understand the industry and to make recommendations about which opportunities are best to pursue. The same strategy could be undertaken at the regional level to reinforce the statewide activity and encourage specialized responses to regional opportunities or expertise. However, these task forces need a well-grounded business development and technology focus.

B. GROWTH OPPORTUNITIES & EMERGING TECHNOLOGIES

INTRODUCTION

No single economic or statistical method can identify industries and technologies that are emerging as sources of competitive advantage in Ohio and its regions. Identifying industries that are growth opportunities and not yet drivers of the state and regional economies takes fine-grained statistical and qualitative research tools. And, the identification of emerging technologies — technologies that may be the precursors to products that hold the promise of shaping and shifting economies but have not passed any sort of market test — is extremely difficult. The project team undertook a multidimensional approach to respond to these difficulties by weaving together information from a variety of sources, forming a tapestry of the state's industrial and technological opportunities.

The team undertook two separate analyses: The first was to spot growth opportunities that were not previously identified as drivers of the state or regional economies; the second was to identify emerging technologies. The methodology for identifying growth opportunities is diagrammed along the left side of the following figure. The process for identifying technologies that have economically meaningful prospects for Ohio is arrayed along the right side of the figure. The growth industry analysis has a stronger statistical base than the emerging technology method whereas the emerging technology method has a much deeper qualitative component, relying on a variety of expert opinion and case study research. The heart of each analysis is outlined in red in the figure.



Each analysis includes data from the expert panels, material from the industry analyses, and Deloitte-Fantus industry expert opinion, as well as learning from previous research on either the industry or technology in question or on Ohio's economy.

OHIO'S GROWTH OPPORTUNITY INDUSTRIES

- Nondepository credit intermediation (nonbank credit)
- Computer systems design and related services
- Headquarters and administrative services
- Scientific research and development services
- Specialized design services
- Electronic and precision equipment repair and maintenance

The foundation of the growth opportunity analysis was data on gross product and productivity at the four-digit NAICS level for all industries that were not identified as drivers of the state's economy. (Drivers of each regional economy were excluded from their respective regional analysis.) The team's specialists supplemented these data with observations from the industry-specific strategic analysis of the driver industries. Comments made by expert panelists and provided by respondents to a Web-based survey the team conducted in fall 2004 were also considered. Most of the comments made by the panels of experts related to technologies. Little mention was made of emerging, or growth opportunity, industries. The team's interpretation of this fact is that the expert panels were dominated by managers of existing businesses who were so busy managing their businesses that they were not in a position to think about industries other than their own.

The growth opportunity analysis employed quantitative methods to identify industries that experienced:

- Large growth in gross product
- Large increases in productivity
- Low gross product location quotients

Location quotients identify how specialized an industry is within a particular area. The rationale for this combination of variables was that jumps in gross product from 1998 to 2002 demonstrated a growing market for the product in the face of a recession, increases in productivity suggested that Ohio was a competitive location and investment was taking place, and low location quotients implied there was room to capture market share, as long as the market was not mature.¹

The 20 highest scores for the state and for each of the regions were selected for inspection. For the analysis, the study team rejected industries in which the change in gross product was negative or productivity declined. Industries were also rejected if their gross product location quotients were greater than 1.05.² The team also rejected

1. For this analysis, the study team converted each of these variables into a z-score to form a statistic with a common unit of measure. Observations for each variable were measured in terms of the number of standard deviations the observation was from the mean. Each of the z-scores was then added to form an emerging industry index.

2. Even though the search criteria were for increases in gross product and productivity and a low location quotient, a very high z-score score in one or two dimensions could offset low, or negative, scores in other dimensions. On occasion, this allowed an industry with a negative value in gross product and productivity growth to enter the list of top 20 industries. An alternative specification to identify growing industries that reflects regional competitive advantage would be to combine large growth in gross product, large increases in productivity, and increases in the

industries in which primary product demand was local. These exempted industries included restaurants, nursing homes, and retail establishments.

A parallel set of calculations was performed to identify large and important industries that were not found to be drivers of the economy. These industries were termed “pillar” industries because, while they are not drivers, they are pillars of employment in their local economies. These industries had:

- Large increases in gross product
- Increases in productivity
- High location quotients

This second screen was introduced to minimize the chance of overlooking an industry that plays a large competitive role in the regional economy (even though a high location quotient implies that the industry became an important part of the economy sometime in the past).

The large table at the end of this section provides a comprehensive list of industries for the state and for each of the regions that have been identified as drivers (noted by a capital D for driver industry); large, important industries that are not drivers (noted in the table by a P for pillar industry), meaning those with growth in gross product and productivity from 1998 to 2002 and a high gross product location quotient; or growth opportunity industries (capital G), meaning those with growth in gross product and productivity but low location quotients. Most of the industries that were identified as growing or as large and important, pillar, industries at the regional level were either drivers in other regions or were statewide driver industries. Industries of interest at this stage of the analysis were those that were novel.

Drawing on Harris Directory information, a list of large establishments for each identified growth industry of interest was produced. An establishment is an individual employment location, not the aggregate employment in all of a company’s Ohio sites. For example, in the nondepository credit industry, GE Capital Corporation has two listings: The first is for GE Capital Corporation in Canton; the second is a branch operation of GE Capital Corporation’s consumer credit card operation in Mason. Each establishment has a listing to identify ownership: A branch is a branch plant or a division of a corporation. A single-location establishment is the sole site of a business. A parent is the top of the corporate tree, where a firm has branch operations elsewhere and most likely a divisional structure. A headquarters location is the headquarters of a multibranch business. The headquarters of a division is identified separately.

WHAT INDUSTRIES ARE GROWTH OPPORTUNITIES?

Nondepository Credit Intermediation

When measured by contribution to Ohio’s gross product, the largest statewide opportunity industry is nondepository credit intermediation (NAICS 5222). This industry comprises credit card issuing, consumer lending, and sales financing, as well as secondary market financing and nonbank international trade financing. The gross

location quotient of gross product. This specification was examined and there was also substantial overlap with industries that were already identified as regional drivers.

product generated by this industry grew by nearly \$750 million from 1998 to 2002 (using 1996 inflation-adjusted dollars). In Ohio, most of this activity is in credit cards and consumer finance. The industry is an emerging driver statewide, and it is emerging as a source of economic development opportunity in the Northeast, West Central, and Southwest regions. This industry has a large back-office component and has characteristics that are similar to general shared-services business functions.

Large establishments in the state, as measured by employment, are a mixture of credit card processors, mortgage service back offices, consumer credit operations, and nonbank lenders (such as GE Capital Corporation's large office in Canton). In Ohio, the industry includes 70 establishments that have more than 20 employees.

5222 - Non-depository Credit Intermediation

Company	Facility Type	Location (City)
Discover Financial Services	Branch	New Albany
General Electric Capital Corp	Branch	Canton
Chase Manhattan Mortgage Corp	Branch	Cleveland
GE Capital Consumer Card Co	Branch	Mason
Huntington Mortgage Group	Single Location	Columbus
Leader Mortgage Co	Branch	Cleveland
United Consumer Financial Svcs	Branch	Westlake
Security National Automotive	Single Location	Mason
Federal Home Loan Bank	Single Location	Cincinnati
First Ohio Mortgage Corp	Single Location	Cleveland

Source: Harris Directory, 2004

The Harris data did not identify MBNA's extensive operations in the Cleveland area, most likely because the company operates back-office call centers that may fall under a different NAICS number, such as office administrative services, which is discussed below.

Office Administrative Services

The nondepository credit industry is, in fact, linked to a second emerging office function, the office administrative services industry (NAICS 5611). The office administrative services industry (which can be thought of as a shared service if the function is outsourced to a supplier company) is emerging statewide and in the West Central region. In Ohio, the industry includes 94 establishments that have more than 20 employees. The table of the industry's large establishments in the state is broad in terms of the number of industries served. However, the amount of hospital administrative back-office activity is striking.

5611 - Office Administrative Services

Company	Facility Type	Location (City)
TriHealth Inc	Parent	Cincinnati
Akron General Health System	Single Location	Akron
Cleveland Clinic Health System	Parent	Cleveland
JCPenney	Branch	Columbus
Blanchard Valley Health Assn	Parent	Findlay
Mercy Health Sys - Nthrn Reg	Branch	Toledo
Clark County Board Of Mental	Parent	Springfield
MEI Hotels Inc	Single Location	Cleveland
Service Corp	Branch	Middletown
Mount Carmel Health System	Headquarters	Columbus

Source: Harris Directory, 2004

The headquarters function (management of companies and enterprises, NAICS 5511) was identified as a driver industry statewide and in all regions of the state except West Central, where it is a growth opportunity industry. Nearly all portions of the headquarters, administrative, and back-office industries are either drivers or emerging as growth opportunities in all of the state's regional economies. Another linked business function consists of call centers and other back-office activities that support financial and nonbank financial institutions, such as Progressive Insurance's Northeast Ohio operations and Key Bank's operations in Dayton. The point to be made with this industry is that back-office, shared-services, and call center operations exist throughout Ohio. This is especially true if the operation has a critical client-service aspect and if the operation is connected to an existing Ohio-headquartered business or division. The exact list of business establishments provided by the Harris Directory is less important than the business and economic development logic that the list provides.

Computer Systems Design and Related Services

The second-largest growth opportunity statewide is a technology and service business: computer systems design and related services (NAICS 5415). Gross product in this industry grew by \$618 million from 1998 to 2002, and the value of gross product per worker increased by nearly \$17,000 over the same period. There is a wide variety of service providers in this industry statewide, with the Harris Directory listing 387 establishments employing more than 20 people.

5415 - Computer Systems Design and Related Services

Company	Facility Type	Location (City)
CheckFree Corp	Branch	Dublin
UGS	Single Location	Milford
Alltel Ohio Inc	Branch	Twinsburg
Columbia Energy Service Corp	Branch	Columbus
Keane Inc	Branch	Dayton
CTG Healthcare Solutions Inc	Branch	Cincinnati
Datavantage Corp	Branch	Solon
Liebert Global Services Inc	Division HQ	Westerville
SARCOM Inc	Parent	Columbus
Hyland Software Inc	Single Location	Westlake

Source: Harris Directory, 2004

The list indicates that Ohio's larger computer systems design service providers are associated with one of the state's driver industries, such as health care, finance, or

distribution. This industry appears as a growth opportunity in all regions of the state, with the exception of the Northwest and Southwest.

The list of business establishments provided by the Harris Directory is haunted by the employment volatility in the industry and the vagaries of the NAICS code in this sector of the economy. The data were collected by Harris in 2003 and released in late 2004. Since that time, employment has changed in some of the business establishments, both positively and negatively. Also, other parts of the computer services industry are classified under different portions of the NAICS. For example, Lexis Nexis in Dayton is classified in the information services sector, and NCR is classified as a device manufacturer and headquarters business function. As was true with back-office operations, what is important is not the specifics of the tables but the message conveyed by the data. Computer systems design and related services is a growth opportunity throughout the state. Growth in this industry is likely to be in software that provides business solutions to highly targeted areas of application. The best chances for success will be in developing applications for industries and business functions in which Ohio has achieved critical economic weight. This is already occurring in the logistics and trucking industries.

Other Emerging Industries

A few smaller, niche industries are emerging in Ohio that are intense users of knowledge and technology. These are:

- Scientific research and development services (NAICS 5417)
- Specialized design services (NAICS 5414)
- Electronic and precision equipment repair and maintenance (NAICS 8112)

Scientific research and development is a growth opportunity in the Southeast. However, prominent establishments in this industry are located throughout the state. The list of large establishments in the Harris Directory was supplemented with the names of a number of important federal laboratories that specialize in environmental research that were identified in the course of this research. The establishments illustrate the geographic and industrial diversity of this emerging sector of the state's economy.

5417 - Scientific Research and Development Services

Company	Facility Type	Location (City)	Federal Agency
NASA-John H Glenn Research Ctr	Branch	Cleveland	NASA
Battelle Memorial Institute	Parent	Columbus	
Noveon Inc	Headquarters	Cleveland	
Procter & Gamble Co	Branch	Mason	
Ethicon Endo-Surgery Inc	Branch	Cincinnati	
Honda R & D America's Inc	Branch	Raymond	
Ashland Specialty Chemical Co	Headquarters	Columbus	
Diebold Inc	Parent	Canton	
Procter & Gamble Co	Branch	Cincinnati	
Kendle International Inc	Parent	Cincinnati	
National Risk Management Laboratory	Branch	Cincinnati	US EPA
National Center for Environmental Assessment	Branch	Cincinnati	US EPA
Division of Applied Research Technology	Branch	Cincinnati	NIOSH
Educational and Information Division	Branch	Cincinnati	NIOSH
Division of Surveillance, Hazard Evaluation and Field Studies	Branch	Cincinnati	NIOSH
Directorate of Science, Technology and Medicine, Technical Center	Branch	Cincinnati	OSHA
National Forensic Chemistry Laboratory	Branch	Cincinnati	FDA

NIOSH National Institute of Occupational Safety and Health

OSHA Occupational Safety and Health Administration

FDA Federal Drug Administration

Source: Harris Directory, 2004

The two largest research establishments are nonprofit research organizations, Cleveland's NASA Glenn Research Center and Columbus' Battelle Memorial Institute. Research establishments in the medical instruments industry are represented in the Harris Directory, as are the consumer products, chemicals, and automotive industries. There are 136 establishments with more than 20 employees in the state listed in the Harris Directory when just this NAICS industry is considered. However, interviews, coupled with research on the polymer industry, indicate that the state has unusually large private-sector depth in research and development activities in the polymer sector of the chemicals industry, as well as in agricultural chemicals and agricultural and food sciences. The interaction between scientific research and development, coupled with divisional headquarters, is a cluster of opportunity.

Specialized design services are an opportunity industry in the Southeast. However, there is also strength in industrial design in Columbus and in the Northeast, as well. Harris Directory data show that, among industry establishments in the state, 35 have more than 20 employees. However, the Harris data can be supplemented with a number of well-known Ohio-based design firms that have national reputations, such as Cleveland's Nottingham Spirk, Worthington's FITCH Design, Columbus' Battelle Product Development Group, and Akron's LJB Group.

5414 - Specialized Design Services

Company	Facility Type	Location (City)
Lakeside Interior Contractors	Single Location	Maumee
Libby Perszyk Kathman Inc	Single Location	Cincinnati
Novar Controls Corp	Parent	Copley
Ohio Design Centre	Single Location	Cleveland
Lipson-Alport-Glass & Assoc	Single Location	Cincinnati
D E I Inc	Single Location	Cincinnati
Deskey Associates Inc	Parent	Cincinnati
Collaborative Inc	Single Location	Toledo
General Theming Contractors	Single Location	Columbus
Fisher Design Inc	Single Location	Cincinnati

Source: Harris Directory, 2004

The largest specialized design establishment listed in the Harris Directory is located outside of Toledo. Design represents a major resource in freshening Ohio's product base, and it is an area in which the state has demonstrable intellectual excellence.

The electronic and precision repair industry is a statewide growth opportunity, even though it is not a driver in any one region. The link between these repair services and the state's central location in the industrial heartland of America and the dispersed nature of the industrial equipment industry within Ohio mean that repair facilities are spread across the state's economic regions. Gross product grew by more than \$123 million from 1998 to 2002. This growth occurred in the face of recession. The Harris Directory records 70 major establishments: Some are associated with Ohio-based manufacturing firms, whereas others reflect the centrality of the state.

8112 - Electronic and Precision Equipment Repair and Maintenance

Company	Facility Type	Location (City)
DecisionOne Corp	Branch	Grove City
Siemens Business Services	Branch	Mason
Dayton Speedometer Service Inc	Single Location	Dayton
Modern Office Methods Inc	Branch	Dayton
Kodak Technical Services Inc	Single Location	Wilmington
Blue Technologies Inc	Single Location	Cleveland
Best Buy Service Center	Branch	Solon
Mobilcomm	Parent	Cincinnati
Whirlpool Factory Service	Single Location	Dayton
ADT Security Services Inc	Branch	Reynoldsburg

Source: Harris Directory, 2004

Tourism and Arts

The tourism industry was identified as a growth industry in the Northeast and Southwest regions in the data analysis, and the growth of leisure industries is an opportunity for all parts of the state. In the Northeast, the tourist industry was based on boating and Lake Erie, a set of attractions shared with the Northwest. The industry was also identified as growing in the Southwest, based on theme parks and the arts industry in Cincinnati. However, all regions of the state have growing tourist industries. These industries have derived from the character, history, and natural resources of each region and are parts of the base of their regional economies — from the sport fishing industry along Lake Erie to the lure of the Appalachian hardwoods of the Southeast. The industry's presence in the state's core cities is an employer of people of all skill levels and is central to the quality of urban life. Ohio's theme parks attract summer visitors from bordering states,

and each major city has a tourist attraction of regional or national renown. Yet, it is clear from the data that tourism is not a central driver of the economy, as it is in Florida, New York, North Carolina, Virginia, and Washington, D.C. In 2002, Ohio ranked eighth among the states in terms of the number of visiting tourists but was 20th in terms of overseas visitors to America's states and territories.

The business challenge presented by tourism and arts in Ohio is that, setting aside the two major theme park operators and the professional and major college sports teams, this is an industry of small businesses that do not have the scale or ability to advertise in multiple regional markets. Additionally, the region-states within Ohio have different product mixes and value propositions. This means that a single and simple tourism brand for Ohio as a whole will have difficulty conveying the recreational and attraction opportunities that exist in each of the state's regions.

What the region-states do share is a market failure in supporting their regional tourist brands. Local businesses cannot promote a regional tourist brand without state or regional intervention and without aggregating the funds required to support a sustained marketing effort. The industry needs to fund its brand through taxes or industry membership fees, and it needs a government-supported body to develop and market tourism under a brand.

What is required to grow tourism as part of the state's competitive portfolio of industries is discipline in identifying the target markets — the dominant market will be day tourism from within Ohio and its bordering states — and in setting expectations for returns from tourism and the arts.

EMERGING TECHNOLOGY INVESTMENT ³

Ohio's Technology Landscape: Building From Strength

Ohio Governor Bob Taft and the Ohio Department of Development have constructed an economic development strategy around six core technology competencies in the state, based on research by the Battelle Memorial Institute's Technology Partnership Practice. These strengths exist in universities, hospital-affiliated research institutes, federal laboratories, and private-sector research institutions clustered in advanced materials, biosciences, instruments, controls and electronics, information technology, and power and propulsion.⁴ Each of these areas of research strength is associated with demonstrated intellectual and human capital depth. And, as a number of commercial investment opportunities have emerged, private companies have organized to build on the flow of research and development dollars invested within the state. A brief sketch of the technological strengths of the state's economy drives home a central finding: The state's economy is composed of a portfolio of products that form a wide array of industries located within a portfolio of regional economies. To this is now added the finding that the state's regional industrial bases contain a portfolio of technologies, both established and emerging.

Based on the research team's survey of Ohio and North American venture capitalists, a potential technology portfolio for the state was identified. These are technologies and emerging products that are viewed as being particularly competitive in Ohio: medical equipment and instruments; fuel cells, with off-grid civilian applications being favored; three nanotechnologies (nanomaterial, nanochemical, and nanobiological applications); general polymer technologies, as well as photonic and electronic polymers; MEMS applications in micromachining and automotive applications; security database and data-mining applications, as well as industry-specific applications of information technology; and liquid crystal displays. The full portfolio of technologies and their relationship to product markets are given in the following figure.

3. Support for the research in this section was supplemented with a grant from the George Gund Foundation.

4. See *An Ohio Technology-Based Economic Development Strategy*, Technology Partnership, Battelle (May 2002) and *Ohio's High Performance Economy*, Ohio Department of Development (2004).

Emerging Technologies – Promising Investment Areas

Technology	Market Impact	Innovation Type Process	Product	Technology Infusion
Polymers	Sustaining	✓	✓	Pull
Biocompatible	Disruptive		✓	Push
Photonic	Unknown		✓	Push
Electronic	Disruptive		✓	Push
Conductive	Disruptive		✓	Push
Liquid crystal displays (next generation)			✓	Push
Medical equipment	Both	✓	✓	Pull/Push
Fuel cells			✓	Push
HVAC	Disruptive		✓	Push
Electric power generation	Disruptive		✓	Push
Automotive	Disruptive		✓	Push
Nanotechnology			✓	Push
Materials	Disruptive		✓	Push
Remote sensing	Sustaining		✓	Push
Biological applications	Disruptive		✓	Push
Chemical applications	Disruptive		✓	Push
Nano-polymers	Disruptive		✓	Push
Information technology		✓		
Medical industry applications	Sustaining		✓	Pull
Finance industry applications	Sustaining		✓	Pull
Industry-specific solutions	Both	✓	✓	Pull
Micro-Electrical Mechanical Systems (MEMS)			✓	Push
MEMS machines	Disruptive		✓	Push
Automotive applications	Sustaining		✓	Push
Basic chemistry	Formative			Pull

Defining Attributes

- Clear linkage to existing state drivers
- Research strength and localized intellectual capital
- Significant Ohio venture-capital interest

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12

RESEARCH STRENGTHS IN OHIO

Ohio's research strengths are briefly discussed because they are a foundation of the state's long-term innovation infrastructure. They are important because they are the foundation that can be used to build out the technologies and products of tomorrow.

Several of Ohio's regional economies are chemistry economies. When agricultural chemicals, soaps and cleaning compounds, and petroleum products are added to polymers, and taking into account the chemistry that lies behind a growing portion of clinical medicine and biomedical research, the importance of chemistry to the state's economic future is clear. Ohio also has deep strength in its corporate laboratories in advanced materials research, such as in steel, polymer chemistry based on oil and gas, and products developed from corn and soybeans.

The polymer industry is a critical driver in a number of Ohio's regions. Depth in polymer chemistry bridges the lubricants, coatings, rubber, and plastics industries.⁵ The strength of this industry is historical, intellectual, and corporate. Northeast Ohio is widely recognized as a rival to Massachusetts as a center of polymer research. The University of Massachusetts at Amherst is a rival to Ohio's University of Akron in polymer chemistry research and development; Massachusetts Institute of Technology and Case Western Reserve University are rivals in a range of basic and applied chemistry research in this field. Ohio's industrial laboratories are pushing the frontiers of polymer chemistry,

5. *Northeast Ohio Polymer Strategic Opportunity Roadmap*, Technology Partnership Practice, Battelle (Cleveland, Ohio: September 2004).

building on research and product development expertise that traces its roots to efforts during World War II to find a synthetic replacement for rubber.

There is the real potential for major advances where Ohio's agricultural research engine, biotechnology, and organic chemistry meet. Battelle has documented that Ohio invests \$39 million annually in its Agricultural Research and Development Center, allowing scientists at the Ohio State University to develop one of the largest concentrations of agricultural research in the United States.

Medical equipment and instruments flow out of the clinical strengths of Ohio's research hospitals and industry strengths in imaging, sterilization, medical equipment and instruments, contract pharmaceutical processing, and materials.

Ohio is a leader in clinical trials, and Ohio hospitals and clinical practices top *U.S. News & World Report's* lists for excellence. In 2004, the magazine placed 14 hospitals that excelled in 6 or more of its annual rankings of 17 specialties on its national honor roll. The Cleveland Clinic ranked fourth on this list, excelling in 12 specialties. Ohio hospitals ranked among the top in all of the specialties *U.S. News & World Report* ranked. The state has world-renowned children's hospitals, with the magazine ranking Rainbow Babies' & Children's Hospital in Cleveland sixth and Cincinnati Children's Hospital seventh. Fourteen of the 50 hospitals rated among the top in respiratory disease treatment are in Ohio. In addition to its pediatrics medical center, Cincinnati was also ranked in the top 25 for the ear, nose, and throat specialty. Columbus' hospital complex rated among the top 25 for the specialties of ear, nose and throat; hormonal disease; rehabilitation therapy; and rheumatology. Dayton facilities were cited among the top 50 in the treatment of digestive disease and heart care, and Toledo's medical care appeared among the top 50 in the treatment of hormonal disease. The magazine listed Lorain as 41st in neurology. Cleveland's hospitals were ranked in the top 20 in most specialties. In addition to the Cleveland Clinic's honor roll ranking, University Hospitals was rated 7th in cancer treatment; 16th in ear, nose and throat; 14th in geriatrics; and 15th in neurology.

U.S. News & World Report rated Case Western Reserve University's medical school 24th out of 60 leading U.S. medical schools in research excellence; Ohio State University's medical school was 38th and the University of Cincinnati was 43rd. The news magazine also ranked the top 60 medical schools by a clinical score. Case Western Reserve University ranked 31st, followed in Ohio by Wright State University's medical school at 50th and Ohio State University at 52nd.

Another benchmark of research excellence is the total amount of grants and awards a medical school earns from the National Institutes of Health. The NIH provided data on 121 medical schools in 2003. Case Western Reserve University ranked 18th for total awards, the University of Cincinnati's College of Medicine was 43rd, Ohio State was 53rd, the Medical College of Toledo was 98th, Wright State University School of Medicine was 105th, and the Northeastern Ohio University College of Medicine in Rootstown was 120th. Because the NIH awards were reported by medical schools, this understates the impact of NIH grants in Cleveland. In 2003, the Cleveland Clinic's research operations were not affiliated with a medical school, and University Hospitals reported its NIH funding separately from the awards to Case Western Reserve University's medical school.

The promise of medical equipment and instruments becoming a driver industry lies in the near future. The connections between the state's materials strengths, clinical trials, and invention based on clinical care are beginning to grow together. A catalyst that will drive these nascent strengths together is still required.

Another area in which the state has unusual research depth is in power and propulsion systems. Ohio's biggest players in this area are the NASA Glenn Research Center, the GE jet engine division, and the companies that revolve around military contracting at Dayton's Wright-Patterson Air Force Base and the Air Force Research Laboratory (AFRL), which has 10 headquarters and research directorates. These strengths are augmented by a large number of engine manufacturing facilities that the automobile industry has located throughout the state. Battery technologies and alternative energy sources are the focus of research at NASA Glenn, Energizer Corporation, and a number of embryonic fuel cell companies and the supply chain that is organizing to serve this growing technology.

A number of crosscutting areas of technology cannot be captured through a pure industry lens. Ohio is becoming recognized as a center for nanotechnology research and production. Nanotechnology cuts across medical, polymer, and advanced materials research, with potential applications ranging from sunglass film to medical membranes. At this time, most nanotechnology applications are distant from the marketplace. However, in coatings, paints, and fabrics, new products based on nanotechnologies and nanochemistry are being rapidly introduced. Capturing these revitalizing technological breakthroughs is critical for companies that are at the heart of the state's economy. Nanochemistry will revolutionize production processes and product categories. Ohio must become a global competitor in nanotechnologies, or its economic future will dim.

Ohio is also a place where "machines on chips," or micro-electro-mechanical systems (MEMS) technologies, are being "packaged" and adopted into instruments, controls, and electronic processes. *Small Times* magazine named Ohio as the 10th MEMS hot spot in the United States.⁶

Ohio's Private-Sector Research and Development Base

Ohio has a broader and deeper set of private-sector, federal, and not-for-profit scientific and research laboratories than is commonly recognized. The study team found this scientific and research infrastructure to be a growth opportunity in the state. Many of these facilities have a direct connection to Ohio's industrial heritage. This is true in aerospace, automobiles and the automobile supply chain, polymers and other chemistry-based products, and metalworking. Other research facilities are tied to the clinical medical excellence of Ohio's regional economies. In 2004, the Harris Directory listed 136 stand-alone scientific research and development laboratories that employed more than 20 people. This is, without a doubt, an undercount. Many of the state's laboratories are connected to another facility, such as a hospital or university. Others are in a mixed-use

6. "Small Times magazine names 2004 top 10 small tech hot spots," (March 15, 2004), *Small Times*. The 10 are: California, Massachusetts, New Mexico, New York, Texas, Illinois, Pennsylvania, Michigan, Connecticut, and Ohio. *Small Times* wrote: "Ohio's strong engineering schools and applied science programs complement small tech research efforts in its medical, space and military labs. Ohio is developing its research expertise into inventions, products and a mix of companies that could grow into a commercial force. 2003 ranking: 17."

corporate facility, frequently a headquarters location, where nonresearch functions dominate the business and dictate the NAICS code assignment. Nearly 30% of Ohio's research facilities are controlled by out-of-state decision-makers. With the exception of the state's largest scientific facility, the NASA Glenn Research Center, and its largest automotive research facility, Honda Motors in Raymond, most research employment is controlled by businesses with headquarters in Ohio.

Ohio's 136 Research Facilities

Region	Total Establishments	Total Employment	In-State Control	Out-of-State Control	Private Ownership
Northwest	12	868	8	3	10
Northeast	52	15,318	46	11	39
West Central	25	1,549	16	9	19
Central	21	9,177	14	7	15
Southeast	2	112	2	0	2
Southwest	24	7,059	15	9	14
State	136	34,083	101	39	99

Source: Harris Directory, 2004

The 10 largest scientific and research facilities in the state were presented in the earlier discussion of growth opportunities. A full list of the 136 research facilities listed in the Harris Directory is given at the end of this section.

Innovation, Technology, and Finance

There is a continuum of science and technology innovation, and different sources of funding and different performance metrics are required to match the types of innovation research and its purpose. This study identified three types of innovation – process, product, and technology — that serve to sustain, disrupt, or form products, creating nine possible interactions between innovation and the economy. However, evidence could be found to support only seven of the nine possible interactions.

Innovation Matrix

Relation to Product	Type of Innovation		
	Process	Product	Technology
Sustaining	X	X	pull
Disruptive	X	X	push
Formative			X

For this analysis, an innovation is defined as any change that results in a product that is either new or fundamentally different in its design, function, purpose, quality, or cost. Some innovations are sustaining: They maintain the position of the product in the marketplace and reinforce a firm's existing competitive advantage. Sustaining innovations frequently affect production processes (meaning they enable products to be made better or cheaper) and can include engineering or management innovations. Other sustaining innovations fundamentally change the nature and quality of the product or are a product extension. Sustaining product innovations typically affect use or design. A

specific form of sustaining product innovation is a platform innovation in which new technology is infused, or pulled, into a product to change its function and competitive characteristics.

Most expert panelists related interest in sustaining process and technology pull innovations. These participants were typically managers highly focused on cost containment and competitive threats to their business's existence. Many were manufacturers, but managers of service-sector firms, such as back-office operations and health care organizations, also voiced demands for cost-containing or cost-reducing process innovations. Substantial demand remains for lean production processes and sustaining product innovations.

Disruptive innovation is any change in product, process, or business model that results in the death of existing products, firms, or competitive business models.⁷ A disruptive innovation that has been on people's minds recently is the threat that low-cost airlines pose to the established major carriers. Another example can be found in the auto industry. Ohio's auto parts industry is still experiencing the aftereffects of the disruption stemming from lean manufacturing systems and business practices of the "new" domestic automotive sector. The new domestics' lean practices, coupled with the absence of legacy costs to retirees, have resulted in a competitive advantage in operating margin, product investment, and, frequently, product quality. Disruptive innovations are embodied in technologies that exist and are close to becoming products. The challenge for the operating company or the entrepreneur is to find an initial market for these products and then begin to move the product up the value chain. This is the history and experience of steel minimills and of public warehousing operations.

Disruptive innovations are frequently based on technology pushes: A new technology exists, and entrepreneurs or managers search for market applications for it. In this sense, technology pushes out products and applications. Venture capital investors tend to be interested in disruptive technologies that can push a wide platform of products. Investment risk lies in the scope of the potential market and the time it will take products to find meaningful markets. This is the stage of development nanotechnologies are currently in.

Formative technologies are closer to pure science than to technology-based economic development. The only characteristic that differentiates formative technological development from pure science is the existence of intellectual property rights protection, meaning access to portions of the knowledge created can be legally excluded. Time to market is most often too distant for venture capitalists to participate in investing in formative innovations. Investing in formative technologies requires patient money, and it is the role of government if the knowledge remains a public good. Otherwise, formative innovation is the province of risk-taking angel investors who may channel public funds or philanthropic sources of funding.

The Role and Formula for Successful Venture Capital Investment

Venture capitalists have a fairly simple rule of thumb to guide their investment: If the investment in a company can be turned over and cashed out in three to five years, then

7. The discussion of innovation is heavily influenced by Clayton Christensen and his *The Innovators Dilemma* (Harvard Business School Press, 1997).

the investment is a success. If the investment takes seven years to be sold, then, after the opportunity cost of capital is considered, the fund expects roughly to break even. If it takes 10 years or more to sell the investment, then the fund has lost money. Yet, how do venture capitalists know what will work? The answer is that they do not know. They use knowledge and experience to focus their investments and to minimize risk. Among the best firms, some 10% to 30% of investments do not work out. The keys to success are having access to a large volume of credible business plans, having specialized knowledge in an area of technology, and being able to bring the skills required to manage fast-growing companies to the startup through the venture capitalist's position on its board of directors. One venture capitalist reported to the research team: "I want to pitch my tent at the crossroads of technology and the market and see what comes by." The trick is in knowing which technology road to camp on. In today's venture capital market, the best technology street is not evident to the crowd. Many venture capital firms are moving into leveraged buyouts as a way to generate returns while the technology picture becomes clearer. In 2004, Stanford University moved from a portfolio that was 66% invested in venture startups and 33% invested in leveraged buyouts to a 50-50 portfolio split. The fund plans to continue to shift toward buyouts as 2005 proceeds.⁸

News sources indicate that experienced venture capital investors are changing the way they invest, pulling money out of venture startups and diversifying into leveraged buyout financing of existing businesses. Meanwhile, the amount of money available for new ventures is actually expanding because newcomers to the marketplace are filling the pipelines of financial supply. The *Wall Street Journal* reported in December 2004 that the venture market is bifurcating. Venture capitalists were reported to be on track to raise \$18 billion in 2004, a 71% increase from last year. At the same time, established venture investors were reducing their risk exposure to the venture capital market. Harvard, Princeton, Stanford, and Boston universities were reported to be joining the Ohio Public Employees Retirement System in cutting their venture capital investment targets. One university money manager told a *Wall Street Journal* reporter that "the smart money is rotating out, and the dumb money is rotating in."⁹ One fear among investors is that too much money may be going after too few quality deals. Thomson Venture Economics reported that venture funds lost 12% a year on average from June 2001 to June 2004. The flow of money into the venture market by new investors has resulted in funds being able to increase both their fees and their cut in any future profits. Accel Partners plans to take 30% of the profits from their new fund. This has encouraged experienced investors to pursue other investment options.

The volume of venture investments picked up in 2004 after declining since 2001.¹⁰ Thomson Venture Economics reported 350 deals in 2001, 315 in 2002, 290 in 2003, and a quarter-to-quarter pickup in investment activity between 2003 and 2004. At the end of the third quarter of 2004, 247 deals had been reported to Thomson. The National Venture Capital Association reported that 33 of the 83 deals booked in the third quarter

8. Grimes, Ann, (December 14, 2004), "Venture investing is popular—with newbies," *Wall Street Journal*.

9. Also see Pettypiece, Shannon, (November 29, 2004), "OPERS trims venture cap plans," *Crain's Cleveland Business*.

10. National Venture Capital Association, press release, November 8, 2004.

of 2003 were for software development projects. Information technology services, media and entertainment, and biotechnology had seven deals each, and medical devices and equipment had five. On average, the largest deals were in software, followed by information technology services and telecommunications.

The *Economist* recently asked, “Has the venture-capital industry learnt its lesson?”¹¹ The *Economist*’s reporters echoed the *Wall Street Journal*: “Many experienced venture capitalists think it [the amount of venture capital in the market] is still too high.” The *Economist* reported that the global flow of funds into venture pools would be \$25 billion in 2004. Many venture capitalists in Europe have been moving into latter-stage, near-market investing. The *Economist* also noted that venture firms were returning to older practices — moving away from portfolio-like incubators and resuming their value-adding, time-tested practice of coaching firms they invest in from seats on the boards of directors.

The key to good venture investing is what it traditionally has been — deep knowledge of an industry or of a product set. In the venture investment market, two strategies are apparent. Large, experienced institutional funds are looking globally but are specializing in markets and technologies in which they have experience. Yet, even these firms try to establish a geographic basis for their practice because technology-based development blossoms in geographically concentrated clusters. Smaller venture pools have a much tighter geographic focus, with disciplined concentration on specific technologies or industries.

Harry Jaako, a venture capitalist in Vancouver, British Columbia, provided the research team with the clearest expression of a geographically based investment strategy:

“In our experience, venture investing for most venture funds is a very pragmatic process. It is driven by the specific experience of the manager, the size of the fund, and the geographic range of the manager. After 18 years in the business, I have concluded that you invest in what has critical mass in your region (cluster theory?) to deliver you the investment returns you need. For example, in Vancouver we have comfort in wireless, new media, life sciences, and certain alternative energies because we have world-class clusters here that ensure that top science, talent, educational and professional infrastructure, investment bankers, etc., all collaborate to make these ventures successful and build shareholder value. On the other hand, we do not have nanotechnology happening here or advanced materials or many others.”

Venture capital investing is taking different paths: Experienced institutional money managers are shortening time horizons and blending leveraged buyout investing with their venture funds. Additionally, national and global funds are concentrating on latter-stage investing. Newer and geographically targeted funds are focusing on areas that have been overlooked in the past; more money will be going into smaller, early-seed and preseed investing. In all cases, the size of investments will be smaller than in 2000.

11. “Once burnt, still hopeful,” Annual Survey on Private Equity, *Economist*, November 27, 2004, pp. 16-18.

Pittsburgh venture capital watchers reported that the typical deal size in that region would range from \$1 million to \$2 million.¹²

Between 60 and 80 private equity firms are located in Ohio.¹³ Although a large pool of private equity funds has long been managed by Ohio firms, these funds have most frequently been invested out of state. Ohio's private equity firms also have tended to specialize in leveraged buyout finance and in reinvigorating firms that are well-established. These tendencies have resulted in a perceived financing gap.

There is an ongoing debate over the reason for the perceived slow flow of early stage investment money into Ohio. Established venture fund operators claim that there are sufficient funds available in the region but that demand for funds, generated by a low density of quality deals, is weak. New entrants in the market claim that there is a shortage of funds. The study team has concluded that the perception of a mismatch between supply and demand may not lie in the actual supply or demand for venture funds, but in the quality of information about potential investments. Economic development advocates are paying attention to the wisdom of Vancouver's Jaako and are building intermediary organizations capable of closing the information gap between investors and borrowers and encouraging investment based on deep industry and technology-specific knowledge. Ohio's private equity investors are also moving toward making smaller investments at earlier stages of a product's and industry's life cycle.

Recent data show that deals located in Ohio have newly found acceptance among venture capital investors. Small, early investment in medical equipment and technologies is the formula now followed by BioEnterprise, a Cleveland-based intermediary that introduces potential companies to the venture capital community. BioEnterprise has reported that the number of venture capital firms investing in bioscience has more than doubled over the past five years; 18 firms are now active in the state, with 11 of those starting operations since 2000. This count does not include angel investors or public purpose funds.¹⁴

12. "Surviving the Big Chill," (November 2004), *Pittsburgh TEQ*.

13. *Crain's Cleveland Business* reported that John Huston, a founder of Ohio Tech Angels Fund LLC, said there were more than 60 sources of private equity and venture capital in the state. The study team identified nearly 70. (Pettypiece, Shannon, February 21, 2005, "Huston pushes organizations to up support of fledgling entrepreneurs," *Crain's Cleveland Business*). Another story in *Crain's* that day reported that Northeast Ohio companies received \$67 million in early-stage investing in 2003, firms in the Columbus region received \$35 million, and Cincinnati-area firms had \$16 million invested. These figures were compared to long-established technology hot spots: Austin, at \$513 million; Research Triangle, at \$296 million; and \$218 million in the Twin Cities of Minneapolis-St. Paul. The study was commissioned by the Greater Columbus Chamber of Commerce, and the research was performed by Mark Butterworth of SciTech. No historical data were contained in the news report. (Pettypiece, Shannon, February 21, 2005, "Cleveland leads state, trails nation in venture capital investments," *Crain's Cleveland Business*.)

14. Mezger, Roger, (February 16, 2005), "Finding money to grow," *Plain Dealer*.

IDENTIFYING EMERGING TECHNOLOGIES — THE INVESTORS' VIEW

The research team surveyed a sample of venture capital firms across North America to determine the technologies and industries they were investing in and to ascertain their opinion of Ohio's technology specializations. A list of 88 emerging technologies or products was developed by the research team, beginning with a list from Ohio-based venture capital experts. This list was supplemented with material from *Technology Review* and from the *Economist* magazine's quarterly technology roundup and industry interviews. The full list is appended to the end of this section.

The survey was e-mailed to 466 venture capitalists and members of private-equity firms. All private equity firms listed in *Crain's Cleveland Business* were surveyed. The *Crain's* statewide list was supplemented with angel, preseed, and venture capital funds associated with the technology division of Ohio Department of Development. The research team then contacted every venture capital firm listed in *VCGate*, a comprehensive electronic directory of North American venture capital firms, that had a Sand Hill Road address in Menlo Park, California. The remainder of the mailing list was a random sample of North American venture firms included in *VCGate*. The research team received 57 responses, for a response rate of 12%.

Respondents were asked to rate Ohio and the United States as sources for investment opportunities for each technology or product. They were then asked to judge the number of years before the technology or product would be ready to go to market.

There are many ways to score and report the survey results. Respondents were asked to rate each technology or product on a scale in which 1 was "avoid investing in this technology in Ohio," 2 was "not a desirable investment in Ohio," 3 signified "neutral in Ohio," 4 was "desirable investment in Ohio," and 5 depicted "very desirable investment in Ohio." Two weighting schemes were used to analyze the data, which is reported in the following tables.

The first gave a value of 1 for the "neutral" response, 2 for the "desirable" response, and 3 for a response of "very desirable." The responses were then added together and divided by the number rating the technology neutral to very desirable. (In this weighting scheme, there is a bias in favor of positive responses.) The second method again gave weights of 1 for a "neutral" response, 2 for "desirable," and 3 for "very desirable," but the total was divided by the number of responses related to the technology in question. (This is a neutral method.) Technologies that are shaded in the following chart were those in the top 25 under both weighting methods.

Venture Capitalists Rate Emerging Ohio Technology Strengths*

Top 25 Weighted Average Dividing by "Neutral" to "Very Desirable" Responses:	Top 25 Weighted Average Using Total Number Responding to Question:
Assigning 1 for "neutral," 2 for "desirable," 3 for "very desirable" and then dividing by number of "neutral" through "very desirable" responses	Assigning 1 for "neutral," 2 for "desirable," 3 for "very desirable" and then dividing by number of total responses
Solar energy	Security: Informational databases and data mining
Security: Informational databases and data mining	Medical equipment
General polymers	Fuel cells: Off-grid civilian applications
Genetically modified pest control	Nanomaterial (material science)
Medical equipment	Nanosensing (chemical sensing and monitoring)
Fuel cells: Off-grid civilian applications	Nano-enhanced polymers
Nanomaterial (material science)	Composite materials
Nanosensing (chemical sensing and monitoring)	Medical instruments
Nano-enhanced polymers	Biocompatible polymers
RFID software	Nanochem (chemical applications)
Systems biology and bioinformatics	Photonic polymers
Composite materials	Security: Remote sensing
Medical instruments	General polymers
Biocompatible polymers	Electronic polymers
Genetically modified agriculture-drug production	Liquid crystals
Automotive: Energy storage/battery	MEMs: Automotive applications
Nanobio (biomedical applications)	Fuel cells: Off-grid military applications
Nanochem (chemical applications)	Fuel cells: Building power and HVAC
Photonic polymers	Conductive polymers
Security: Remote sensing	RFID software
Automotive: Control software	Security: Chemical sensing and monitoring
Electronic polymers	Automotive: Energy storage/battery
Liquid crystals	Remote sensing
MEMs: Micromachining	Data mining and database management
MEMs: Automotive applications	MEMs: Micromachining

* Blue highlights show where Ohio emerging strengths overlapped national strengths.

The responses about Ohio varied from those rating emerging strengths in the nation as a whole. This indicates that respondents were sensitive to geographic differences in research strengths. The comparable U.S. tables are as follows:

Venture Capitalists Rate Emerging U.S. Technology Strengths

Top 25 Weighted Average: Assigning 1 for "neutral," 2 for "desirable," 3 for "very desirable" and then dividing by number of "neutral" through "very desirable" responses	Top 25 Weighted Average Using All Ratings: Assigning 1 for "neutral," 2 for "desirable," 3 for "very desirable" and then dividing by number of total responses
Power-grid hardware	Genetically modified pest control
Security: Chemical sensing and monitoring	Medical equipment
Regenerative medicine (stem-cell research)	Medical instruments
Genetically modified pest control	RFID software
Nanobio (biomedical applications)	Security: Informational databases/data mining
Security: Water-quality monitoring	Power-grid control
Medical equipment	RFID hardware
Medical instruments	Fuel cells: Off-grid civilian applications
RFID software	Artificial intelligence/fuzzy logic
Data mining and database management	Regenerative medicine (stem-cell research)
Systems biology and bioinformatics	Security: Chemical sensing and monitoring
Security: Informational databases/data mining	Security: Remote sensing
Power-grid control	MEMs: Biological applications
Space technology	Fuel cells: Building power and HVAC
RFID hardware	Fuel cells: Off-grid military applications
Fuel cells: Vehicle propulsion	Biocompatible polymers
Genetics	Data mining and database management
Security: Smart/robotic weapons	Systems biology and bioinformatics
Fuel cells: Off-grid civilian applications	Power-grid hardware
Artificial intelligence/fuzzy logic	Nanobio (biomedical applications)
Distributed storage	Security: Water-quality monitoring
Solar energy	Fuel cells: Vehicle propulsion
Genetically modified foods	Genetics
Security: Remote sensing	Distributed storage
Security: Identification technology	Wireless technologies

EMERGING TECHNOLOGIES — OPPORTUNITIES IN OHIO

Members of the study team convened expert panels throughout the state to get a business and qualitative perspective on where technological and industrial innovation will emerge in Ohio. Comments from the expert panels have been organized by technology area and aligned with the results from the venture capital survey. The following is a summary of the expert panel input and the research performed by the study team.

1. Process Improvements — A Critical Basis of the Near-Term Portion of the Innovation Portfolio

In the great majority of cases, the panel participants were highly focused on the day-to-day challenges of running their businesses in the face of global competition and intense cost pressures. Manufacturers were extremely interested in productivity-enhancing process innovations and infusions of machinery that would hold costs down and increase productivity while improving quality. Employers in service industries, especially health care, were focused on process improvements that would cut the cost of paperwork and also improve health outcomes.

An interchange in the expert panel that was held near Cincinnati on this point was illuminating. A participant representing the financial services industry said that future investment in financial services would be in two areas: back-office efficiency and improvement in the efficiency and ease of doing business. He talked about aggregation

of data. A representative of the health care industry followed up with talk of a health care database that would make genetic information on patients readily available, as well as show how patients metabolize particular medicines. “Being able to extract information from huge databases becomes critical,” he said. Hospitals will benefit from being able to access information, such as whether a patient was recently seen at another facility for a different ailment. In the region, “there’s a critical mass of groups that want to share that information.” Hospitals will be investing in technology that allows them to streamline admissions and reduce paperwork for patients, lessening the hassle of being asked repeatedly to give their name and Social Security number. “We are so far off that in health care,” he said, pointing to what technology has done for the banking industry. “We’re light years behind many industries.”

2. Information Technology — A Crosscutting Platform Set of Technologies

A theme emerged throughout the expert panels about the business prospects for the information technology (IT) industry. This theme usually was built around process improvements. Participants agreed with the study team’s observation that computer systems design, data warehousing, and information technology represent growth opportunities throughout the state. Their comments indicated that success in the IT industry will come from “narrowcasting” — developing and marketing industry-specific solutions. The state’s advantage in this narrowcasting strategy is that Ohio has a dense and broad array of customers. Process improvements both in the service sector and in manufacturing, coupled with data warehousing, are leverage points for the information technology industry in Ohio.

IT and instrument controls. There is an emerging area of expertise in instruments and controls equipment (ICE) that is hard to distinguish from IT products. National recognition of the state’s competency in ICE and IT has been slow to come because Ohio firms are focused on applications, especially factory automation, not basic research. This work is coming from the instruments and controls industry and process engineering, not from computer science. This is clearly an area of technology that is private-sector-led, not university-led. Innovations in ICE allow companies to improve how they interpret, react to, and access data about what is happening on factory floors, one panelist noted. A second area of growth in ICE will be in the deployment of sensors to improve quality during the manufacturing process and in the integration of sensors into automated processing.

IT, RFID, and self-serve technology. Pointing to ubiquitous ATMs and scanners, one West Central panelist predicted that more innovation was to come through data mining and other technologies, such as radio frequency identification (RFID). RFID, he predicted, will further automate manufacturing processes, in much the same way self-scanners have transformed the transaction process in retail checkout lines. “We’ve only scratched the surface in the area of self-serve technology.”

Venture capitalists on Ohio and IT. The venture capital survey indicated two areas in which Ohio may have a competitive edge in information technology: data mining and database management in general and database mining with security applications. Venture capitalists also saw strength in the development of RFID software, bioinformatics, and systems biology.

3. Chemistry — A Foundation of the Economy of the Future Incorporating a Critical Crosscutting Area of Science, Polymer Chemistry, and Nanotechnology

Those who participated in the venture capital survey responded strongly to both nanotechnologies and polymer science. This response led the study team to hypothesize that the intersection of these two sets of intellectual activities is a particular strength of the state. General polymer science was highly rated by the venture capital community, as were more specific polymer chemistry applications:

- Biocompatible polymers
- Photonic polymers
- Electronic and conductive polymers

Nanotechnology. The science of all things small is of growing interest to investors in Ohio, and it is a crosscutting set of technologies that will disrupt many existing product lines and companies. Despite *Business Week* declaring in its February 14, 2005, issue that nanotech is a set of technologies ready to emerge from the lab and go to the market, area venture capitalists noted that the technologies have yet to find substantial market penetration.

Nanotechnologies were not mentioned in-depth during the expert panels, but they were very well-represented in the venture capital survey, both locally and nationally. Nanomaterials were identified as a strength of the state, as was the intersection of nanotechnologies and polymer science. “We’re trying to figure out how to make it benefit us,” said one Northeast Ohio manufacturer. “We’re looking into novel ways to create material.”

Nanosensing was another application that interested investors, given the demand for remote-sensing security applications. Other applications of interest were in the areas of nanobiology, nano-enhanced polymers, nanochemistry, and nanocoatings.

Liquid crystal research. Liquid crystals were viewed as a growing area in Ohio and were ranked among the top 25 technologies by both of the methodologies used to analyze the venture capital survey. This research was not viewed as being a competitive area of investment elsewhere in the nation.

Micro-electro-mechanical systems (MEMS). The two applications in which venture capitalists considered Ohio to be strong were MEMS machining and automotive MEMS applications. However, MEMS research is beginning to merge with chemistry, and the borderline between MEMS and nano-scale chemistry is beginning to blur.

4. Agriculture and Biotechnology

The expert panel in Columbus noted a connection between research and agriculture. “Ohio is on the cutting edge of technology,” said one Central region manufacturer, citing increases in genetic engineering as an example. “But I don’t see a lot of research and development around it.” Another participant considered genetic engineering of plant materials to be a natural bridge linking Ohio’s agricultural history to a technology-rich future. Respondents to the venture capital survey saw genetically engineered pest control as a likely area of investment nationally and locally, but the national ranking was higher. The Ohio venture capital survey also ranked genetically modified drug production as a potential area of investment.

5. Fuel Cells

"I'm heartened by any advance in energy cell technology," said one Northeast Ohio banker. "We have to figure out different ways to move things around in this country." Despite the interest and optimism about fuel cells as an emerging technology, the applications and market are still distant. Fuel cells are a decade or more away from widespread application, predicted one Northeast Ohio manufacturer. Although expert panelists noted the potential that fuel cells have for changing the world economy, one Northeast Ohio manufacturer who has been involved with the industry since 1998 predicted that applications for fuel cells would emerge faster in developing countries because "they don't have the infrastructure that we do. You have to have hydrogen fueling stations develop first before you can see fuel cells develop."

Other opportunities now lie in bridge technologies: hybrid fuel uses that combine batteries, fuel cells, and electric motors with petroleum-based fuel sources. Some expert panel members viewed bridge technologies as intermediate steps that could take consumers from current technology to a fuel cell hydrogen economy of the future.

Fuel cells were viewed as an opportunity area for Ohio-based venture investing. The embryonic technology is rooted in the state, and industries that can ride down the application curve, which is measured by the cost per kilowatt hour, are also located in Ohio. However, the mass application to automobiles remains in the future. Respondents to the venture survey agreed with members of the expert panel: The immediate target market consists of civilian applications that are off the electric grid. One of the weighting schemes also brought out off-grid military applications and heating, ventilation, and air-conditioning as top 25 technology areas. All three fuel cell uses were ranked by the venture capitalists nationally. However, fuel cells for automobile use appeared on the national list and was absent from the Ohio list.

6. Medical Devices

"As much as we want to be biotech here, I don't think it will happen here," said a representative of a Northeast Ohio medical technology incubator. Instead, the region's best prospects lie in leveraging its clinical knowledge and its manufacturing base to develop and produce medical devices and equipment. "I think we will be on par with Minneapolis within a few years." But such a goal requires nurturing small to midsized businesses, she said.

The venture capital survey was in agreement with the panelist's comments. Medical equipment and instruments were highly ranked in Ohio, receiving higher marks in the state than in the nation as a whole. Biocompatible polymers were also highly ranked as a potential area of investment in Ohio. This technology was missing from the national list. Biological applications of nanotechnology were ranked as a potential Ohio specialization under one of the analytic methodologies.

Crain's Cleveland Business reported in early March 2005 that Northeast Ohio saw a 90% increase in venture capital commitments in the area of bioscience.¹⁵ The region has grown from being a place of very limited bioscience investment to being in the "middle of the pack" among metropolitan areas, with more than \$61 million in venture capital raised in 2004. The leadership of BioEnterprise, the venture capital intermediary has set a

15. Pettypiece, Shannon (March 7-13, 2005), "Investments in bioscience balloon," *Crain's Cleveland Business*.

target of \$100 million per year in investments for Northeast Ohio. The organization sees that level of deal flow as a threshold to becoming a life sciences investment hot spot and a clear-cut market test of the quality of local work. Investment also took place outside of Northeast Ohio, with \$10 million going to a cell culture producer in Athens and another \$19 million being invested in companies elsewhere in the state.

7. Automotive

A number of emerging technologies relate to automobiles. None was identified as being of interest to the venture capital community. When these results were discussed with private equity investors, they indicated that these technologies will disrupt the automobile market when they come. However, the timing is distant, and these technologies will most likely be the province of large, established businesses because of the amount of money required to place them in the cars of the future.

Energy and battery systems. This was seen as technology in which Ohio is competitive in producing hybrid propulsion systems and in providing way stations for an alternative fuel source to the hydrocarbon engine. However, the respondents to the venture capital survey disagreed, indicating that hybrid systems are being developed by global automotive OEMs or Tier 1 suppliers.

Vehicle control software. This technology was viewed as the province of automotive systems integrators and Tier 1 suppliers. Therefore, Ohio firms are not expected to make a contribution in this area.

Drive-by-wire. Airplanes have migrated from mechanical flight controls to electronic, or fly-by-wire, controls. In the process, aircraft original equipment manufacturers replaced a number of mechanical parts and lightened the weight of planes and airframes. The same advancements are expected to occur in automobiles, with electronics replacing much of the steering, braking, and control systems. Industry experts also have noted that, if the gasoline engine is replaced with smaller electronic propulsion systems, the entire drive train can be changed. The venture capitalists who responded to these technologies showed little interest. Two reasons were given: First, technologies connected to the drive train were considered dependent on electric propulsion systems, which were viewed as being distant. Second, for those technologies that are imminent, such as antilock braking and skid-control systems, the capital and system integration requirements make this an area in which existing automotive supply companies with knowledge of automotive electronics will dominate. Tier 3 and 4 suppliers of mechanical subassemblies will most likely lose business from these technological innovations.

Advanced modeling and simulation. Testing automobiles is a costly endeavor, said one Central region supplier for the automotive industry. Efforts are under way to build computer simulation models for testing components such as tires. "It cuts down on testing," he said. "It takes some of the risk and money out of it." Finite element analysis is one application of mathematics and IT that could be the core of industry-based simulation opportunities. Other forms of applied mathematics, statistical analysis, and computer modeling could also be important to this area of product development and testing.

8. Alternative Energy Sources

Alternative energy sources generate much interest on the part of environmentalists and futurists. In the northwestern corner of Ohio, agricultural researchers consider biomass a fuel source.¹⁶ They join wind-power advocates in seeing such technologies, including clean coal, as ways of fueling Ohio's future. However, other than fuel cell technology, the surveyed venture capitalists did not put power at the top of their lists of technologies in which the state has a current competitive advantage.

Clean coal is an active area of research funded by the state, with a decision forthcoming on the location of a pilot plant. However, this technology was not viewed as an area for venture capital investing. Respondents deemed solar power an area in which Ohio could be technologically competitive. Wind power technology was viewed as largely established; survey participants considered going to market with these technologies to be a matter of relative energy costs.

16. Biomass is any organic matter that is available on a renewable or recurring basis, including trees, plants, and associated residues; plant fiber; poultry litter and other animal wastes; industrial waste; and the paper component of municipal solid waste. Most biomass is derived from cellulose, which is a polymer, and combinations of lignin, which is the glue that holds the cellulose polymer chain together.

Scientific and Research Facilities in Ohio by Region Listed in the Harris Directory

	Primary NAICS	Company Name	Employees	Parent Name	Parent State	Ownership	Location Description
Northwest							
1	541710	Surface Combustion Inc	120			Private	Parent
2	541710	Flexsys America LP	100			Private	Parent
3	541710	Millerville Lime Inc	100	Carmeuse Lime Inc	IL	Private	Division HQ
4	541710	Pilkington North America Inc	100	Pilkington North America Inc	OH	Private	Branch
5	541710	Plastic Technologies Inc	100			Private	Single Location
6	541710	Pilkington North America Inc	100			Private	Single Location
7	541710	Honeywell International Inc	100	Honeywell International Inc	NJ	Public	Branch
8	541710	Brookside Laboratories Inc	40			Private	Single Location
9	541710	First Solar LLC	30	First Solar LLC	OH	Private	Branch
10	541710	Premier Research	28	Vesuvius USA Corp	IL	Private	Branch
11	541710	FT Stone Laboratory	20	Ohio State University	OH		Branch
12	541710	E I S C Inc	30			Private	Single Location
Northeast							
1	541710	NASA-John H Glenn Research Ctr	6,114	National Aeronautics Space ADM	DC	Government	Branch
2	541710	Noveon Inc	3,200	Noveon International Inc	OH	Private	Headquarters
3	541710	Diebold Inc	900			Public	Parent
4	541710	Energizer Battery Mfg	482	Energizer	MO	Public	Branch
5	541710	WIL Research Laboratories	370	Great Lakes Chemical Corp	IN	Private	Branch
6	541710	Sherwin-Williams Co	300	Sherwin-Williams Co	OH	Public	Branch
7	541710	Sherwin-Williams Automotive	300	Sherwin-Williams Co	OH	Public	Headquarters
8	541710	Quark Biotech Inc	285			Private	Single Location
9	541710	Glidden Co	275	ICI Paints	OH	Public	Branch
10	541710	Timken Co	250	Timken Co	OH	Public	Branch
11	541710	Northrop Grumman Information	250	Northrop Grumman Information	VA	Public	Branch
12	541710	Gould Electronics Inc	245			Private	Parent
13	541710	Ricerca Biosciences LLC	200			Private	Single Location
14	541710	Goodyear Tire & Rubber Co	200	Goodyear Tire & Rubber Co	OH	Public	Branch
15	541710	McDermott Technologies Inc	180			Private	Single Location
16	541710	UCAR Carbon Co Inc	162	GrafTech International Ltd	DE	Public	Branch
17	541710	GSI Laboratory	100	Glowe-Smith Industrial Inc	OH	Private	Branch
18	541710	Ferro Corp	75	Ferro Corp	OH	Public	Branch
19	541710	Athersys Inc	65			Private	Single Location
20	541710	Omnova Solutions Inc	65	OMNOVA Solutions Inc	OH	Public	Branch
21	541710	Michelin North America Inc	60	Michelin North America Inc	SC	Private	Branch
22	541710	AN Atys US Inc	55	SIAS		Private	Parent
23	541710	Battelle Memorial Institute	52	Battelle Memorial Institute	OH	Private	Branch
24	541710	Promerus LLC	52	Durez Corp	TX	Private	Branch
25	541710	Metal Coatings International	45	NOF Corp		Private	Parent
26	541710	Gliatech Inc	45			Private	Single Location
27	541710	Universities Space Research	30	Universities Space Research	MD	Private	Branch
28	541710	Pliant Corp	30	Pliant Corp	IL	Private	Branch
29	541710	Firestone	30	Bridgestone/Firestone Retail	IL	Private	Branch
30	541710	Foundation Clinical Neuro Resr	30			Private	Single Location
31	541710	Technology 2000 Inc	29			Private	Single Location
32	541710	Science Applications Intl Corp	28	Science Applications Intl Corp	CA	Private	Branch
33	541710	Kumho Technical Center	26	Kumho Group		Private	Branch
34	541710	Solar Mower	26			Private	Single Location
35	541710	Cleveland Steel Container Corp	25			Private	Single Location
36	541710	Circle Prime Manufacturing Inc	25			Private	Single Location
37	541710	White Environmental Services	25			Private	Single Location
38	541710	Appalachian Geophysical Svcs	25			Private	Single Location
39	541710	Chantest Inc	23			Private	Single Location
40	541710	A Schulman Inc	23	A Schulman Inc	OH	Public	Branch
41	541710	Summit Environmental Tech	22			Private	Single Location
42	541710	AES PC Experts	20			Private	Single Location
43	541710	Akron Polymer Laboratory Inc	20			Private	Single Location
44	541710	Concept Development Institute	20			Private	Single Location
45	541720	Clinical Research Management	150			Private	Single Location
46	541720	Gestalt Institute Of Cleveland	100			Private	Single Location
47	541720	Biostatistics	80			Private	Single Location
48	541720	Fibratek Inc	53			Private	Single Location
49	541720	Canton Medical Education Fndtn	50			Private	Single Location
50	541720	Hankook Tire Co Ltd	40			Private	Single Location
51	541710	Ea Group	35			Private	Single Location
52	541720	OFEQ Institute Inc	26			Private	Single Location

Scientific and Research Facilities in Ohio by Region Listed in the Harris Directory

	Primary NAICS	Company Name	Employees	Parent Name	Parent State	Ownership	Location Description
West Central							
1	541710	Science Applications Intl Corp	304	Science Applications Intl Corp	CA	Private	Branch
2	541710	ITW FEG Corp	200	Illinois Tool Works Inc	IL	Public	Branch
3	541710	Anteon Corp	127	Anteon International Corp	VA	Public	Branch
4	541710	Sytronics Inc	100			Private	Single Location
5	541710	Advanced Info Engineering Svcs	100	General Dynamics Advanced Info	MN	Public	Branch
6	541710	Mission Research Corp	70	Mission Research Corp	CA	Public	Branch
7	541710	Adtech Systems Research Inc	60			Private	Single Location
8	541710	Flowserve Corp	60	Flowserve Corp	TX	Public	Branch
9	541710	Innovative Scientific Solution	55			Private	Single Location
10	541710	CACI Technologies Inc	50	CACI International Inc	VA	Public	Branch
11	541710	International Truck & Eng Corp	50			Private	Single Location
12	541710	MTL Systems Inc	40			Private	Single Location
13	541710	Monsanto Enviro-Chem Systems I	30			Private	Single Location
14	541710	Landing Gear Test Facility	30			Private	Single Location
15	541710	UES Inc	25			Private	Single Location
16	541710	North American Nutrition Co's	25	North American Nutrition Co's	OH	Private	Branch
17	541710	Plastipak Packaging Inc	25			Private	Single Location
18	541710	Rogosin Institute Inc	25	Rogosin Institute Inc	NY	Private	Branch
19	541710	Cornerstone Research Group Inc	21			Private	Single Location
20	541710	Strategic Analysis Inc	20	Strategic Analysis Inc	VA	Private	Branch
21	541710	IAP Research Inc	20			Private	Single Location
22	541720	Klein Associates Inc	40			Private	Single Location
23	541720	Islet Purification	30			Private	Single Location
24	541720	Fore Testing Laboratories Inc	21			Private	Single Location
25	541720	Hipple Cancer Research Center	21			Private	Single Location
Central							
1	541710	Battelle Memorial Institute	4,712	Battelle Memorial Institute		Private	Parent
2	541710	Honda R & D America's Inc	1,400	Honda R & D Americas Inc	CA	Private	Branch
3	541710	Ashland Specialty Chemical Co	1,200	Ashland Inc	KY	Public	Headquarters
4	541710	Owens Corning	400	Owens Corning	OH	Public	Branch
5	541710	Battelle Memorial Institute	230	Battelle Memorial Institute	OH	Private	Branch
6	541710	R & D Nestle Center Inc	220	Nestle Product Technology Ctr	CT	Private	Branch
7	541710	Short & Sweet	200	Children's Hospital	OH	Private	Branch
8	541710	Westvaco Corp	100	MeadWestvaco Corp	NY	Public	Branch
9	541720	American Polar Society	100			Private	Single Location
10	541710	TS Tech North America Inc	100			Private	Parent
11	541710	Abbott Laboratories	75	Abbott Laboratories	IL	Public	Branch
12	541710	Dublin Technical Center	69	Crompton Corp	CT	Public	Branch
13	541710	Prologue Research Intl	56			Private	Single Location
14	541710	Ventaira Pharmaceuticals Inc	51	Battelle Memorial Institute	OH	Private	Branch
15	541710	Microweld Engineering Inc	45			Private	Single Location
16	541710	Guild Associates Inc	45			Private	Single Location
17	541710	Velocys Inc	43	Battelle Memorial Institute	OH	Private	Branch
18	541720	Economic Zone Resource Assoc	30			Private	Single Location
19	541710	Metss Corp	21			Private	Single Location
20	541720	Neuroscience Center Inc	40			Private	Single Location
21	541720	Ingenix Chips	40	UnitedHealth Group Inc	MN	Public	Branch

Scientific and Research Facilities in Ohio by Region Listed in the Harris Directory

	Primary NAICS	Company Name	Employees	Parent Name	Parent State	Ownership	Location Description
Southeast							
1	541710	Organic Technologies	65			Private	Parent
2	541710	Sunpower Inc	47			Private	Single Location
Southwest							
1	541710	Procter & Gamble Co	2,400	Procter & Gamble Co	OH	Public	Branch
2	541710	Ethicon Endo-Surgery Inc	1,500	Johnson & Johnson Inc	NJ	Public	Branch
3	541710	Procter & Gamble Co	850	Procter & Gamble Co	OH	Public	Branch
4	541710	Kendle International Inc	500			Public	Parent
5	541710	Harris Corp	300	Harris Corp	FL	Public	Branch
6	541710	Psychiatric Professional Svcs	250			Private	Single Location
7	541710	Medpace Inc	190			Private	Single Location
8	541710	Equistar Chemicals LP	190	Equistar Chemicals LP	TX	Public	Branch
9	541710	Barrett Center For Cancer	100			Private	Single Location
10	541710	Answer Group	100	Wirthlin Worldwide Inc	VA	Private	Branch
11	541710	Advanced Drainage Systems Inc	100	Advanced Drainage Systems Inc	OH	Private	Branch
12	541710	Lockheed Martin Technology's	70	Lockheed Martin Corp	MD	Public	Branch
13	541710	Bionetics Corp	70	Bionetics Corp	VA	Private	Branch
14	541710	Schulman Associates Instnl	70			Private	Single Location
15	541710	AK Steel Corp	62	AK Steel Corp	OH	Public	Branch
16	541710	Cincinnati Foundation Research	50			Private	Single Location
17	541710	Alkermes Inc	50	Alkermes Inc	MA	Public	Branch
18	541710	Millennium Petrochemicals Inc	40			Private	Parent
19	541710	Environmental Chemical Corp	35	Environmental Chemical Corp	CA	Private	Branch
20	541710	Amersham Health Inc	25	Amersham Health Inc	NJ	Public	Branch
21	541710	A S E Technologies Inc	24			Private	Single Location
22	541710	Lindner Center	20			Private	Single Location
23	541720	Atricure Inc	33			Private	Single Location
24	541720	Center For CJ Research	30			Private	Single Location

U.S. News & World Report's Honor Roll Medical Centers in 2004

Hospitals or medical centers that excelled in six or more specialties:

1. Johns Hopkins Hospital, Baltimore, 32 points in 16 specialties
2. Mayo Clinic, Rochester, Minn., 28 points in 14 specialties
3. Massachusetts General Hospital, Boston, 24 points in 13 specialties
4. Cleveland Clinic, 24 points in 12 specialties
5. UCLA Medical Center, Los Angeles, 23 points in 14 specialties
6. (TIE) Duke University Medical Center, Durham, N.C., 18 points in 10 specialties
6. (TIE) University of California, San Francisco Medical Center, 18 points in 10 specialties
8. Barnes-Jewish Hospital, St. Louis, 17 points in 11 specialties
9. (TIE) New York-Presbyterian Hospital, 17 points in 10 specialties
9. (TIE) University of Washington Medical Center, Seattle, 17 points in 10 specialties
11. University of Michigan Medical Center, Ann Arbor, 13 points in 9 specialties
12. Brigham and Women's Hospital, Boston, 12 points in 8 specialties
13. Hospital of the University of Pennsylvania, Philadelphia, 11 points in 6 specialties
14. Stanford Hospital and Clinics, Stanford, Calif., 10 points in 7 specialties

Ohio medical centers included in the *U.S. News & World Report's* specialty rankings are presented in the following list. The ranking within the specialty is listed first, followed by the name of the hospital and then its score out of 100. Those specialties with only scores based on their reputations are lower than those scored using the full *U.S. News & World Report* methodology.

Cancer

- 7 University Hospitals of Cleveland, 32.9
- 30 Cleveland Clinic, 29.4
- 39 Arthur G. James Cancer Hospital, Columbus, 28.0
- 49 Riverside Methodist Hospitals, Columbus, 27.2

Digestive

- 2 Cleveland Clinic, 70.3
- 25 University Hospitals of Cleveland, 29.1
- 36 Summa Health System, Akron, 27.7
- 45 Christ Hospital, Cincinnati, 26.8
- 46 Miami Valley Hospital, Dayton, 26.7

Ear, Nose, & Throat

- 8 Cleveland Clinic, 53.0
- 16 University Hospital, Cincinnati, 38.3
- 17 Ohio State University Medical Center, Columbus, 38.1
- 31 University Hospitals of Cleveland, 33.7
- 43 Summa Health System, Akron, 32.5

Geriatrics

- 11 Cleveland Clinic, 38.1
- 14 University Hospitals of Cleveland, 34.8
- 30 Christ Hospital, Cincinnati, 30.6
- 36 Summa Health System, Akron, 30.2

Gynecology

- 8 Cleveland Clinic, 48.4
- 33 Ohio State University Medical Center, Columbus, 33.6

34 University Hospitals of Cleveland, 33.5

Heart

- 1 Cleveland Clinic, 100.0
- 29 Summa Health System, Akron, 31.0
- 47 Miami Valley Hospital, Dayton, 29.3
- 50 Riverside Methodist Hospitals, Columbus, 29.1

Hormonal Disease

- 10 Cleveland Clinic, 37.4
- 24 Ohio State University Medical Center, Columbus, 27.2
- 38 University Hospitals of Cleveland, 25.5
- 50 St. Vincent Medical Center, Toledo, 24.8

Kidney Disease

- 5 Cleveland Clinic, 92.8
- 35 Ohio State University Medical Center, Columbus, 46.1

Neurology/Neurosurgery

- 6 Cleveland Clinic, 58.0
- 15 University Hospitals of Cleveland, 31.5
- 36 Ohio State University Medical Center, Columbus, 27.9
- 41 Community Health Partners Hospital and Surgical Center, Lorain, 27.6
- 49 St. Elizabeth Medical Center-North, Covington, Ky., 27.0

Ophthalmology*

- 14 Cleveland Clinic, 5.8

Orthopedics

- 5 Cleveland Clinic, 43.6
- 25 University Hospitals of Cleveland, 27.4
- 41 Summa Health System, Akron, 25.4

Pediatrics*

- 6 Rainbow Babies & Children's Hospital, Cleveland, 15.9
- 7 Children's Hospital Medical Center, Cincinnati, 12.1

Psychiatry*

- 22 University Hospitals of Cleveland, 3.8
- 26 Cleveland Clinic, 3.1

Rehabilitation*

- 7 Ohio State University Medical Center, Columbus, 15.7
- 24 Cleveland Clinic, 3.3

Respiratory Disorders

- 11 Cleveland Clinic, 41.9
- 17 University Hospitals of Cleveland, 31.1
- 27 Ohio State University Medical Center, Columbus, 27.8
- 33 Miami Valley Hospital, Dayton, 27.5
- 35 Southwest General Health Center, Middleburg Heights, 27.3
- 36 Christ Hospital, Cincinnati, 27.3
- 39 University Hospital, Cincinnati, 27.1
- 41 MetroHealth Medical Center, Cleveland, 27.1
- 43 Community Health Partners Hospital and Surgical Center, Lorain, 27.0
- 46 Meridia Hillcrest Hospital, Cleveland*, 26.9
- 47 Grandview Hospital and Medical Center, Dayton, 26.8
- 48 St. Elizabeth Medical Center-North, Covington, Ky. 26.8
- 49 Summa Health System, Akron, 26.8
- 50 Akron General Medical Center, Akron, 26.7

Rheumatology*

- 3 Cleveland Clinic, 33.5

Urology

- 2 Cleveland Clinic, 81.1
- 35 University Hospitals of Cleveland, 30.9
- 45 University Hospital, Cincinnati, 30.3
- 46 Ohio State University Medical Center, Columbus, 30.2

* Reputation score only

Source: *U.S. News & World Report*. Complete list available at
<http://www.usnews.com/usnews/health/hosptl/tophosp.htm>

Technologies or Products of the Future

Environmental clean-up	Genetically modified foods
Environmental remediation	Genetically modified agricultural products (seed, fertilizer, etc.)
Automotive hybrid: Propulsion systems	Genetically modified pest control
Automotive hybrid: Energy storage/battery	Genetically modified agricultural -drug production
Automotive hybrid: Propulsion software	Fuel cells: Off-grid military applications
Automotive hybrid: Drive train	Fuel cells: Off-grid civilian applications
Automotive hybrid: Control software	Fuel cells: Building power and HVAC
Automotive: Drive-by-wire, braking	Fuel cells: Vehicle propulsion
Automotive: Drive-by-wire, safety	Solar energy
Automotive: Drive-by-wire, drive train/steering/controls	Wind energy
Automotive: Drive-by-wire, electrical (lights, visioning, entertainment)	Biomass energy
Automotive: Drive-by-wire, system integration	Clean-coal technologies
Home robotics	Power-grid control
Artificial intelligence/fuzzy logic	Power-grid hardware
Predictive technologies, simulations (politics, stock market)	Nano-enhanced polymers
Remote sensing	Biocompatible polymers
Internet related semiconductors	Electronic polymers
Distributed computer data storage	Conductive polymers
RFID hardware	Photonic polymers
RFID software	General polymers
Health care procurement software	Composite materials
Health care management software	Liquid crystals
Health care claims processing software	Nanowires
Universal language translation software	Nanobio (biomedical applications)
Automated network software	Nanochemical (chemical applications)
Data mining and database management	Nanosensing (chemical sensing and monitoring)
Wireless technologies	Nano water quality monitoring
Internet-related telephones, VOIP, and PDAs	Micro-electro-mechanical systems (MEMS): Micromachining
Advanced optical fibers (microfluids)	MEMS: Biological applications
Photonics: Energy generation	MEMS: Chemistry applications
Photonics: Communications	MEMS: Automotive applications
Photonics: Information processing	MEMS: Security applications
Photonics: Telecommunications	Security technology: Identification technology
Photonics: Security	Security: Chemical sensing and monitoring
Medical equipment	Security: Water quality monitoring
Medical instruments	Security: Remote sensing
T-ray imaging	Security: Informational databases/ data mining
Regenerative medicine (stem cell research)	Security: Smart/robotic weapons
Genetics	Ultrahigh-speed rail travel: Magnetic levitation
RNAi therapy (RNA interference)	Ultrahigh-speed rail travel: Electric propulsion
Systems biology and bioinformatics	Ultrahigh-speed rail travel: Controls
Synthetic biology	Space travel
Prosthetics	Small corporate jets

14 Groups of Driver, Growth, and Established Pillar Industries for the State and Region (part 1)

D indicates a Driver Industry

G indicates a Growth Industry--Large increases in Gross Product, increasing productivity, and low Gross Product Location Quotient

P indicates a Pillar Industry--Large increases in Gross Product, increasing productivity, and high Gross Product Location Quotient

NAICS	Industry Name	State	Northwest	Northeast	West Central	Central	Southeast	Southwest
1. Automotive and related								
3361	Motor vehicle manufacturing	D	D	D	D	D		D
3362	Motor vehicle body & trailer manufacturing	D	D	D	D	D		D
3363	Motor vehicle parts manufacturing	D	D	D	D	D	D	D
3369	Other transportation equipment manufacturing	D		D				D
2. Aerospace								
3364	Aerospace product and parts manufacturing	P			D			D
GVF	Federal government				D			
ML	Military personnel				D			
3. Bio-medical								
6221	General medical and surgical hospitals	D	D	D		D		D
4. Building products								
Wood-based								
1133	Logging	G		G			D	
3211	Sawmills & wood preservation						D	
3212	Veneer, plywood, engineered wood products manufacturing						D	
3219	Other wood products manufacturing						D	
Mechanical, electrical, appliance								
3334	Ventilation, heating, air-conditioning, and commercial refrigeration equipment				D			
3351	Electric lighting equipment manufacturing	P		D		D	D	
3352	Household appliance		D					
3371	Household and institutional furniture and kitchen cabinets		D					
5. Chemicals								
3251	Basic chemical manufacturing						D	
3252	Resin, synthetic rubber, & artificial synthetic fibers & filaments							D
3253	Pesticide, fertilizer, & other agricultural chemicals					D		D
3255	Paint, coating, and adhesive manufacturing							
3256	Soaps, cleaning compounds, & toilet preparation		D	D		D	P	P
3261	Plastic product manufacturing		D					D
3262	Rubber product manufacturing		D	D	P	D		
3271	Clay product & refractory manufacturing		D	D		D	D	
3279	Other nonmetallic mineral product manufacturing		D	D		D		
4246	Chemical and allied products merchant wholesalers			P	D	D		D
6. Energy production and transportation								
2121	Coal mining						D	
2211	Electric power generation, transmission and distribution	D		G				
2212	Natural gas distribution			P		D		
3241	Petroleum and coal products manufacturing		D					
4247	Petroleum and petroleum products merchant wholesalers							D
4860	Pipeline transportation	D		G	D			D

14 Groups of Driver, Emerging, and Established Industries for the State and Region (part 2)

D indicates a Driver Industry

G indicates a Growth Industry--Large increases in Gross Product, increasing productivity, and low Gross Product Location Quotient

P indicates a Pillar Industry--Large increases in Gross Product, increasing productivity, and high Gross Product Location Quotient

NAICS	Industry Name	State	Northwest	Northeast	West Central	Central	Southeast	Southwest
7. Environmental remediation technology								
5622	Waste Treatment and Disposal	D	P	D		D	P	D
5629	Remediation and Other Waste Management Services	P		P	D			
8. Food manufacturing								
3111	Animal Food Manufacturing	P	D		D	D	D	D
3112	Grain and oil see milling		D					
3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing	P	D			D	D	
3115	Dairy Product Manufacturing			P	P	D		
3118	Bakeries and Tortilla Manufacturing		D					P
3119	Other Food Manufacturing						P	
3121	Beverage Manufacturing	P						D
FR	Farms		P				P	
9. Logistics/Distribution Centers								
4242	Drugs and Druggists' Sundries Merchant Wholesalers			G	G			
4243	Apparel, Piece Goods, and Notions Merchant Wholesalers							P
4249	Miscellaneous Nondurable Goods Merchant Wholesalers							G
4841	General freight trucking					D		
4884	Support Activities for Road Transportation			P				
4885	Freight Transportation Arrangement					D		P
4889	Other support activities for transportation	D	D	D				
4931	Warehousing and Storage				P	D		P
10. Machinery								
3331	Agriculture, Construction, and Mining Machinery Manufacturing		D					
3332	Industrial Machinery Manufacturing				D			
3335	Metalworking Machinery Manufacturing		D	D	D			
3339	Other General Purpose Machinery Manufacturing		D					
8113	Commercial and Industrial Machinery and Equipment Repair	G						
11. Metals and Metal Working (except direct automotive)								
3311	Iron and steel mills and ferroalloy manufacturing		D	D	D		D	
3312	Steel product manufacturing from purchased steel	D	D	D	D		D	D
3313	Alumina and aluminum production and processing							
3314	Nonferrous metal (except aluminum) production & processing							
3315	Foundries		D	D		D		
3321	Forging and stamping	D	D	D				
3322	Cutlery and hand tool manufacturing		D	D				
3324	Boiler, tank, and shipping container manufacturing		D	D				
3326	Spring and wire product manufacturing		D	D				
3327	Machine shops, turned product, & screw, nut, & bolt mfging			D				
3328	Coating, engraving, heat treating, and allied activities		D	D				
3329	Other fabricated metal product manufacturing			D				
4235	Metal and mineral (except petroleum) merchant wholesalers			D				

14 Groups of Driver, Emerging, and Established Industries for the State and Region (part 3)

D indicates a Driver Industry

G indicates a Growth Industry--Large increases in Gross Product, increasing productivity, and low Gross Product Location Quotient

P indicates a Pillar Industry--Large increases in Gross Product, increasing productivity, and high Gross Product Location Quotient

NAICS	Industry Name	State	Northwest	Northeast	West Central	Central	Southeast	Southwest
12. Other Manufacturing								
3353	Electrical Equipment Manufacturing							P
3272	Glass and glass product manufacturing		D			D		
13. Scientific, instruments, controls and electronics								
3343	Audio and video equipment manufacturing							D
3359	Other Electrical Equipment and Component Manufacturing	P		D				
5414	Specialized Design Services						G	
5415	Computer Systems Design and Related Services	G		G	G	G		G
5417	Scientific Research and Development Services						G	
8112	Electronic and Precision Equipment Repair and Maintenance	G						
14. Professional services/value added services								
Finance and insurance								
5221	Depository credit intermediation (banks)	D	P	D	D	P	P	D
5222	Nondepository Credit Intermediation	G		G	G			G
5241	Insurance Carriers	D		D		D		P
Headquarters, administrative, back office-shared services								
5511	Management of Companies and Enterprises	D	D	D	G	D	D	D
5611	Office Administrative Services	G			G			
5612	Facilities Support Services	P			P			D
5615	Travel Arrangement and Reservation Services				P			
8134	Civic and Social Organizations							P
Other services								
5613	Employment services	D						
7113	Promoters of Performing Arts, Sports, and Similar Events						P	
7114	Agents and Managers for Artists, Athletes, Entertainers, and Other Public Figures							G
Tourism								
7115	Independent Artists, Writers, and Performers							G
7121	Museums, Historical Sites, and Similar Institutions		P					P
7139	Other Amusement and Recreation Industries							P
FH	Fishing, Hunting, Etc.			G				

Industries that are Growing but are Not Drivers for the State and Region
Large increases in Gross Product, increasing productivity, and Low Gross Product Location Quotient
Sorted by Change in the Value of Real Gross Product

NAICS Code	NAICS Title	Change in Gross Product 1998-2002	Change in Productivity 1998-2002	Gross Product LQ 2002
State				
5222	Nondepository Credit Intermediation	748,910,000	12,512	0.67
5415	Computer Systems Design and Related Services	617,720,000	16,953	0.50
5611	Office Administrative Services	283,150,000	28,857	1.02
8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	123,490,000	20,728	0.79
8112	Electronic and Precision Equipment Repair and Maintenance	56,040,000	24,327	0.54
1133	Logging	15,410,000	26,443	0.35
Northwest				
5511	Management of Companies and Enterprises	190,350,000	34,961	0.51
Northeast				
2211	Electric Power Generation, Transmission and Distribution	380,780,000	48,568	0.97
5222	Nondepository Credit Intermediation	374,400,000	21,277	0.68
5415	Computer Systems Design and Related Services	135,120,000	19,390	0.34
4242	Drugs and Druggists' Sundries Merchant Wholesalers	121,500,000	28,364	0.89
1133	Logging	5,500,000	22,917	0.31
4860	Pipeline Transportation	4,780,000	42,209	0.49
FH	Fishing, Hunting, Etc.	1,480,000	74,000	0.01
West Central				
5511	Management of Companies and Enterprises	141,420,000	28,945	0.65
5415	Computer Systems Design and Related Services	115,780,000	12,731	0.89
5222	Nondepository Credit Intermediation	82,180,000	18,677	0.69
5611	Office Administrative Services	26,200,000	104,368	0.90
4242	Drugs and Druggists' Sundries Merchant Wholesalers	24,250,000	44,787	0.48
Central				
5511	Management of Companies and Enterprises	673,720,000	34,957	0.95
5415	Computer Systems Design and Related Services	160,330,000	12,372	0.68
Southeast				
5511	Management of Companies and Enterprises	94,230,000	58,336	0.55
5414	Specialized Design Services	7,320,000	152,971	0.41
5417	Scientific Research and Development Services	1,320,000	356,727	0.20
Southwest				
5415	Computer Systems Design and Related Services	179,400,000	22,985	0.61
5222	Nondepository Credit Intermediation	101,030,000	8,160	0.49
4249	Miscellaneous Nondurable Goods Merchant Wholesalers	42,920,000	43,907	0.89
7115	Independent Artists, Writers, and Performers	4,610,000	34,422	0.17
7114	Agents and Managers for Artists, Athletes, Entertainers, and Other Public Figures	1,180,000	26,500	0.14

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