



WORLD CLASS OHIO

*A Prospectus for Achieving Success
in the Third Frontier*

June 2003



OHIO BUSINESS
ROUNDTABLE



41 South High Street
Columbus, Ohio 43215
614-469-1044

E. Linn Draper, Jr. *Chairman*
John F. Barrett, *Chairman-elect*
Richard A. Stoff, *President*

June 10, 2003

The Honorable Bob Taft
Governor of Ohio

The Honorable Doug White
President of the Ohio Senate

The Honorable Larry Householder
Speaker of the Ohio House of Representatives

Dear Governor Taft, President White and Speaker Householder:

The Ohio Business Roundtable is pleased to submit this prospectus – **“World Class Ohio”** – for your consideration. We hope it will provide guidance to you and other state policy leaders on the strategic direction and investment priorities of the Third Frontier Project.

Ohio has a wealth of riches – quality of life, location, a diversified range of industries, an abundance of natural resources, strengths in basic research, a tradition of innovation and invention, and a work ethic second to none. At the same time, per capita income in Ohio – once ahead of the national average – has steadily declined since the 1940s and has lagged the rest of the country since the 1980s.

We applaud your leadership in making technology-based economic growth a top priority for Ohio.

Likewise, we appreciate that you have asked us to work with you to assure that such growth is, indeed, driven by the business community – by the job makers and income creators of our economy.

Where do we focus this job growth? This prospectus represents the best thinking in the state from a broad base of business people with input from academic leaders, researchers, technologists, scientists and public officials. Building on the work of Battelle, it focuses attention on five core areas of strength where Ohio has already demonstrated world-class leadership – advanced materials ... biosciences ... information technology ... instruments, controls, sensors and advanced manufacturing technologies ... and power and propulsion.

These are difficult times in Ohio. We understand fully the reality of the budget, and yet we see rising levels of commitment to high-tech initiatives in other states. Hence, the rationale for the sharp focus offered in this prospectus that seeks to direct the state’s limited resources to the most promising, actionable opportunities.

Ohio’s economic and social vitality is the BRT’s overarching goal. We embrace this goal holistically; which is to say that technology, alone, is not the answer. Of course, we need progress on multiple “fronts” – a better educated citizenry and an improved business climate, especially tax, regulatory and civil justice reform. The BRT pledges to continue working with you to move Ohio a quantum leap forward on each of these fronts.

This document is the product of an intensive effort led by BRT Executive Committee member Thomas Waltermire, Chief Executive of PolyOne. In addition to Mr. Waltermire, the BRT extends its gratitude and appreciation to Mike Benzakein, General Manager, GE Aircraft Engines; Mark Collar, President, Procter & Gamble Pharmaceuticals; Joe Keithley, Chairman and CEO, Keithley Instruments; Bill Pardue, President and CEO, LexisNexis, Corporate and Federal Markets; and Michael Thaman, Chairman and CFO, Owens Corning – and to the more than three hundred Ohioans who participated as members of the task forces they chaired.

Sincerely,

E. Linn Draper, Jr.
Chairman and CEO, American Electric Power
Chairman, Ohio Business Roundtable

AN ASSOCIATION OF CHIEF EXECUTIVE OFFICERS COMMITTED TO IMPROVING OHIO

American Electric Power • American Financial • The Andersons • ArvinMeritor • Ashland • Aultcare • Banc One • Battelle • Big Lots • BP • Brennan Management Group • Bricker & Eckler • Calfee, Halter & Griswold • Cardinal Health • Chemical Abstracts • Children’s Hospital of Cincinnati • Cincinnati Bell • Cintas • Cleveland Clinic • Columbia Gas • Convergys • Cox Financial • DaimlerChrysler • DPL Inc • Deloitte & Touche • Delphi • Diebold • Dispatch Printing Company • Dominion Resources • Ernst & Young • Federated Department Stores • Ferro • Fifth Third Bancorp • FirstEnergy Corp. • GE Aircraft Engines • GE Consumer Products • General Motors • Goodyear • Honda • Hoover • HMS • Huntington Bancshares • J.M. Smucker Company • Jones, Day, Reavis & Pogue • KeyCorp • Kokosing Construction • KPMG • Kroger Co. • LexisNexis • Limited Brands • Lockheed Martin • Longaberger • McGraw-Hill • McKinsey • Milacron • Nationwide • National City • NCR • NetJets • New Albany Company • OhioHealth • Ohio Casualty • Owens Corning • PolyOne • Porter, Wright, Morris and Arthur • Premier Health Partners • PricewaterhouseCoopers • Procter & Gamble • ProMedica • Reynolds & Reynolds • Rockwell • RPM • SARCOM • SBC • Scotts • Sky Financial • Squire, Sanders & Dempsey • Sprint • Standard Register • STERIS • The Timken Company • TriHealth • University Hospital Health Systems • Verizon • Vorys, Sater, Seymour & Pease • Western-Southern Financial Group • Whirlpool

WORLD CLASS OHIO

*A Prospectus
for Achieving Success in the Third Frontier*

June 2003

LETTER OF TRANSMITTAL

EXECUTIVE CALL TO ACTION3

CORE STRENGTHS AND OPPORTUNITIES

1. Advanced Materials8
2. Biosciences12
3. Information Technology16
4. Instruments, Controls, Electronics and Advanced Manufacturing20
5. Power and Propulsion23

COMMERCIALIZATION28

ACKNOWLEDGEMENTS33

Executive Call to Action

***As Ohio's leaders and policymakers, you drive the future of this state.
High-wage jobs simply must be a part of that future.***

***In leveraging Ohio's technology strengths and focusing financial resources
carefully on those opportunities that hold the most promise for high-wage,
high-growth jobs, you shape a future of promise for all of Ohio.***

Innovation is the future of the U.S. economy, and it must be the future of Ohio's economy as well.

Innovation is growth. In industry. In jobs. In wages. In quality of life. An accelerated technology-driven growth economy adds substantial momentum to Ohio's overall economy. Each and every Ohioan stands to benefit from a prosperous economy that holds the promise of better schools, better opportunities and better living – across regions and across the state.

State leaders in business, government and education recognize this reality, and since 2000, a host of programs, projects and initiatives have focused on accelerating Ohio's high-tech, high-wage, high-growth future. In September 2001, Governor Taft built on these initiatives in asking the Ohio Business Roundtable and the Ohio Technology Partnership to work with him and legislative leadership to move a focused agenda forward. That agenda – based on innovation, economic growth, committed programs, commercialization and jobs – is the Third Frontier Project, which Governor Taft unveiled in February 2002.

This project is the state's largest-ever commitment to expanding Ohio's high-tech research capabilities and promoting startup companies to build high-paying jobs for generations to come.

Specific components of the 10-year, \$1.6 billion effort include:

- Third Frontier Action Fund (formerly Technology Action Fund and Biomedical Research and Technology Transfer Fund): Committing \$500 million over the next 10 years for early-stage capital, commercialization activity and large collaborative projects to increase jobs and business.
- Capital Funding: Proposing a new 10-year \$500 million capital improvement program to improve research facilities. Funds will finance buildings and provide equipment for globally competitive Wright Centers of Innovation – \$100 million currently authorized by the General Assembly.
- Third Frontier Operating Bond Program: Initiating a \$500 million bond program to provide much-needed resources to recruit world-class researchers and provide for technology commercialization – a constitutional amendment on the statewide ballot for voter approval on November 7, 2003.
- Innovation Ohio Fund: Creating a \$100 million fund to help finance targeted high-growth industries that demonstrate potential for creating high-paying jobs. The fund will support advanced manufacturing to help existing industries become more productive, competitive and profitable.

Through the Third Frontier Project, additional federal and private sector support can boost the total investment to more than \$6 billion and make Ohio a leader in high-tech, high-paying jobs over the next decade.

FOUNDATION FOR SUCCESS

Ohio's future in the Third Frontier is rooted in clusters of strength and promise. An in-depth analysis by Battelle Memorial Institute in 2002 identified five core areas that provide a foundation for world-class technology-based economic development in Ohio:

- Advanced materials
- Biosciences
- Information technology
- Instruments, controls, electronics and advanced manufacturing technologies
- Power and propulsion

Each of these clusters has reached critical mass in Ohio, and each has established a track record of excellence. This prospectus identifies top assets in each cluster and provides strategies to help policymakers target resources for maximum impact. In assembling this prospectus, Ohio Business Roundtable task forces – composed of CEOs and other business leaders from around the state, regional technology organization directors, university representatives and staffers from the Development Department and Board of Regents – sought input from Ohio's business, agriculture and trade organizations. More than 300 Ohioans have thus far participated in this process. Such wide engagement is vital in moving the Third Frontier from vision to reality.

CORE STRENGTHS AND OPPORTUNITIES

The base of research drivers and industry leaders in Ohio is rich and varied. To move successfully into the Third Frontier, however, it is essential to match innovation to need, to ensure that technology is not research-driven, but *market-driven*. Market-driven innovation is a partnership of research and industry. It is this type of innovation – the commercialization of technology – that results in jobs, economic growth and enhanced quality of life for every Ohioan.

With that basic truth in mind, task forces identified prime opportunities and critical process enhancements for commercialization in each cluster. Specific opportunities are:

- Advanced Materials
 - High-performance materials for structural components: These materials have a relatively high strength-to-weight ratio, can transmit high mechanical loads dynamically or statically, or can effectively operate in harsh environments.
 - Functional polymer-based materials: Functional materials have special properties beyond those of basic materials. Ohio's strength in one particular area of functional materials -- functional polymer-based materials -- holds high potential for application growth.
- Biosciences
 - Medical devices and imaging; translational and clinical services; cardiovascular, cancer, and child health (Ohio's 3C's); agriculture, pharmaceuticals and homeland security project: Ohio has strength on which to build in all of these areas.
 - Intersections between complimentary, well-developed technology areas and bioscience: bio-informatics, bio-materials, bio-science targeted nano-devices and advanced manufacturing all hold promise for collaboration and commercialization.
 - Emerging technologies: This includes regenerative medicine and cellular engineering, and other areas defined by entrepreneurs as growing in importance.

- Information Technology
 - Data management: This is a specific Ohio information technology strength that cuts across all segments of industry.
 - Support other technology focus areas: information technology is a crosscutting need that supports all of the other key focus areas. Ohio must invest in accelerating IT application and adoption in these areas.
- Instruments, Controls, Electronics and Advanced Manufacturing Technologies
 - Integration of computing, communication, measurement and control: An industry-university center with this focus would help align needs with development.
 - Technology transfer: Again, Ohio has an opportunity here to leverage university and research strengths.
- Power and Propulsion
 - Turbine technology: This directly impacts the aviation industry, where Ohio already is a leader. Spin-off technology benefits the entire power industry.
 - Fuel cells: The quest for cleaner, more efficient power has sparked significant national interest in this emerging technology.

In addition, there are substantial opportunities to drive technology growth at the intersections of these core focus areas, e.g. bio-informatics, IT-intensive control systems. These opportunities will surface as we execute strategies and tactics in each of the core technology areas. And as these interconnected opportunities are acted upon, they will help create and strengthen synergy among the five areas.

Along the way, there must be process improvements. Recommendations for such improvements run throughout this prospectus to ensure that ideas in each of these clusters reach the marketplace and generate returns for all of Ohio. Commercialization, after all, must be the end result.

WHY COMMERCIALIZATION IS CRITICALLY IMPORTANT

Ohio's strong manufacturing and service company base creates a platform for commercialization of all kinds and from all geographic locations – both inside and outside of Ohio. The basics are there; we just need to improve the processes so that innovation flows quickly and unimpeded from research and development to market application. Improving these commercialization processes will open doors for Ohio nationally and globally, allowing the state to truly leverage the core strength of its industrial diversity.

Thus, turning technology and commercialization strengths into competitive advantages for Ohio companies will drive industry growth across the board, and growth will drive job creation. Technology-enabled job creation generally means higher skills and higher wages for employees at every level of the economy, in every region in the state.

Commercialization is the hub of that wheel of progress. It is the fusion of technology, talent and capital. It is a fusion that is delicately balanced among a great many partners: university and industry research and technology transfer programs, technology validation, founders and CEOs, angel investors, seed and early-stage venture funds, technology adoption programs for established businesses, incubators, tax incentives, etc. Ideas alone will not do the job. Nor will bright and talented people. And all the resources in the world – without a focused concentration on commercializing the promise of technology – will not result in sustained high-wage job creation for Ohio.

The Third Frontier Project aims to achieve the right mix of ideas, people and resources. The goal is to create a working commercialization engine that is effective in each core competency area and each region of the state. As a start, we recommend:

- Narrowing award criteria for the Third Frontier Action Fund (formerly the Technology Action Fund). Target support on translational research and commercialization activities that have significant focus on the growth areas identified in this prospectus.
- Targeting bond issue funds solely on commercialization and solely on the opportunities outlined in this prospectus:
 - Use two-thirds of the funds to rationalize and support commercialization engine programs that are customized for each of the identified technology areas and geographic regions of the state. These programs should be funded for up to five years and renewable beyond to allow the hiring of staff, and should include validation funds to accelerate the movement of technology from lab to marketplace. Funding should be awarded on a competitive basis to programs with a strong Ohio activity focus and a strong case that commercialization will result in high-wage Ohio jobs.
 - Use one-third of the funds to attract and support entrepreneurial scholars, world-class researchers with a track record of translating research and creating new companies and who are focused on the specific technology areas identified in this prospectus. Resources are limited; we must be certain that the limited entrepreneurial scholars we fund are laser-focused on commercialization and on the best opportunities for the state.
- Optimizing and synchronizing intellectual property (IP) and technology transfer processes. Benchmark, brainstorm, and apply our business capability to identify changes to advance these processes at Ohio's universities and the federal labs located in Ohio. These processes must run better.
- Leveraging unused IP within Ohio businesses for Ohio businesses and academic institutions. Explore ways to share this work and exploit it for the good of the state.

ACTIONABLE NEXT STEPS

The announcement of the Third Frontier Project and the strategies outlined in this prospectus are a concrete sign of Ohio's commitment to a knowledge-based economy. As the state moves to implement these strategies, it is critical to note that this work constitutes only the beginning of what must be a sustained, focused and increasing commitment.

The \$1.6 billion is a major step, but not the quantum leap that we need. Ohio is not alone in its quest for technology jobs. Most states are similarly focused on developing the promised land of technology. Most states are similarly focused on making the investments necessary to sustain technology. Most states are similarly well positioned with assets – either general or specific – in technology.

At the end of the day, it will come down to execution. The state or region that has the best leadership, the broadest commitment and the most focus will win, and a win for a state or region is a win for all of its residents. To become truly world class, Ohio must look for opportunities to step up efforts in the Third Frontier Project. More funding. More people. More commitment *to making it happen*.

Now is the time to get started. Here is what we can do together:

- Pass the November bond issue. These funds are critical to making the Third Frontier Project work – they are required for the key commercialization efforts.
- Measure progress. Use a clear system of metrics in addition to jobs to measure results and correct course as necessary. In the fast-changing technology world, we must be agile as well as focused.

- Expect Third Frontier Advisory Board business members to harness business involvement. Existing Ohio businesses must contribute to and directly benefit from the Third Frontier Project.
- Create wins early. Do what it takes to build early successes, then celebrate and publicize these wins to build momentum.
- Target. Target. Target. Follow the recommendations outlined in this prospectus to carefully target Third Frontier awards and issue RFPs. Use this process to stimulate novel cross-technology, cross-regional, and cross-sector collaborations to create never before seen statewide synergies. Focus on world class, but make certain that *commercial results for Ohio* are the final determinant of awards.
- Align state programs with the focus and objectives of the Third Frontier Project. Be aggressive in achieving this alignment. Leveraging as many sources of state support as possible will be vital to achieving critical mass.
- Use public and private influence at the federal government level. Ohio must be front and center in Washington to secure as much federal funding as possible for state programs.
- Improve IP and technology transfer processes now. Ohio's processes should be ranked among the nation's best within 18 months. Appoint a select group of academic and business leaders to identify and recommend the necessary changes. Commit to remove any legal barriers to achieving excellence.
- Drive the creation of commercialization engines to support commercialization efforts. While awards should be made through a competitive RFP process, we must be aggressive in encouraging talented individuals to develop programs by working with them – not simply being reactive to RFP responses. We need to move from hunting/gathering to planning/farming/harvesting.

While these activities will get Ohio moving in the right direction, they cannot operate in a vacuum. Every task force working on this prospectus emphatically noted that a number of efforts under way in other venues are critical to the overall success of the Third Frontier Project. These efforts focus on creating a more competitive business climate, a more robust entrepreneurial environment, more seed and early stage capital, and workforce development. These less tangible strategies are just as real, and just as critical, as the actionable steps outlined.

Achieving the vision for all of Ohio undoubtedly will take a concentrated effort among many partners. Fortunately, the state has a great many physical and intellectual assets, and a great many leaders willing to take up the cause. It is this collaboration – among organizations, among regions and among sectors – that can make the difference. And it is our job, collectively, to cultivate that collaboration and focus it to build a stronger, more prosperous Ohio so every Ohioan has a better future.

Core Strengths and Opportunities: Advanced Materials

OHIO ASSETS

Ohio's abundance of natural resources has created an economy long driven by robust materials-manufacturing industries, including steel, glass and ceramics in various regions, paper in the Miami Valley and rubber and plastics in the Northeast. Ohio companies with a materials focus include PolyOne, Ashland, Owens Corning, Goodyear, Goodrich, Milacron, P&G, Sherwin Williams, Timken, Nordson, Honda, Delphi, General Electric, Lubrizol, TRW, Eaton, Parker Hannifin, Owens-Illinois, STERIS, Lau Industries, ABB, Webcore Technologies, Metamateria, Maverick, Oak Ridge Micro-Energy, Dana Corp., Faraday and others.

Ohio also has academic institutions with considerable strength and reputation in materials. The polymer programs at the University of Akron and Case Western Reserve University rank among the top six in the country. Kent State University is known internationally for its Liquid Crystal Institute. Ohio State University, the University of Dayton and the University of Cincinnati all demonstrate leadership and excellence in advanced materials.

At the same time, world-class research and development organizations in the state are focusing on materials development. Organizations such as Battelle Memorial Institute, the University of Dayton Research Institute, the National Composites Center in Dayton, the Edison Materials Technology Center in Toledo and the Cleveland Clinic are leaders. Additionally, Ohio has two major federal laboratories, Wright-Patterson Air Force Base and NASA Glenn, where advanced materials research is conducted.

These assets are considerable in a world in which the potential of advanced materials is clear. So clear, in fact, that a number of states – Virginia, Maryland, North Carolina and Georgia among them – have aggressively invested resources to establish leadership positions in advanced materials and process R&D. Ohio, too, must invest, and must invest strategically so the state can grow as a center of materials-based product innovation and manufacturing.

MARKET DRIVERS

The opportunity in advanced materials over the next two to ten years lies in five primary market drivers:

- Reduction in fossil-fuel dependency and the resulting quest for alternative energy sources
- Drive for environmental friendliness
- Demand for cost-effective health care
- Need for performance and productivity improvement
- Need for cost-effective infrastructure

To best seize this opportunity, Ohio must focus on the classes of advanced materials that hold the most potential for high growth, the classes of advanced materials that marshal Ohio's strengths and directly impact primary market drivers. Those classes are high-performance materials for structural components and functional polymer-based materials.

High-performance Materials

High-performance materials for structural components have a relatively high strength-to-weight ratio, can transmit high mechanical loads dynamically or statically, or can effectively operate in harsh environments. These characteristics make such materials attractive for a variety of problem-solving applications such as improved-efficiency gas turbines, fuel-cell development, advanced battery systems, wind-power generation, pollution treatment and reduction systems, prosthetics, general component miniaturization and mass transit.

The global industries served by such material developments include aerospace, vehicles, power generation, construction, military and defense, and various processing industries.

Functional Polymer-based materials

Functional materials are those that have capabilities beyond basic materials. Functional materials include polymers, glasses, composites, ceramics and other advanced materials that offer technologically exciting applications for business growth opportunities. Ohio's strength in polymers and universal needs across the market drivers make functional polymer-based materials a strategic choice for Ohio investment.

Emerging functional polymer-based materials developments relate to electrical conductivity, electroluminescence, thermochromism and photochromism. Other new developments include polymers with non-linear optical properties, polymers for information technology, porous polymers, supramolecular chemistry with polymers and nanocomposites. The array of growth opportunities in the medical, automotive, aerospace and energy industries is endless. Functional polymer-based materials can be used in lasers, displays and medical engineering systems. In electronics, wave-guide applications and color development. In photovoltaic, magnetic and dielectric applications. Nanomaterials technology will play an important role in achieving and improving functionality.

BARRIERS TO SUCCESS

The key, then, is to focus resources where they can make the most difference, and to overcome any barriers that may stand in the way. Those barriers are:

- A fragmented conglomeration of small companies. A strong and robust industry cluster is essential. The 2,800+ polymer companies in Ohio have annual shipments of more than \$49 billion and provide the state \$300 million in tax revenues. However, 80 percent of the processors making parts have less than 100 employees. They need ready access to resources, new technologies, and programs to upgrade the workforce.
- Exceptionally poor in-state collaboration between and among universities, companies, industries and regions
- Inactive or ineffective industry leadership in providing guidance to the state in directing resources
- A significant gap between successful lab-level research activity and marketplace execution/commercialization
- No "Ohio systems" approach that creates incentives for in-state collaboration
- A pessimistic attitude among businesses about the manufacturing climate in Ohio

BECOMING WORLD CLASS

The strategies that follow aim to mitigate the barriers and provide concrete recommendations in making Ohio a world-class leader in advanced materials.

Strategy: Create Technology Extension Service

Launch the Technology Extension Service, a mechanism for real, focused communication, training and effective collaboration among all business, academic, public and private organizations in Ohio. The service would mimic the agricultural extension service to connect people and organizations for individual and collective reward.

Features would include:

- Agents located across the state to be links between needs and technology. These agents could access subject experts in industry, education, government and nonprofits.
- A Web site to allow broad-based interactive communication across the state

- An Ohio “Technet” Materials Database to keep Ohio industry current on relevant technology; staffing must be provided to effectively utilize this database as a statewide tool
- Seminars and training for Ohio’s advanced materials companies
- Ideation focus groups
- Marketing to state policymakers and the public
- Business support to link technical business opportunities with financial resources
- An advisory board to the state on issues that impact materials companies

This service would be preferentially aimed at organizations focused on high-performance materials for structural components and functional polymer-based materials. Funding is essential, and we envision the state and industry sharing investment. As a first step, we recommend involving industry in refining the concept by invitation of the governor. The Technology Extension Service should be launched by July 1, 2004.

Strategy: Define “Pro-Ohio” Rules for State Dollar Use

Pro-Ohio rules are a combination of how collaboration should be conducted and what kind of value can be created. Three general requirements should be incorporated:

- Include as many Ohio-based team members as possible. Target three groups: universities, big businesses and small businesses.
- Proposals must define the ways Ohio will benefit from the support
- Proposals must include all aspects of the commercialization process. Preference should go to proposals that include more Ohio-based companies on the commercialization path.

In defining an Ohio-based company, the state should examine several criteria, including incorporation, percentage of workforce in the state, number of employees in the state and impact on Ohio facilities or entities. Value can be monetary or non-monetary.

Strategy: Conduct Directed University Research

Proactively move from hunting/gathering at Universities to planting/farming/harvesting:

- Establish an industry/commercial council guiding R&D to sow seeds for needed Ohio commercial solutions
 - Preferentially aim this council at organizations focused on high-performance materials for structural components and functional polymer-based materials
 - Make a substantial funding increase (three- to five-fold) to universities to establish faculty chairs to attract star researchers; in selecting these chairs, use criteria that ensures candidates are focused on commercialization and on core opportunity areas for Ohio

Strategy: Leverage State Funds to Close the “Proof of Concept” Gap

Use state money to attract private and federal investment to close the gap between lab-level research activity and commercialization of new technologies, known as the “proof of concept” stage:

- Provide incentives to select companies for in-house incubation; this is an effective model for economic development and cost-effective as well
- Establish technology commercialization centers at universities having the required scale and capabilities to ensure proof of concept; these centers must be industry-lead and –sponsored

- Place more emphasis on managing existing incubators to be self-sustaining after a certain length of time, i.e., five to seven years. Also align the incubators more closely with the five core opportunity areas for Ohio in the Third Frontier
- Develop rapid non-bureaucratic distribution of significant pre-seed funds in small grants of \$50,000 or less; provide preference to proposals that leverage the strong macroscale materials and manufacturing industry and research in Ohio to microscale and nanoscale materials and products
- Preferentially aim resources at organizations focused on high-performance materials for structural components and functional polymer-based materials

Strategy: Leverage All Resources of the State

Aggressively break down in-state warring and stimulate collaboration:

- Proactively disincant regional and/or special interest group tactics
- Elevate proposals that comprehend and engage real participation and/or steering team leadership from across the state wherever there is applicable competence
- Preferentially apply to organizations focused on high-performance materials for structural components and functional polymer-based materials
- Create points of commercialization entry (universities, tech transfer entities or federal laboratories) for communities within the state; university commercialization centers should work with regional or specialized incubators to develop a framework that has clear business processes to support long-term growth

Although forecasting the needs of tomorrow is limited by the perspectives of today, effectively deploying these five interdependent strategies will significantly break down barriers and pave the way for wealth creation in Ohio. These very targeted investments are a start to developing the commercialization climate and success rate Ohio needs for long-term economic success.

Core Strengths and Opportunities: Biosciences

OHIO ASSETS

A robust bioscience industry delivers a high return on investment – both in terms of a growing economy and a growing quality of life for residents. This return comes at a price. Commercialization of bioscience technologies requires sustained financial and infrastructure commitment. We are confident it is a price worth paying.

In restructuring a significant portion of the economy to one that is based in biosciences, Ohio can benefit from the industry's innovations and the resulting improved access to medical technologies and medical experts. At the same time, bioscience innovations will fuel growth in Ohio's specialty manufacturing and agricultural sectors and will further establish Ohio's clinics among the world's best in delivering low-cost, high-benefit medical outcomes. Finally, bioscience jobs created in Ohio will not easily or rapidly move off shore, due to the emerging nature of the biosciences, the ability to patent-protect inventions, and the intellectual resource dependence among other factors.

Already, as Battelle noted, Ohio has great strength in biosciences, including:

- The nation's No. 1 ranking in per capita clinical trials
- The fifth-largest food processing industry in the country
- Three of the top 20 pediatric medical clinics in the United States
- While Ohio ranks 10th in total National Institutes of Health funding, we have enjoyed twice the national average growth of research funding (100 percent versus a national average 41 percent)
- Case Western Reserve University's bioengineering program is ranked fifth in the country and three medical schools (Ohio State University, Case Western and the University of Cincinnati) are ranked in the top 50
- Ohio is the headquarters state for three Fortune 35 companies involved in biosciences, (Procter & Gamble, Cardinal Health and Kroger), as well as four leading bioscience companies in their commercial segment (Ethicon, STERIS, Invacare and Ross Laboratories)
- Cleveland Clinic is ranked the No. 3 hospital in the United States and No. 1 in cardiology

Additionally, Ohio has significant strengths in complementary technology, including informatics, materials and specialty manufacturing.

MARKET DRIVERS

Biosciences are only at the front edge of reaching commercial potential. The commercial applications of biosciences – including medical devices, pharmaceuticals and improved crops – over the next decade will impact more than 30 percent of the GDP of the United States. Currently, health care expenditures alone represent 14 percent of the GDP and are predicted to rise to more than 22 percent in the next decade. The major pharmaceutical companies of the world expend more than \$37 billion in research and development, and the National Institutes of Health are the largest supporters of research in the federal government.

Demand for all forms of medical and advanced nutritional products will continue to increase globally as the trend to urbanization accelerates even in Third World countries, and especially in the United States as the Baby Boomer population reaches its golden years with ever-increasing demands for more effective

healthcare products. Global urbanization is fueling the demand for more effective approaches to controlling infectious diseases, and increasing wealth is fueling demand for medical and nutritional approaches to extending and improving life.

Job growth in biosciences will occur through:

- Starting and growing new innovative product and/or service companies (commercialization of technology arising from private and academic sources)
- Recruiting existing innovative companies from outside the state
- Accelerating growth of existing Ohio companies
- Growing the academic and private research enterprise

For Ohio to successfully execute growth strategies, the dynamic infusion of business leadership and practices is essential. The strategies below recognize the need for this market-focused involvement. And, while designed to leverage opportunities across all of the market drivers, these strategies in particular highlight the opportunities inherent in new company formation.

Company Formation

Supporting new company formation will accelerate the creation of high-skill, high-wage jobs in Ohio by starting a chain reaction of growth: Rapidly growing new and small companies will be the major source of new jobs, drawing the attention of more efficient large companies. The large companies will acquire the smaller businesses and add to an accelerating tax base. At the same time, applied research as practiced in public and private partnerships will provide a more immediate source of job creation.

This climate of growth requires a highly incentivized free-market strategy that encourages diverse responses from public and private sources. The state's ongoing commitment – in both infrastructure and direct support – is critical, as is continued basic, university-driven research.

Also critical is collaboration among a diverse range of partners. Such collaboration will work to engage the business sector in strategy and execution, create new synergies and competitive strengths among inter-related disciplines and maximize resources through pooling. State funds simply must support initiatives capable of attracting private dollars, preferably upfront. This protects Ohio's investment and works to ensure success through literal buy-in from business.

BARRIERS TO SUCCESS

Ohio has the assets to develop a robust biosciences industry, but the infrastructure needed to support and sustain this economy is under-developed. Specifically, the state lacks:

- Access to "first dollars" that enable initial technology commercialization
- Focused biosciences workforce development and training
- Clearly described tax incentives for investors and bioscience companies
- Coordination of state and regional "packages" of incentives for relocating companies
- Marketing and advertising support for out-of-state company attraction and to create visibility for investors
- Mechanisms to engage Ohio pension funds and other sources of in-state capital

BECOMING WORLD CLASS

Strategies to transform Ohio from a leader to a world leader in biosciences focus tightly on commercialization, collaboration and cultivation of existing strengths and relationships. In all cases, state support must be weighted toward projects that have significant potential to recruit and expand the pool of experienced entrepreneurs in Ohio. Additionally, to keep Ohio investments working for Ohio, we recommend that any project that receives state funding must substantially reside in Ohio for the duration of the project, or pay a redemption fee. The only possible exception is Big Pharma, the largest source of bioscience research and development dollars. Broad engagement of this partner is required, even though it will mean some technologies will leave the state.

In all of the strategies outlined below, private-sector involvement -- and often management -- will result in increased commercialization potential, increased market intelligence and increased success. To a large degree, the private sector is free of the bureaucracy that sometimes plagues government and academia, and is highly incentivized to create technology that improves business. In flowing technology to industry's bottom line, the state will flow results to its own bottom line as well.

Strategy: Focus Funding on Opportunities for Rapid Commercialization

The RFP process should encourage technology-based, collaborative projects managed by the private sector and designed to result in rapidly commercialized technologies. Areas to target:

- Projects based on acknowledged Ohio strengths
 - Medical devices, including Therapeutic, Diagnostic and Medical Imaging
 - Translational and clinical services, including healthcare delivery
 - Cardiovascular, cancer, and child health (Ohio's 3Cs)
 - Food and nutritional products
 - Targeted pharmaceuticals
 - Agricultural biotechnology
 - Bio-defense
- Projects based on intersecting technologies that are well-developed in Ohio
 - Bio-informatics
 - Bio-materials
 - Bio-Science Targeted Nano-devices
 - Bio-Science Targeted Advanced manufacturing
- Projects based on emerging (unanticipated) technologies as defined by entrepreneurs, including
 - Regenerative medicine/cellular engineering

The most immediate priorities are projects that encourage growth in medical devices; cardiovascular, cancer and child health; translational and clinical services; projects based on intersecting technologies; and projects based on emerging technologies such as regenerative medicine and cellular engineering.

Strategy: Support and Leverage Academic Partnerships

Basic, university-based research is essential for the long-term growth of biosciences, and the effective utilization, capitalization and translation of this research is key in building a technology-based economy:

- Through the RFP process, support academic and private research initiatives that are aggressively translational in nature and linked to a private-sector partner

- Recruit eminent or entrepreneurial scholars whose expertise in applied research matches the targeted opportunities outlined above
- Capitalize on bioscience initiatives at the federal laboratories located in the state

Strategy: Establish Privately Managed Funds to Spur Commercialization

Use the RFP process to establish privately managed funds to provide:

- “Walk-around” money managed by qualified investors experienced in very early-stage exploratory investments
- Matching and/or leverage cash to help raise private investor funds in pre-seed, seed, technology validation investment categories
- Business-based assessments and recommendations for universities’ technology transfer systems to improve new business starts
- Matching funds for successful SBIR application

The most immediate priorities should focus on establishing funds for exploratory investment and providing matching funds to raise pre-seed, seed and validation investment.

Strategy: Create a Comprehensive Biosciences Support Network

Through the RFP process, focus on projects that create privately managed enablement functions, including:

- New company formation services
- Infrastructure coordination
- Company incubation
- Bioscience community networking
- Company recruiting
- Creation of asset visibility
- Creation of state resource clearinghouse
- Entrepreneur/CEO pool
- Entrepreneurial leave program for academic and industrial scientists

In this strategy, the most immediate focus should be projects that create services for new company formation, infrastructure coordination, incubation, networking, recruiting and asset visibility.

The biosciences represent the next major technical revolution. These strategies will effectively guide Ohio in selecting investments that offer the greatest return potential. We also believe these strategies create the flexibility needed to respond with agility to emerging technologies and innovations.

Core Strengths and Opportunities: Information Technology

OHIO ASSETS

Information technology is ubiquitous. It stretches across nearly every industry segment in the economy. Information technology, or IT, also represents a major opportunity for near-term job growth in Ohio. The seven fastest-growing job classifications in Ohio are all from the IT sector, according to the Ohio Department of Job and Family Services.

It's no wonder: Information technology knows no regional boundaries, and commercialization is not hindered by protracted regulatory restrictions. It is largely an intellectual-based industry, therefore less capital-intensive than some other industries. It frequently gives birth to new IT companies. And it is needed by just about everyone.

Financiers recognize these market dynamics. IT companies in Ohio have raised more venture capital than any other industry sector. During the last 18 months alone, Ohio IT companies and companies developing IT products for all sectors raised more than \$113.5 million in venture funding (Source: MoneyTree).

Ohio has solid assets in IT on which to build, including:

- Large IT-focused companies such as Chemical Abstract Services, Cincom, Convergys Corp., Diebold, LexisNexis, NCR Corp., the Online Computer Library Center, and Reynolds & Reynolds. Ohio also has major companies in other industries which are large consumers of IT products and services.
- Statewide Edison incubation networks and tech center facilities with educational, funding and management assistance. These kinds of ventures are proven accelerators for business growth and over the last five years have helped create more than 350 new businesses, 75 new products and over 3,300 new jobs (Source: Edison Annual Economic Impact Report).
- Academic research programs, including those at Kent State University, Ohio State University, the University of Cincinnati and Wright State University
- Significant federal research facilities at Wright-Patterson AFB and NASA-Glenn Research Center
- Several newly created pre-seed and seed funds supported by the Technology Action Fund, and regional angel networks supported by Ohio's IT Alliance. This type of support is critical for a company to make its first steps.
- Venture funding networks including state-backed entities. This funding is critical for the startup to grow and expand, especially in the high-risk area of new product development.
- Technology Investment, Job Creation and Retention, Education, and Franchise Fee Tax Credit programs. These types of programs directly affect the cash flow of companies -- the critical factor for survival. These programs also positively affect non-IT related companies.
- Wide broadband availability; an E-Com Ohio study showed that Ohioans with available broadband increased from 63 percent in 2000 to 84 percent in 2002
- Nationally recognized networking and information service organizations, including OARnet, Ohio Supercomputer Center and OhioLINK

MARKET DRIVERS

Virtually every company in Ohio is dependent on IT for growth due to competitive pressures and supply-chain partner requirements. Business retention is dependent on Ohio companies achieving a higher rate of technology adoption than their competitors in other states and countries. As Ohio companies become better consumers of IT, then Ohio will become a better place for attracting and spawning IT industry development.

Driving the market for information technology advances are three primary factors:

- Technology invention
 - Hardware improvements – lower price/performance ratios create opportunities that were previously cost prohibitive
 - Dense Wave Division MultiPlex (DWDM) – fiber optics / broadband
 - Graphical User Interface (GUI) – advances in user interface capabilities
 - Internet
- Technology application – linking and leveraging invention toward specific uses
 - Equipment – servers, routers, data storage, PCs, cell phones, PDAs
 - Platform applications – Windows, ERP systems, e-mail
 - Tailored applications – Power Point, CRM systems, content services, data management
- Technology adoption – user-driven activity of technology applications for economic growth and business transformation
 - Productivity gain – PDAs, collaboration tools, sales automation
 - Market expansion – e-commerce
 - Business transformation – conversion of a company into a new form based on opportunities presented through technology use

Of the three factors, sustained economic growth is derived mainly from technology application and technology adoption. These are the categories where usable products and services are being made, bought, consumed and leveraged by companies. The Ohio companies identified earlier as IT assets are all in these two categories.

BARRIERS TO SUCCESS

Despite Ohio's current assets and opportunity inherent in those assets, the state's growth in information technology faces obstacles. Challenges include:

- Niche-oriented IT strengths, with no leading centers of IT research excellence
- Significant loss of technology graduate level students to other states
- Lack of support for newly emerging businesses
- Under-funded and ineffective marketing programs (E-Corridor)
- A relatively high-cost general business climate

Many of these barriers are applicable to most Ohio industries' expansion.

BECOMING WORLD CLASS

Information technology is a fundamental enabler in the knowledge economy and already one of Ohio's successful areas for job creation. Over the past three months, the IT Task Force has studied significant actions essential to spur Ohio growth in the IT industry. We examined best practices and policies and also shortcomings in similar efforts by other states. We convened two statewide meetings with diverse representation from public, private and academic sectors. Additionally, a smaller working group met weekly to create a knowledge base, review and vet potential strategies. Our conclusion is the state can help to move IT to the next level by pursuing the following strategies:

Strategy: Leverage Ohio's One Clear IT Strength

Ohio excels at data management and analysis. It is the state's one clear IT strength, and the state must exploit that strength to build world-class research and application capability. The proposed Wright Center of Innovation for Advanced Data Management and Analysis is an excellent start. It will:

- Leverage Ohio's considerable strengths in networking, database services and simulation and modeling
- Leverage Ohio's primary research and development resource, Wright Patterson AFB
- Help Ohio capture a huge new growth market in electronic product code technologies
- Help coalesce a super-regional coalition of Ohio's universities and information industries in a close-knit team
- Create an early win for the Third Frontier Program since the Center will have immediate national and international recognition by being designated the national ePC Certification Lab.

Strategy: Leverage Strengths in Focus Areas Through IT Application

As noted earlier, information technology crosses all industries and enables all industries to perform more efficiently. To truly maximize IT results for Ohio, the state should strategically invest in accelerating IT application development in the key focus areas outlined in this report:

- Biosciences
- Advanced materials
- Instruments, controls, electronics and advanced manufacturing technologies
- Power and propulsion

These are the areas that hold the most opportunity for high-wage, high-tech growth for all of Ohio. Improved IT application can accelerate growth in these industries.

Strategy: Strengthen Support for New and Emerging IT Businesses

This represents a major opportunity for Ohio to create near-term, long-lasting, high-paying jobs. New and emerging companies need more than capital to succeed. They need a host of support programs and the help and counsel of seasoned entrepreneurs. The following tactics would benefit not only emerging IT companies, but also emerging companies across all areas:

- Provide consistent, long-term, increasing funding to the existing network of Edison incubator and tech center accelerators
- Create a network of "advanced development partners," end-users to work with start-ups on product development. New and emerging companies need access to technical and product development

advice from potential customers to complete and improve their product. These “development partners” could become the first-to-market adopters – many times a key competitive edge.

- Create a network of minority share “local venture partners” (perhaps \$500,000 or \$1 million in a total \$15 million) to mitigate risk for and thereby attract more large out-of-state investors than currently are interested in Ohio.
- Create resource pools of employable, qualified, experienced management talent to strengthen leadership teams. New and emerging companies do not have all the management skills to grow their companies. The ability to access this pool of talent will significantly increase their chances for success.
- Give Ohio companies, especially newer ones, a preference in purchases made by the state. Iowa currently has a bill in process to implement this. Other states have similar programs.

Strategy: Market Ohio IT

Effective IT marketing can lure ideas, talent and capital – the ingredients for commercialization – to Ohio. The key is focus. Focused audiences. Focused messages. IT marketing must focus on IT. Period. Marketing must be aggressive:

- Critically assess existing E-Corridor marketing plan; if another program is needed, develop an IT-dedicated one that can spotlight Ohio’s strength in IT technology
- Integrate key selling points into marketing program, either E-Corridor program or whatever program is ultimately developed. Messages should be integrated by professionals.
- Build a program national in scope; commitment must be for two to three years to achieve acceptable market penetration and subsequent traction for economic development.
- Target program specifically to IT professionals and IT companies
- Use Ohio’s IT success as a marketing tool both within and outside the State, e.g. Ohio Bureau of Workers’ Compensation.

Strategy: Complete the Third Frontier Broadband Initiative

Support initiatives such as Ohio BroadbandLink, the Third Frontier Network, Ohio E-Community, e-Vantage Ohio and a state coordinating mechanism:

- Fully fund initiatives listed above
- Develop programs to create wireless network access along Ohio’s major interstates and within airports
- Market and promote broadband strengths

Core Strengths and Opportunities: Instruments, Controls, Electronics and Advanced Manufacturing Technologies

OHIO ASSETS

Instruments, controls, electronics and advanced manufacturing technologies, or ICE&AM, are the core of high-tech manufacturing products and services. Examples include industrial electronics, computers & office equipment, consumer electronics, electronic components, semiconductors, defense electronics and electromedical equipment. Importantly, Ohio's large base of manufacturing companies provides a ready market for these products.

Ohio's electrical equipment and instruments industry has grown to \$11.6 billion and 100,000 jobs. This industry helps feed new technology into the state's \$13.4 billion industrial machinery sector. The combined impact on Gross State Product exceeds \$25 billion. Basic strengths in ICE&AM include active basic and applied research programs at Ohio State University and Case Western Reserve, federal labs and private institutions. The University of Cincinnati, University of Toledo, Ohio University, University of Dayton and University of Akron also have ICE&AM programs. Cleveland State University is focused on transitioning research to industrial applications. Complementing the effort to help transfer technical applications knowledge to the industrial sector, and facilitate commercialization of that technology, are Techsolve and Camp Inc., both funded by the state Edison program.

Additionally, as Battelle noted, Ohio is recognized as the machine tool capital of America. The state is home to some of the largest ICE&AM producers as well as a range of industrial consumers for these products. Ohio ranks fifth in the nation for industrial electronics manufacturing, eighth for communications equipment manufacturing and computers and office equipment, and tenth in data processing and information services. This industry presence, matched with research expertise, creates a foundation for success in the Third Frontier.

MARKET DRIVERS

The Battelle Report noted that ICE&AM opportunities lie in reconfigurable manufacturing systems involving adaptable, integrated equipment, processes and systems. As with advanced materials, nanotechnology will be a crucial component of ICE&AM in the years ahead. Additional market drivers include:

- Free global markets supported by the General Agreement on Trade and Tariffs and the World Trade Organization
- Ability of semiconductor industry to innovate and integrate new technology into devices
- The broadband communication revolution, which emphasizes miniaturization, portability, and universal access
- New technologies
 - Nanotechnology
 - MEMS (micro electro-mechanical machines)
 - Information technology: software development and wireless access
 - Wireless communication
 - New components and sensors
 - Advanced materials

- The drive for higher precision, speed and repeatability in manufactured products emphasizes measurement, control, computation and communication
- The global decentralization of consumer goods manufacturing to the lowest labor regions while still requiring the highest precision, quality and performance

Controls Technology

The common need to compute, communicate, measure and control unites all electronics sectors, and innovations in these technologies enable new capabilities to be deployed in telecommunications, transportation and consumer products. Automobiles, aircraft, the Internet, and processing industries all depend upon closed loop measurement, control, communication and computation to function. This capability is pervasive and embedded in every electronic innovation of the past decade as diverse as your cell phone, car or wide-screen television. Enhancing the ability of more Ohio companies to incorporate these technologies in their products will create more competitive high technology products and generate high paying jobs.

The Path from R&D to Application

The increasing need for manufacturing efficiency and precision across a wide spectrum of products demonstrates the increasing need for ICE&AM. Effectively moving ICE&AM technology research from the university or lab level to the industry level will require help from the state.

That help can take the form of funding, collaboration and lobbying. It also can take the form of something subtler: Helping to create an environment that is appealing to researchers, entrepreneurs and industry.

BARRIERS TO SUCCESS

Ohio's ICE&AM sector is limited partly by its low profile; few understand its core relationship to Ohio's future economic growth, and few graduates recognize the achievement they can attain in this field in their home state. Additional challenges include:

- No industry identity to focus efforts, enhance networking, and rally resources and better coordinate investment in research
- Shortage of graduates with system level design, analysis and simulation skills applied to motion and process control technology
- Lack of platform capital investment to model and test system designs and algorithms
- Shortage of skills in next-generation Internet-enabled communication and control applications
- Lack of access to cost-effective design, prototyping and low-volume production of MEMS devices, sensors and mixed-signal ICs
- Lack of access to skilled, experienced workers; we need both a continuing supply of research talent and industry talent that can meet needs during periods of rapid expansion

BECOMING WORLD CLASS

Ohio needs a solid base of applied research that attracts and holds top talent. The primary need is to build a state reputation that is very attractive to technology people. The opportunity for state government to aid this industry relates specifically to the university-industry connection, especially by strengthening university EE/CS programs and driving manufacturing improvements into Ohio's established manufacturing base.

Strategy: Fund an Industry/University Center Focused on Applying ICE&AM Technologies

Support the formation of an industry/university center whose research focus is on the integration of computing, communication, measurement and control. The intent would be to align the technology needs of industry with the multifunction needs of the university and the general need to increase the state's electrical

engineering/computer science university programs. This center should conduct active outreach to cluster companies and foster an environment of academic, industry and investment community collaboration. The center would:

- Be accountable for contributing to industry growth
- Enable startups from concept to production
- Serve as a consultant for applications within ICE&AM industry
- Connect all regions of the state

Strategy: Strengthen University Programs

Having leading electrical engineering and computer science programs at Ohio universities is essential to the viability of this industry. The state should work to strengthen the EC/CS programs, and give funding priority to entrepreneurial scholars in these disciplines, especially at universities with very strong existing programs: Case Western, Ohio State and the University of Cincinnati

Strategy: Attract More Federal Research Funding to Ohio

While private-sector investment is the largest source of spending for product development, federal government spending is the largest source of funding for basic research and technology advances. The state of Ohio and its industries need to have a coordinated Washington lobbying effort to attract more of these funds to Ohio.

Strategy: Support Technology Transfer Programs

Transferring technology from the research sector to the development and application sector takes funding. Ohio should:

- Strategically fund effective technology transfer programs at key universities
- Support the mission of the Edison Centers (Techsolve and CAMP) to work with ICE&AM sector companies

Core Strengths and Opportunities: Power and Propulsion

OHIO ASSETS

Although power and propulsion systems are basic drivers of the industrial age, they are far from relics of the past. From automobiles to aerospace to industrial power, these systems remain critical technologies and continue to undergo significant advances. More importantly, they represent an established industrial base with significant current employment in the state of Ohio and the potential for expansion.

Ohio is uniquely positioned for success in the power and propulsion sector. Only Ohio can claim it is the global center for advanced turbine technology and production, with the No.1 manufacturer of gas turbines (GE Aircraft Engines) and two world-class federal laboratories. NASA Glenn Research Center at Lewis Field near Cleveland and the Air Force Research Laboratories at Wright Paterson Air Force Base near Dayton bring significant federal research dollars to Ohio and they help engage Ohio universities and companies in the programs.

Additionally, Ohio is ranked 10th in the nation for aerospace and aviation employment (Commission on Aerospace), with more than 20,000 jobs in propulsion alone. The state is home to a number of leading aerospace manufacturers, suppliers and engineering universities. Ohio also is the corporate headquarters for NetJets, one of the world's leaders in fractional aircraft ownership, and a direct beneficiary of propulsion technology developed in the state of Ohio.

Spinoff technology benefits companies in other segments of the power industry. For example, American Electric Power, which generates about 30 percent of the commercial and residential power consumed in Ohio, is an end-user of much of the same technology used in aero-propulsion.

In the critical emerging technology area of fuel-cell research, Ohio also has significant strengths:

- Case Western Reserve University and the Ohio State University lead the list of Ohio academic institutions with ongoing fundamental research in fuel cells. Other academic institutions with fuel cell or related research include the University of Toledo, the University of Cincinnati, Ohio University, the University of Akron and the University of Dayton.
- In the government and nonprofit sectors, NASA Glenn, Wright Patterson Air Force Base and Battelle Memorial Institute have significant fuel-cell development activities.
- Ohio has two nationally recognized fuel-cell developers, Technology Management Inc. (Cleveland) and SOFCo-EFS Holdings LLC (Alliance). These companies are developing planar solid oxide fuel cells for portable and auxiliary power applications. Ohio also has a long list of component suppliers to the fuel-cell industry.

Finally, power and propulsion innovations are essential to the automobile industry. Ohio's automotive infrastructure, research attributes and proximity to Michigan manufacturers provide a strong foundation on which to build an increasingly high-tech, high-skill, high-wage workforce.

MARKET DRIVERS

As we seek to create new high-paying jobs in the state, we must not lose sight of the need to sustain the high-paying jobs we already have. This is particularly true in the power and propulsion sector. For this reason, we recommend a balanced investment that will sustain and create new jobs in the near term and lay the foundation for entrepreneurial opportunities and new industry in the longer term.

Consider:

- The market drivers for advanced energy systems are energy efficiency to reduce emissions and to combat the inevitable rise in fuel costs over the longer term; distributed power for higher reliability and quality; and the drive for energy independence through reduced demands for fossil fuels from foreign sources. (The latter envisions a combination of high efficiency and the utilization of the domestic coal supply for power supplied by advanced power systems and the production of hydrogen for the transportation infrastructure).
- From an aviation perspective, airlines face increasingly more stringent regulations on noise and emissions, thereby limiting when and where they can fly. At the same time, performance and reliability remain critical elements for any turbine engine. And for a propulsion system to be marketable, it must be affordable – to own and to operate.
- Security both at home and around the world is paramount. Our military strength over the past decade has been founded in dominant air power and superior intelligence generated from our air and space platforms. As hostile countries continue to advance their technology to counter our advancements, it is critical for the United States to continue to invest in technology to maintain our ownership of the skies. The research being done by Ohio's partnerships is a vital link to our national security.

To best capitalize on Ohio's assets and on the factors driving the market in power and propulsion, we identified four potential opportunities – turbine technology for propulsion and power, fuel cells, FutureGen and wind power. In evaluating the potential for success for these four opportunities, the task force utilized the following criteria: the ability to drive economic growth over a sustained period of time; the benefit to anchor companies in Ohio; the ability to build on Ohio strengths and make Ohio nationally/globally competitive; the ability to create or sustain collaboration within Ohio's industry, universities and federal labs; and the ability to help Ohio respond to significant market opportunities both now and in the future. After evaluating each of the four areas, the group decided that two areas – turbine technology and fuel cells -- were better positioned for immediate action.

Turbine Technology for Propulsion and Power

The direct application of turbine technology is the aviation industry. Innovations address needs for improved performance, higher speed and environmentally friendly intelligent systems. Those innovations lead to new product introductions, which, in turn, create jobs. According to Forecast International, over the next 10 years, the market for gas turbines (power and propulsion) will be \$414 billion; of this, aviation will account for \$210 billion. Beyond aviation, spin-off technology will benefit the power industry by improving the efficiency of land-base gas turbines used for power generation. Turbine technology also will benefit wind power and FutureGen.

Fuel Cells

The clean and efficient power of fuel cells holds great promise for state and for our nation. Since this is an emerging technology, Ohio's position is related to fuel-cell development and the existing manufacturing infrastructure that *could* participate in a fuel-cell industry. Ohio is one of the few states that have significant fuel-cell activities across the academic, government, and industrial sectors. These activities now are coalescing around common needs with the Ohio Fuel Cell Coalition, a group of more than 150 companies, and with the development of strategic partnerships among smaller companies and leading developers.

In the stationary and auxiliary power area, Ohio has three significant fuel-cell developers (including Battelle). It is generally believed that the solid oxide fuel-cell technology, which is the basis for these developers, could be the winning technology in the long term. Because of this, Ohio has the opportunity to be the location of a revolutionary new industrial base, analogous to the electronic packaging industry.

Significant public and private interest in emerging fuel-cell technology is expected to drive commercialization by 2010.

BARRIERS TO SUCCESS

While Ohio's power and propulsion assets are clear, the state also faces obstacles in fully leveraging these assets:

- Ohio needs a dedicated center of research, development and testing for power and propulsion; a Wright Center for Innovation proposal by the Ohio State University to create the Ohio Center for Advanced Propulsion and Power (OCAPP) was not successful in the first round of funding requests
- Turbine technology and its promise of innovation is poorly understood and poorly valued among the public and private sectors
- Connectivity between the turbine industry and Ohio's universities is neither acknowledged nor nurtured at the state level
- The two nationally recognized industry fuel-cell developers in Ohio -- Technology Management Inc. (Cleveland) and SOFCo-EFS Holdings LLC (Alliance) -- are small and highly dependent on development contracts for advancing technology to commercialization
- Unless these developers can gain access to substantial capital resources over the next 10 years, there is a risk of acquisition and departure
- Ohio lacks a recognized center for academic research in fuel cells, a national laboratory with the leadership in fuel-cell development programs and an industrial base that is growing fuel cell business

BECOMING WORLD CLASS

To maintain and advance its position as a world leader in power and propulsion, Ohio must commit resources in a focused, targeted manner:

Strategy: Fund the Ohio Center for Advanced Propulsion and Power

Ohio State University plans to resubmit the OCAPP proposal for the next round of funding pending a debriefing from the evaluation panel and the Ohio Department of Development. This center of innovation and public-private collaboration is critical to providing real-world research opportunities, drawing the best and brightest students and graduates and developing industry clusters around research institutes. Funding OCAPP is central to the success of the turbine strategy:

- Provide capital funding for OCAPP; this in turn will bring federal dollars for turbine research at Ohio's universities
- Provide operational funding for OCAPP to leverage that coming from within the universities, industry and the federal government

Strategy: Advocate for Propulsion Programs

To keep federal funding for turbine research flowing to the state of Ohio, the governor must play a leading role in advocating propulsion programs:

- Advocate on the national level for programs such as Propulsion 21, an Ohio-based program that in fiscal year 2003 drew \$16 million in federal funds to the NASA Glenn Research Center; additional augmentations are planned for fiscal year 2004
- Advocate in Ohio the unique opportunity for existing Ohio-based companies to grow with the emerging advanced energy systems through supply of components, followed by the growth of companies that are developing advanced power technologies. This advocacy provides credibility to the industry, attracts private capital that is essential for growth and focuses attention on the key

requirements for success. In addition, this approach can raise public interest through support of demonstrations, recognition of accomplishments and sponsorship of credible studies that provide roadmaps, along with their economic impact, for the development of this industry in Ohio.

Strategy: Plan for the Fuel-cell Industry

Strategic partnering is likely to dictate location and investment for fuel-cell manufacturing. Thus, as fuel-cell technology becomes commercially viable, it is likely that market pairs will form: suppliers and systems integrators; integrators and market leaders and possibly market leaders and energy service providers, e.g. utility companies. These pairings can be facilitated through carefully structured programs at the state level. To deliver the desired outcome, these programs should be designed to encourage operations in Ohio that would lead to expanding existing businesses, establishing new businesses, and attracting moves of operations to Ohio. The state must anticipate the growth of this industry and plan accordingly:

- Engage leaders across the state in dialogue
- Establish timetable for gauging growth and potential
- Focus on workforce planning

Strategy: Facilitate Fuel-cell Technology Demonstrations

Design programs to showcase fuel-cell technology and Ohio technology in general:

- Aim at educating the public and raising the general awareness of the benefits of this technology
- Focus on fuel cells, hydrogen infrastructure and links to associated industries, e.g. automobile, electric utilities, natural gas and manufacturing

Strategy: Enable Fuel-cell Technology Support

Establish programs to foster advances in technologies that enable fuel-cell commercial products:

- Provide easy access for developers, suppliers and customers
- Place emphasis on growing the interaction among academia, government and industry through symposia, program participation and central communications
- Maintain alignment with national energy policy

Strategy: Enable Hydrogen Fleet and Infrastructure Demonstrations

Design programs to enhance collaboration and opportunity:

- Align with the recently announced DoE program for hydrogen fleet and infrastructure that focuses on demonstrations of hydrogen-fueled automobiles and hydrogen fueling systems. This program requires leadership by either an automobile company or an energy supplier. Thus, for Ohio institutions to participate in this program it is critical for Ohio to:
 - Facilitate partnerships to respond to opportunities for fuel-cell automobile and hydrogen infrastructure demonstrations
 - Provide site options, seek to coordinate with Michigan initiatives and work with local governments to provide community support

Strategy: Provide Grants for Technology Development

Continue the competitive grant program for technology development:

- Require Ohio content and commercialization partner lead

- Seek to leverage with DoE or other government funds

Strategy: Increase Access to and Awareness of State Economic Development Funds

Provide central support for access to state economic development funds:

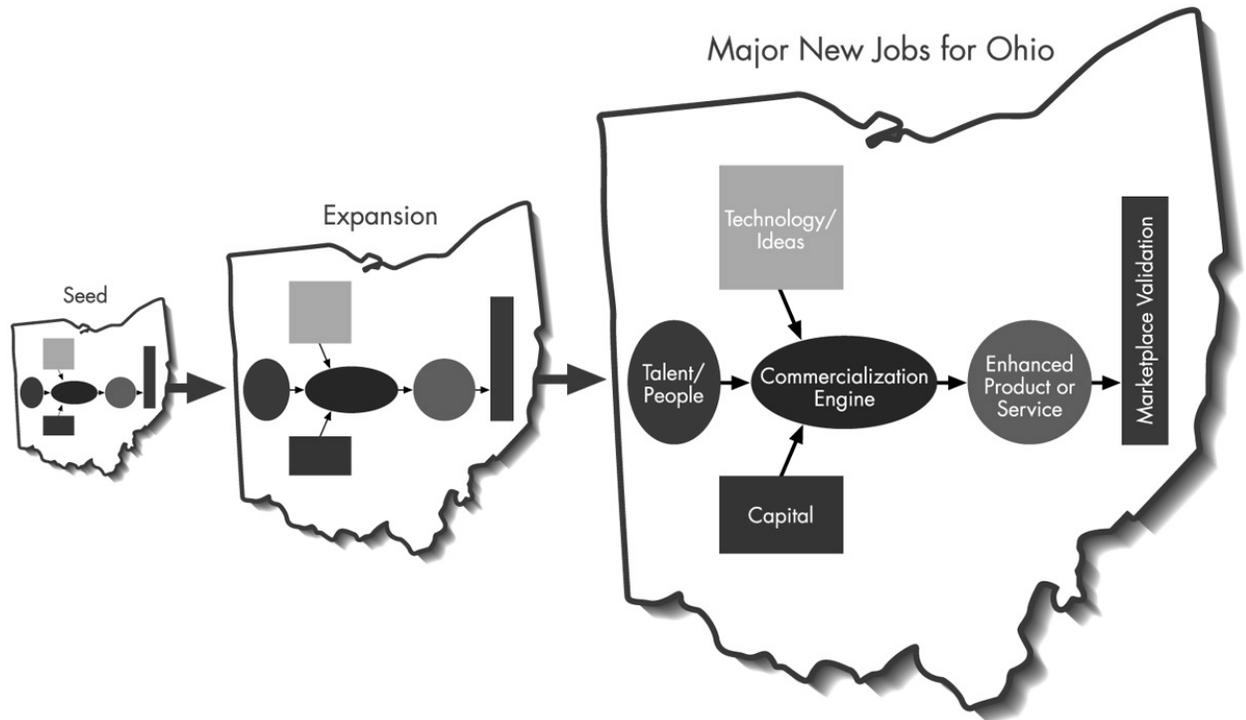
- Use tax abatements and low-interest loans to increase access to these funds
- Elevate profile of Ohio fuel-cell interest through communications to media and stakeholders
- Establish an infrastructure to facilitate information-sharing

If the state provides the required support – both funding and advocacy – Ohio can become a world-class Center of Excellence for turbine technology and will be positioned for growth in the emerging fuel-cell industry. For both visions to become reality, Ohio needs centralized support, coordination and collaboration.

Commercialization

Technology, in and of itself, creates neither jobs nor wealth. It is the commercialization of technology that drives economic engines and prosperity. Commercialization is absolutely critical if research investment is to create growing companies and more high-paying jobs.

At a high level, commercialization is a cyclical process that supports the growth of a company at each critical stage of development as shown below.



At the next level down, within each stage, the commercialization engine consists of elements that must be appropriately balanced for that stage of development as shown in the diagram that follows this section.

Ohio can support commercialization efforts in each of these stages through a two-pronged effort: Helping new, innovative companies get started and supporting established companies' quest for products and services that increase efficiency and effectiveness through technology.

COMMERCIALIZATION THROUGH NEW COMPANY FORMATION

The creation of new, technology-oriented companies in Ohio is a primary objective of the Third Frontier. It requires three critical ingredients: ideas, talented people and capital. The formula is well understood. The execution is extremely difficult.

New company formation is spurred by a complex chain of interaction among multiple elements of the entrepreneurial equation. Such interaction creates an entrepreneurial environment, and that entrepreneurial

chain is only as strong as its weakest link. Balance is essential; extreme strengths in one area can be rendered valueless because of deficiencies in others.

Ohio's objective must be to have a commercialization engine that is in balance and constantly improving.

COMMERCIALIZATION THROUGH EXISTING COMPANIES

Most commercialization processes within existing companies work reasonably well. The opportunity for improvement from a Third Frontier standpoint is better linkage between external sources of innovation (university research, entrepreneurial ideas, etc.) and internal corporate R&D programs. This is largely addressed by the systemic recommendations outlined in previous pages calling for heavy private industry involvement in all Third Frontier-funded innovation work. It gets everyone working collaboratively right from the beginning.

At the same time, Ohio must work to change the corporate culture of Ohio corporations to become more entrepreneurial in their approach to commercialization. Entrepreneurial corporate cultures tend to encourage high levels of innovation both from within companies and from the outside. Within companies, they spark new ideas and new connections to the external world that result in improved products and services and more efficient business processes. Some innovators may go out on their own, with or without their company's support, to form new businesses. Entrepreneurial corporate cultures also help encourage spinouts, which in turn create jobs.

Finally, entrepreneurial cultures at established companies improve the innovation and commercialization climate for all entrepreneurs. It is that spirit of entrepreneurship in a region that drives growth. And, that spirit is contagious.

BARRIERS TO SUCCESS

There are several challenging elements to creating a world-class commercialization engine for Ohio:

- Commercialization tends to be a local activity. While at later stages, talent and capital flow across geographic boundaries, early-stage activity generally centers around the specific locale of the innovation. Thus, there must be strong commercialization engines in each of the state's geographic centers.
- Commercialization is simultaneously general and specific to the technology. From a general standpoint, the overall entrepreneurial climate and activity level influence the ability of an entrepreneur to form a business. At the same time, activity is frequently specific to a technology: Angel investors won't invest in technologies they don't understand, and mentors generally provide expertise in the fields they know; e.g. a successful information technology entrepreneur is of limited value to a bioscience start-up. Thus, there must be commercialization engine activity focused in each of the specific core technology areas.
- Seed and early-stage capital is insufficient or, in some cases, inaccessible to entrepreneurs
- While Ohio has the capacity to provide angel investment, there is a mismatch between the experience of angel investors (generally manufacturing and service businesses) and the need for investment (bioscience, advanced materials, etc.)

BECOMING WORLD CLASS

With aggressive, focused support across all sectors, Ohio can lead in commercialization efforts:

Strategy: Address Funding and Investor Gaps

There is a gap between the development of technology ideas and the point at which their commercial viability has been demonstrated sufficiently to attract angel and institutional investment. In highly active entrepreneurial environments, this gap is filled by a large number of angel investors looking for early entry

into emerging opportunities. Ohio does not have such a presence of angel investors, so the state must fill this gap in the near term:

- Provide validation funds to demonstrate the commercial viability of ideas. Focus this on the technology areas identified earlier in this report.
- Effectively implement SB180, which will substantially increase seed and early-stage capital as well as the number of seed and early-stage venture capital firms that provide important mentoring to seed-stage companies
- Work to develop angel networks that can link angels together so that their shared experiences can result in investment flowing to the needed technology areas
- Develop approaches to increase Ohio's nonprofit institutions' investment in Ohio venture capital funds: Ohio's pension funds, foundations, university endowments, etc.

Strategy: Link Experienced Entrepreneurs to Technology Ideas

Connect the talent to the ideas:

- Create "CEO-in-residence programs" within the commercialization engines. These programs would provide a needed pool of experienced CEOs who could flow to emerging technology opportunities and help create new Ohio companies.
- Create connections between university researchers and entrepreneurs to increase the commercialization flow.

Strategy: Create World-class Technology Transfer Programs

Many of the best technology growth opportunities occur as a result of research taking place at Ohio's research universities and at the federal labs located in Ohio. These opportunities must be moved quickly and efficiently to external commercialization. The focus should be on creating successful commercialization by new or established Ohio companies, thereby creating jobs in Ohio:

- Develop and implement world-class technology transfer programs in our key research universities, research hospitals, nonprofit research institutions and the federal labs in Ohio. While we've been improving in this area, a SWAT-team approach and appropriate funding is needed to deliver dramatically better performance quickly.
- Give preference to Ohio companies in the technology transfer process. Our objective is to create jobs in Ohio. Transferring promising technology to new or established Ohio companies makes sense. Licensing to out-of-state companies generates fewer Ohio jobs.
- Work with Ohio companies to release their unused intellectual property for development by Ohio-based companies, entrepreneurs and academic institutions.

Strategy: Create Strong Commercialization Engines

Ohio has various pieces of the commercialization engine at differing strengths around the state. But they are typically out of balance with the other pieces or under-fueled so they can't deliver the results we need. To create a system that works for all of Ohio, the state must:

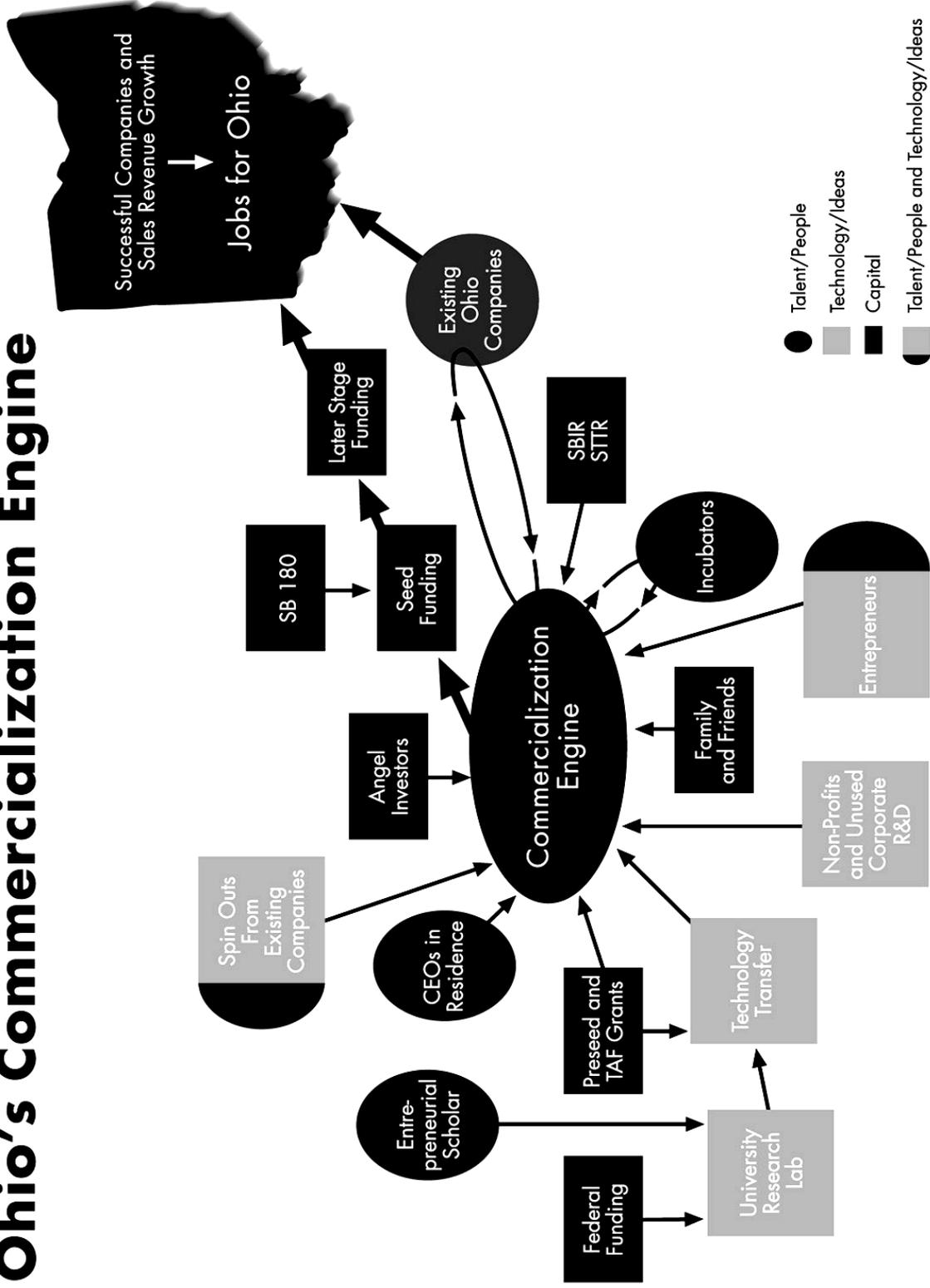
- Agree on a basic commercialization engine model to guide development efforts. This allows everyone to communicate and share ideas. And, the state can fund elements with confidence knowing that its investment will deliver commercial results.
- Create a strong commercialization engine in each region. As noted earlier, commercialization is a local activity. Each region of the state needs a robust commercialization engine if it is to participate in technology-driven economic growth.
- Create a strong commercialization engine focused on each of the five technology areas discussed in this report. While local in nature, commercialization also has an important technology-specific

component to it. By having statewide specific technology-focused commercialization engines in addition to local commercialization engines, we create the highest probability that good ideas in our five technology focus areas will make it to the marketplace.

- Allow each commercialization engine to seek support for its weakest link. Each locale and technology has various strengths and weaknesses in their existing commercialization infrastructure. They need the capability to strengthen their specific piece to bring the engine into balance and then begin overall improvement.
- Make certain these commercialization engines are well connected to Ohio's state and regional economic development infrastructure, e.g. regional economic development councils, tech councils, chambers of commerce, etc.

Ohio's investments in the Third Frontier must be focused on commercial outcomes. High-paying jobs is the key metric, and commercialization is the driver.

Ohio's Commercialization Engine



Acknowledgements

The Ohio Business Roundtable wishes to acknowledge the efforts of the more than three hundred Ohioans who provided insight and expertise and participated in this business-led task force process during the period February through June 2003. We extend our special appreciation to BRT Executive Committee member **Thomas Waltermire**, Chairman and CEO of PolyOne for his strategic leadership and to our five task force chairs who established the tone and vision for their particular technology clusters – **Mike Benzakein**, General Manager, GE Aircraft Engines; **Mark Collar**, President, Global Pharmaceuticals, Procter & Gamble; **Joseph Keithley**, Chairman and CEO, Keithley Instruments; **Bill Pardue**, President and CEO, LexisNexis Corporate and Federal Markets; and **Michael Thaman**, Chairman and CFO, Owens Corning.

ADVANCED MATERIALS TASK FORCE

Chairman, Michael Thaman, Chairman and CFO, Owens Corning
Director, Frank O'Brien-Bernini, Vice President, Owens Corning Science & Technology

Donald Bailey, Vice President, Industry Relations, Ohio Aerospace Institute
George Brandenburg, Attorney, SBTechnology Law
James Cawley, Professor of Materials Science & Engineering, Case Western Reserve University
Gary Childress, General Manager, Orton Foundation
Craig Darragh, Senior Product Technologist, The Timken Corporation
Jack Dawson, Director, Technology Planning & Development, DANA Corporation
Wayne Earley, Executive Director, PolymerOhio, Inc.
Arthur Epstein, Director, Center for Materials Research, The Ohio State University
Sherwood Fawcett, Chairman, Transmet Corporation
J. R. Gaines, Jr., Vice President, Business Development, Oak Ridge Micro-Energy, Inc.
Srini Gowda, Department Staff Engineer, GE Aircraft Engines
Robert Gray, President, Maverick Corporation
Steve Hupp, Corporate Research Director, Ashland Speciality Chemical Company
Joe Jacomet, VP, Advanced Materials Applications, Battelle
Keith Johanns, Associate Vice President, BTG
Barr Klaus, Vice President Technology, Milacron, Inc.
L. James Lee, Department of Chemical Engineering, The Ohio State University
John Leland, Director, Technology Partnerships, University of Dayton Research Institute
Jeanne Longmuir, Attorney, Calfee, Halter & Griswold
Lou Luedtke, National Composite Center
Rebecca Martin, President, American Association of Physician Specialists
Mickey McCabe, Associate Vice President for Research & Director, University of Dayton Research Institute
Edward McNeal, Vice President-Government Relations, DANA Corporation
Sharell Mikesell, Executive Director, OhioPolymer
Salvatore Miraglia, Senior VP, Technology, The Timken Company
David Mirth, Laboratory Director, Owens Corning
Arun Nadarajah, Professor of Graduate Studies, The University of Toledo College of Engineering
George Newkome, Vice President, Research & Dean of Graduate School, University of Akron

Thomas D. Nixon, Section Leader, Goodrich Corporation Materials & Simulation Technical Center
David Novak, SBTechnology Law
Peter Palffy-Muhoray, Professor, Chemical Physics, Kent State University
Dan Rooney, President & CEO, SCI Engineered Materials
Phillip Sanger, Executive Director, High Performance Glass Forming Technology Consortium, Cleveland State University
J. Richard Schorr, President, MetaMateria Partners
P. Doug Shull, President, Transmet Corporation
Ora Smith, President, Scitech
Jennings Taylor, President & Chief Technical Officer, Faraday Technology, Inc.
Bob Tweig, Kent State University
Larrell Walters, Vice President Product Development, Edison Materials Technology Center
Chyi-Shan Wang, Polymers Group Leader, University of Dayton Research Institute
Susan Ward, New Business Development, National Composite Center
John West, Liquid Crystal Institute, Kent State University
Jim Williams, Dean, College of Engineering & Honda Professor, The Ohio State University
Ryan Willis, Attorney, Taft, Stettinius & Hollister
Warren Wolfe, American Ceramic Society

BIOSCIENCES TASK FORCE

Chairman, Mark Collar, President, Global Pharmaceuticals, The Procter & Gamble Company
Director, Tony Dennis, President, Omeris, Inc

Dorothy Air, Associate Senior VP for Entrepreneurial Affairs, University of Cincinnati
Stephen Albainy-Jenei, Patent Attorney, Frost Brown Todd LLC
Jack Bantle, Vice President Research, Ohio University
Gerry Barna, Consultant, Nortech
John Barnard, Vice President for Scientific Affairs, Director,
Center for Cell & Vascular Biology, The Columbus Children's Research Institute
Robert Baxter, COO / Director Northern Region, BioEnterprise
Dave Beck, Vice President, Center for Innovative Food Technology
Ron Beltz, VP Business Development, Computer Horizons Corp.
Jeff Bergen, CEO, BioCrystal, Ltd.
Thomas Bihari, Vice President Research & Development, AMT Systems Engineering
Tomothy Biro, Managing Partner, Ohio Innovation Fund
Thomas Boat, Director, Cincinnati Children's Medical Center
George Brandenburg, Attorney, SBTechnology Law
Chuck Brumlage, President, Battelle Pharma
Donald Bush, Managing Partner, PricewaterhouseCoopers
Mark Byrn, Chief Executive Officer, Cardio Enerentics
Paul Cashen, President, Emerging Concepts, Inc.
Robert Charles, President & CEO, Copernicus
Marc Cloutier, Executive Director, Biomedical Research & Technology Transfer Commission
Christopher Coburn, Exec. Director, Cleveland Clinic Foundation Innovations, COO, NovaMedics, Inc.
Mark Coticehia, Vice President, Research/Technology Management, Case Western Reserve University
Eric Cottingham, Associate Vice President, Research Administration, Case Western Reserve University
Rick D'Augustine, CEO, UMD
David Deeds, Director of the Bioscience Specialization,
Weatherhead School of Management, Case Western Reserve University

Michael Dennis, Special Assistant. to the Director, Chemical Abstracts Service
Pamela Docherty, Senior Associate, Calfee, Halter & Griswold
Adrienne Dziak, Director of Government Relations, Case Western Reserve University
Lynn Elfner, Chief Executive Officer, The Ohio Academy of Science
Joseph D. Fondacaro, Director, Intellectual Property & Venture Development,
Cincinnati Children's Research Institute
Carol Frankenstein, President, BIO/START
Lawrence Frohman, Head, Department of Medicine, University of Illinois at Chicago
Peter Geier, Chief Financial Officer/Director, The Ohio State University
Stan Gerson, Chief, Division of Hematology/Oncology, Biomedical Research, Case Western Reserve
University
Robert Glidden, President, Ohio University
Vijay Goel, Professor & Chairman, The University of Toledo
Carl Grove, President, iMEDD
Scott Hall, Technology Transfer Manager, Airforce Research Laboratory
Bob Harriman, Vice President-Biotechnology, The Scotts Company
Arthur Hecker, Vice President Research & Development, Ross Products Division/Abbott Laboratories
James Hillard, Director, Psychiatry, College of Medicine, University of Cincinnati
Richard Hitchcock
Michael Hooven, President, Atricure
N. Gary Howell, Associate Director, Intellectual Property & Venture Development,
Cincinnati Children's Hospital Research Foundation
Joel Ivers, General Manager, Hill Top Research, Inc.
Howard Jackson, Vice President Research & University Dean of Advanced Studies, University of Cincinnati
Matthew Jennings, President, BioEnterprise
Ira Kaplan, Attorney at Law, Benesch Friedlander Coplan & Aronoff LLP
Vincent Kazmer, President and CEO, Intervential Imaging, Inc.
John Lewis, Central Ohio Regional Director, Omeris
Chris Little, Director, Ethicon Endo-Surgery
Dan Lohmeyer, President, Ohio's IT Alliance
Donald Lucus, World Wide Strategic Alliances, Discovery, Procter & Gamble Pharmaceuticals
Jacob Maczuga, Executive Vice President, SciTech
David Mancino, Attorney, Taft, Stettinius & Hollister
Matthew McCollister, Manager, Corporate Site Locations Group, Greater Columbus Chamber of Commerce
Gary Meyer, Assistant Vice President, Economic & Technology Development, Ohio University
Adel Mikhail, CEO, Recentris
David Millhorn, Director, Genome Research Institute, University of Cincinnati
A. Malachi Mixon, Chairman & CEO, Invacare Corporation
David Morehead, Senior Vice President & Chief Medical Officer, Ohio Health
Bobby Moser, Dean, College of Food, Agriculture & Environmental Sciences, The Ohio State University
Vincent Paglino, Vice President, Senmed Medical Ventures
John Patrick, Director, Business Development, Philips Imaging
David Powell, Executive Vice President, Greater Columbus Chamber of Commerce
M.K. Raheja, Life Science Executive
Julie Rehm, Senior Director, Research Strategy & Development, The Cleveland Clinic Foundation
John Rice, Managing Director, Triathlon Venture Partners
Rich Rosen, Senior Vice President & General Manager, Battelle Healthcare Products
Fred Sanfilippo, Senior Vice President for Health Sciences and Dean, College of Medicine and Public
Health, The Ohio State University
Keith Schleiffer, Business Development Manager, Omeris
Matt Schutte, Manager, Corporate Communications, Omeris

Jim Schwab, Cincinnati Market President, U.S. Bank
David Scholl, President and CEO, Diagnostics Hybrids, Inc.
James Scozzie, Senior Vice President, BioEnterprise
Bill Sellers, Director Office of Research & Sponsored Programs, Wright State University
Baiju Shah, Vice President, BioEnterprise
Mitch Shapiro, Director, OralTech Pharmaceuticals, Inc.
Daniel Shelly, Senior Regulatory Affairs Specialist, Kendle International
Ronald Sicker, Project Manager, NASA Glenn Research Center
Chris Snell, Chief Innovation Officer, inChord Communications Inc.
Eric Stahlberg, Senior Systems Manager, Ohio Supercomputer Center
Don Stredney, Director, Interface Lab, Ohio Supercomputer Center
David Swenson, Vice President Research Blvd., Edison Materials Technology Center
Bill Tacon, Senior Program Director, Omeris
Michael Taylor, Technology Specialist, Wright Technology Network
Clark Tedford, President & CEO, Solentix BioSciences, Inc.
William Vaughan, Business Development Manager, The Ohio State University
Larrell Walters, Vice President Product Development, Edison Materials Technology Center
Don Wetherhold, President, Cardinal Health Sales Services
Ken Weixel, Deputy National Industry Leader, Healthcare & Life Sciences, Deloitte & Touche
Caroline Whitacre, Associate VP for Health Sciences Research & Vice Dean for Research,
College of Medicine & Public Health, The Ohio State University
Sandy White, President, Columbus Technology Leadership Council
Amy Whitehead, Director, Regional Technology Alliance of Northwest Ohio
David Wight, Director, Edison Biotechnology Institute, Ohio University
James Willey, M. D., Department of Medicine, Medical College of Ohio
David Winwood, Associate Vice President for Knowledge Transfer & Commercialization,
The Ohio State University
Chris Woolverton, Kent State University

INFORMATION TECHNOLOGY TASK FORCE

Chairman, Bill Pardue, President and Chief Executive Officer, Corporate & Federal Markets, LexisNexis
Director, John Simmons, Vice President for Data Center and Network Services, LexisNexis

Hal Babson, Department Chair, Business Management, Columbus State Community College
Casey Barach, Executive Director, Madison E-Zone
Phil Bergstedt, Loan Executive, Reynold & Reynolds
Greg Boyd, President, Results Engineering
Mark Butterworth, Executive Vice President, Scitech
Lynn Child, President, Aardvark Inc.
Steven Clark, Director, Information Technology, Business Technology Center
Mark Clower, Director, Finance & Administration, Cohesia
Harvey Cohen, Attorney, Dinsmore & Shohl
Thomas Conrad, Implementation Support, Material System Group/Systems Requirement,
The Greentree Group
Jim Cunningham, Director, Telecommunications Special Interest Group, Black Data Processing Associates
John Davalos, Director, Fabrication Support, LexisNexis
Alan Dillman, Partner, Park Hill Technologies
Steve Dippold, Information Technology Partner, NCR Teradata
Anthony DiSanza, Director, Blackwell Consulting Services

Neil Drobny, Principal, Avantt Consulting
Michael Eck, Sales Manager, Computer Horizons
Al Fahimi, President, Caspian Software, Inc.
John Fonner, Director, Technology Adoption, CincyTechUSA
David Frost, Deloitte & Touche
Mark Furst, Business Development Manager, Allen, Williams & Hughes Company
Frank Henson, Columbus Technology Council
Frank Hill, Jr., President, Hiltronics
Ken Illgen, Chief Information Officer, Schottenstein, Zox & Dunn
Dwight Johnson, Vice President, Technology, Dayton Development Coalition
Michael Kehoe, Vice President, SBC
Kim Keiser, Ohio Hospital Association
Casey King, Senior Account Executive, Sysix Companies
John Kratz, President/Chief Executive Officer, Information Control Corp.
Olu Lafe, Chief Executive Officer, Quik Cat Technologies
Gary Little, President, Information Technology Alliance of Appalachia Ohio
Andrew Lloyd, Technical Engagement Manager, LexisNexis
Dan Lohmeyer, President, Ohio's IT Alliance
Dave MacKenzie, Executive Account Manager, Cisco Systems
Robert Madden, Chief Solutions Officer, Westfield Group
Joe Malloni, Vice President, Strategic Marketing, EDS
Mark Manoukian, Director of Information Services, Kegler, Bown, Hill & Ritter
David Matusoff, Manager, Outreach and Development, Fisher College of Business, The Ohio State University
Jeffrey McGurk, President, Trinity Management Consulting
Allan McLaughlin, Senior Vice President & Chief Technology Officer, LexisNexis
David Novak, SBTechnology Law
Kathleen O'Neill, Vice President, Communication Sector Sales, IBM
Larry Pritchard, Associate Partner-Application Management Services, IBM
Rajiv Ramnath, Director, Enterprise System Initiative, The Ohio State University
Tyler Reed, Chief Executive Officer, Progress Forge, LLC
Steve Rucinski, Dream River Group
Gordon Sargent, Vice President, Graduate Studies, University of Dayton
Stephanie Singer, Director Data Center Facilities, LexisNexis
Dena Smith, Director Technology Management, Allen, Williams & Hughes Company
Ed Smith, Dean of Administrative Services, DeVry University
Kathy Sparks, Senior Manager Information Systems & Technology, Convergys
Don Stredney, Director-Interface Lab, Ohio Supercomputer Center
Jay Thomas, Dean of School of Graduate Studies, Wright State University
Arthur Trevethan, Founder/Chief Executive Officer, Companion Applications, LLC
Matthew Wald, Vice President, Information Systems Engineering, Battelle
Michael Wallace, Q Consulting
Richard Wegmann, Chief Executive Officer, BusinessLabs
Leslie Weilbacher, Executive Director, Advanced Logistics Council, Greater Columbus Chamber of Commerce
Mark Weilbacher, Executive Director, Mid Ohio Training Consortium
Dennis Yun, Senior Program Manager, James Gregory Associates
Zach Zettler, Executive Vice President & Chief Operating Officer, Optimum Technology, Inc.
Stu Zweben, The Ohio State University

INSTRUMENTS, CONTROLS, ELECTRONICS & ADVANCED MANUFACTURING TASK FORCE

Chairman, Joseph Keithley, Chairman, President and Chief Executive Officer, Keithley Instruments, Inc.
Director, Dave Patricy, Corporate Development, Keithley Instruments, Inc.

Dennis Adamkiewicz, Professional Engineer, Quantum Electronics Development
Charles Alexander, Dean, Fenn College of Engineering, Cleveland State University
Jerry Antle, President & Chief Executive Officer, Harris Instruments
Allen Arthur, Associate Dean of Academic Affairs, University of Cincinnati
George Baaklini, Senior Research Scientist, NASA Glenn Research Center
Dick Beery, Chief Executive Officer, Strategic Sales, RBB Systems, Inc.
Al Behbahani, Senior Program Manager, Air Force Research Laboratory
Gina Beim, Senior Engineer, Pile Dynamics, Inc.
Douglas Blakeley, Director Medical Research Development, Philips Medical Systems
Dan Briones, Director of Business Development, Design Engineers & Consulting
Kevin Brown, Wright Patterson Air Force Base
Kiyong Chung, GE Aircraft Engines
John Davalos, Director, Fabrication Support, LexisNexis
Rhonda DeMuth
Andy Dunn, Norsdon Corporation
Stephen Gage, President, CAMP, Inc.
Fred Garber, Associate Professor & Chair, Department of Electrical Engineering, Wright State University
Frank Henson, Columbus Technology Council
Dave Hiscock, Vice President, Engineering, PentaLim Corporation
Nadeane Johnson, Manager Technology Initiatives, Regional Technology Alliance of Northwest Ohio
Jack Kleinhenz, Chief Economist, Greater Cleveland Growth Association
John Kohls, Executive Vice President, TechSolve, Inc.
Stephen Kowel, Dean of Engineering, University of Cincinnati
Thomas Kuklo, General Manager, Bird Electronic Corporation
Leonard Lewis, Attorney, Calfee, Halter & Griswold
Robert Loeffler, P. R. Manager, ABB Automation
Larry Matus, NASA Glenn Research Center
Walt Merrill, Executive Director, Glennan Microsystems
Mike Nargi, Vice President, Inservco
Kelly Navarra, Sustaining Portfolio Manager, Air Force Research Lab
David Novak, Associate, SBTechnology Law
M. W. Overhoff, President, Overhoff Technology Corporation
Richard Pace, Cumberland Development, LLC
Gayle Rominger, Senior Vice President/General Manager, Environmental Products Group
Kathryn Ross, Director Regional Manager, Greater Cleveland Growth Association
Steve Schmidt, President & Chief Executive Officer, APSCO International
Bob Schwarz, Principal, Focus Consulting
Mark Smith, Corporate/Business & Intellectual Property Lawyer, SBTechnology Law
Philip Stevens, Carey/Falor Realty Partners
Craig Stickel, Managing Director, Scitech
Scott Sudnick, President, EMSNET
Jeff Thornberry, President, J.R. Thornberry Company, Inc.
Pete Toot, Manager, Advanced Controls Engineering, GE Aircraft Engines
Lou Trippel, Electrical Engineer, YSI, Inc.
Fatima Weathers, Vice President Training & Technical Services, CAMP, Inc.
David Youkers, Managing Principal, Computer Technology Solutions

POWER & PROPULSION TASK FORCE

Chairman, Mike Benzakein, General Manager, Advanced Engineering Program Development,
GE Aircraft Engines

Director, Carol Cash, NASA Programs-Cleveland Office, GE Aircraft Engines

Donald Bailey, Vice President, Industry Relations, OAI

Dilip Ballal, Professor, Department of Mechanical & Aerospace Engineering, University of Dayton

Rob Banerjee, Vice President, Webcore Technologies

Michael Benjamin, Parker Hannifin Corporation

Rathindra Bose, Kent State University

Galdemir Botura, Senior Product Engineer, Goodrich

Minel Braun, University of Akron,

Peter Buca, Technology Director, Parker Hannifin Corporation

Ted Bucaro, Government & Regional Relations Director, University of Dayton

Frank Calzonette, Vice Provost for Research, The University of Toledo

Brian Carley, Partner, Deloitte & Touche

John Cherr, Argo-Tech Corporation

Henry Cialone, Senior Vice President, Energy Products, Battelle

Gary Conley, President, TechSolve, Inc.

Jack Dawson, Director of Technology Planning & Development, Dana Corporation

Joann Erno, Air Force Research Laboratory

Kenneth Fisher, Business Development Manager, Goodrich

Ted Ford, President & Chief Executive Officer, Edison Welding Institute

Gearld Fox, Timken Corporation

Awatef Hamed, University of Cincinnati

Robert Hancock, Branch Chief, Combustion Science, Air Force Research Laboratory

Subramaniya Hariharan, University of Akron

Dan Hutcheson, Webcore Technologies

Nadene Johnson, Manager, Technology Initiatives, Regional Technology Alliance of Northwest Ohio

Roger Knudsen, Vice President, Engineering/Industrial Businesses, The Timken Company

Binod Kumar, University of Dayton Research Institute

S. K. Lau, Vice President, Research & Development, Goodrich Corporation

Benson Lee, President & Chief Executive Officer, Technology Management, Inc.

Anita Liang, NASA Glenn Research Center

Wangen Lin, Director, Research & Technology, Edison Welding Institute

Rodger McKain, Vice President & General Manager, SOFCo Holdings LLC

Walt Merrill, Director, Glennan Microsystems, Inc.

Jeff Meyers

Tom Migala, Chief Executive Officer, Surface Enhancement Technologies

Thomas D. Nixon, Section Leader, Goodrich Corporation

Paul Orkwis, University of Cincinnati

Michael Orth, Timken Corporation

William Randle, Director, Technology Ventures, American Electric Power

Mark Reeder, Assistant Professor, AFIT/ENY

Gordon Sargent, University of Dayton Research Institute

Kristen Schario, Technology Transfer Manager, Air Force Research Laboratory

John Schneider, Staff Engineer, American Electric Power

Arun Sehra, Director of Aeronautics, NASA Glenn Research Center

Michael Sheppard, Project Engineer, Webcore Technologies

Mark Smith, SBTechnology Law

Richard Smith, III, Executive Vice President, NetJets
David Vargo, Business Development Manager, National Machine Company
Timothy Wickenheiser, Chief Safety Office, NASA Glenn Research Center
James Williams, Dean of Engineering & Honda Professor, College of Engineering, The Ohio State University
Greg Wilson, Kent State University
Rich Yori, Engineering Manager, National Machine Company

OHIO BUSINESS ROUNDTABLE STAFF

Rich Kiley	Project Director, 3 rd Frontier Initiative
Nick Lashutka	Director of Governmental Relations
Richard Stoff	President
Jackie Swick	Director of Operations
LaWanda Trotter	Administrative Assistant

The BRT staff appreciates the outstanding collaborative relationship we have with the Ohio Technology Partnership (OTP) – Dorothy Baunach, Director, Northeast Ohio Technology Council; Johnathan Holifield, Executive Director, CincyTechUSA; Dwight Johnson, Technology Director of the Dayton Development Coalition; Sandy White, Director, Columbus Technology Council, and Amy Whitehead, Director of the RTA of Northwest Ohio. Members of the OTP created the recommendations herein related to technology commercialization.

Business is united in its support of the Third Frontier – and, to this end, the BRT values its partnership with the leaders of the major, statewide business organizations, especially Eric Burkland, President, Ohio Manufacturers' Association; Andrew Doehrel, President, Ohio Chamber of Commerce; Roger Geiger, Executive Director, National Federation of Independent Business/Ohio; Jack Fisher, Executive Vice President, Ohio Farm Bureau; and John Mahaney, Jr., President, Ohio Council of Retail Merchants.

The BRT staff gratefully acknowledges the advice and counsel of Norm Chagnon, Assistant Deputy Director, Ohio Department of Development, who participated in virtually all the task force meetings; Rod Chu, Chancellor, Ohio Board of Regents; Brian Hicks, Governor Taft's Chief of Staff; Bruce Johnson, Director, Ohio Department of Development; and Frank Samuel, the Governor's Science and Technology Advisor. It goes without saying that we admire the Governor for putting technology-based economic growth squarely on his policy agenda.

We sincerely appreciate the assistance we have received from so many legislative staffers on both sides of the aisle and applaud the members of the Ohio General Assembly, and especially President White and Speaker Householder and their respective chiefs of staff, Teri Geiger and Brett Buerck, for making the Third Frontier a top legislative priority.

Finally, the BRT fully embraces the proposition that Ohio's business leaders and university presidents – both public and private – share a mutual objective and common bond in moving the state forward in technology-based economic growth. We look forward to continuing to work closely with the higher education community of this state.