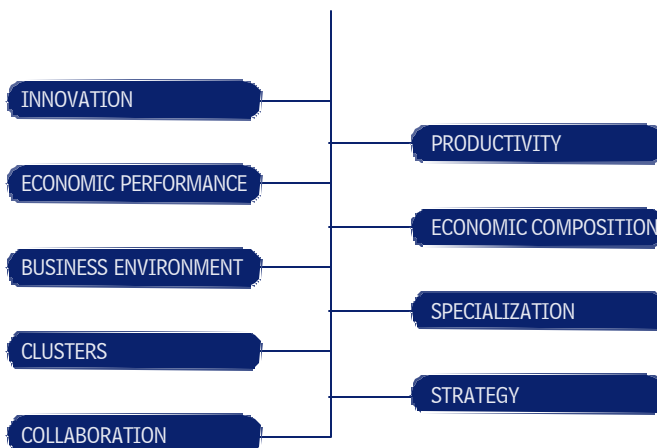


Professor Michael E. Porter, Harvard University  
Monitor Group  
ontheFRONTIER  
Council on Competitiveness

## CLUSTERS of INNOVATION: Regional Foundations of U.S. Competitiveness



### CLUSTERS OF INNOVATION INITIATIVE



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Regional Foundations of U.S. Competitiveness**

Professor Michael E. Porter, Harvard University  
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ontheFRONTIER  
Council on Competitiveness

# CLUSTERS OF INNOVATION INITIATIVE: REGIONAL FOUNDATIONS OF U.S. COMPETITIVENESS

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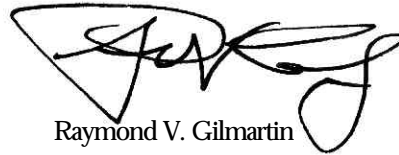
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Foreword by the Chairman of the  
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The Clusters of Innovation Initiative is perhaps the most ambitious project in the nearly 20-year history of the Council on Competitiveness. As cited in the Acknowledgments, many individuals and organizations played key roles in the project's success. None, however, gave more of their time, attention, and expertise than the project's co-chairs, Duane Ackerman, chairman and CEO of BellSouth, and Michael Porter of Harvard University, both of whom are members of the Council's Executive Committee. Duane brought his tremendous leadership and prestige, and Michael his international reputation as the leading expert on cluster theory and competitiveness. Michael's pioneering work on innovation and industry clusters is embedded in this project. The Council on Competitiveness owes a debt of gratitude to them both.



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Foreword by the Co-Chairs of the Clusters of Innovation Initiative

Since its founding nearly two decades ago, the Council on Competitiveness has addressed a wide range of economic issues affecting the nation including trade policy, technology policy, the federal budget, and workforce skills. Competitiveness has tended to be seen primarily from a federal perspective, and national policies and circumstances surely affect the prosperity of our economy. However, the Clusters of Innovation Initiative was undertaken with the realization that the real work of raising productivity and innovative capacity usually occurs not in our nation's capital, but in the cities and regions where firms are based and competition actually takes place.

Regional economies are the building blocks of U.S. competitiveness. The nation's ability to produce high-value products and services depends on the creation and strengthening of regional clusters of industries that become hubs of innovation. Understanding is growing about how these clusters enhance productivity and spur innovation by bringing together technology, information, specialized talent, competing companies, academic institutions, and other organizations. Close proximity, and the accompanying tight linkages, yield better market insights, more refined research agendas, larger pools of specialized talent, and faster deployment of new knowledge.

Utilizing a unique database developed at the Institute for Strategy and Competitiveness at the Harvard Business School, we are now able to systematically measure the relative strength of regional economies and their clusters and track their economic and innovation performance over time. In addition, a team consisting of individuals at Monitor Group and its affiliate on the FRONTIER, the Council on Competitiveness, and the Institute have conducted surveys, in-depth interviews, and strategic analyses in order to assess the strengths and challenges of five pilot regions: Atlanta, Pittsburgh, the Research Triangle in North Carolina, San Diego, and Wichita.

This national report draws heavily upon the five regional studies and synthesizes the implications for any region that seeks to improve its economic performance. The report examines the composition and performance of regional economies, how industry clusters develop and innovation arises, how clusters affect a region's economic future, and how a region can establish a strategy and action program to drive its economy and clusters forward. The framework employed and the lessons learned apply to every region of the country.

We wish to acknowledge the support we received from the national steering committee, advisors in the participating regions, the many individuals who gave their valuable time to be surveyed and interviewed, and the many project sponsors. All of you have helped us to create a unique knowledge base and a process for catalyzing action. Your thoughts and insights are embedded in this report, and will, hopefully, benefit not only the five regions that participated in the study but other parts of the country as well.



F. Duane Ackerman  
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This report benefits from the leadership of co-chairs Duane Ackerman, BellSouth Corporation; Professor Michael Porter, Harvard University; as well as a national steering committee. They have guided a partnership involving Monitor Group and its affiliate, ontheFRONTIER, the Institute for Strategy and Competitiveness at Harvard Business School, and the Council on Competitiveness.

Professor Porter provided the theoretical and methodological framework for the Initiative and led the research and writing of this national report.

Jeff Grogan of the Monitor Group served as overall project leader. Kurt Dassel of the Monitor Group managed the efforts in each of the five regions studied. Kurt Dassel and Pedro Arboleda of the Monitor Group, with assistance and guidance from Jeff Grogan and Mark Fuller of the Monitor Group, took the lead in preparing this report. Pedro Arboleda, and Randall Kempner, Kyle Peterson, and Michael Brennan of OntheFRONTIER, under the guidance of Professor Porter, Jeff Grogan, and Kurt Dassel, prepared the regional reports from which this report draws. These four individuals performed the basic economic and cluster analyses and were the primary contacts with business and government leaders in each region.

The Institute for Strategy and Competitiveness, led by Professor Porter, conducted the Cluster Mapping Project, a multi-year research effort that developed the data for benchmarking regional and cluster performance. Elisabeth de Fontenay, Weifeng Weng, Daniel Vasquez and other staff at the Institute for Strategy and Competitiveness contributed to the conceptual development of the project and the interpretation of economic and cluster data presented in the regional reports and the national report. These individuals include Christian Ketels, Veronica Ingham and Orjan Solvell.

John Yochelson and Alan Magazine at the Council on Competitiveness provided project coordination and interfaced with business and government leaders. Michelle Lennihan coordinated the fieldwork, performed data analysis, and contributed to the regional and national reports. Debra VanOpstal and Jackie Mathewson provided additional national economic data and analysis, as well as ongoing review and critique of the research. Judith Phair and Lea Kleinschmidt at the Council on Competitiveness and Jodie Klein, KleinOnPoint, helped communicate the findings of the regional and national reports to the media and other groups.

Lily Rappoli, Alyson Lee, and Julie Sherman at the DesignStudio at Monitor Group illustrated, designed, and created the layout of the regional reports and this report.

Almost 1300 business and government leaders contributed to this project in some way by providing background information, submitting to interviews, completing surveys, and offering their views. Regional advisors provided the Initiative valuable information and coordination assistance in the regions. While this report aims to reflect the consensus view of those interviewed and surveyed, it cannot do justice to all their contributions. Any errors, omissions or inconsistencies are the responsibility of the report writers and not any one individual or institution.

For additional information on this research, contact Kurt Dassel at Monitor Group (e-mail: Kurt\_Dassel@monitor.com), Christian Ketels at the Institute for Strategy and Competitiveness (e-mail: Cketels@hbs.edu), or Michelle Lennihan at the Council on Competitiveness (e-mail: Lennihan@compete.org).

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# EXECUTIVE SUMMARY OF THE CLUSTERS OF INNOVATION NATIONAL REPORT

## Introduction

During the 1990s, Americans found a way to do what seemed no longer possible — grow the economy, create jobs, and increase the standard of living, without driving up inflation. Much of the credit goes to the nation’s ability to develop and commercialize new technology. The result: one of the most robust periods of economic expansion and prosperity of the past century.

Today, the nation is experiencing an economic downturn. While fiscal and monetary policies pump dollars into the economy to boost the level of activity, innovation infuses the economy with growth-incubating new ideas, new products, services, and technologies. National policies and national investment choices have much to do with the growth and capacity of the American economy. For innovation, however, the real locus of innovation is at the regional level. The vitality of the U.S. economy then depends on creating innovation and competitiveness at the regional level.

In healthy regions, competitiveness and innovation are concentrated in **clusters**, or interrelated industries, in which the region specializes. The nation’s ability to produce high-value products and services that support high wage jobs depends on the creation and strengthening of these regional hubs of competitiveness and innovation.

The Clusters of Innovation Initiative was launched to help meet this challenge. The Initiative examined five regions around the country: Atlanta, Pittsburgh, the Research Triangle, San Diego and Wichita. These regions were selected to provide a diversity of size, geography, economic maturity, and perceived economic success. The regions were similar enough to allow interesting comparisons, yet diverse enough to encompass a wide variety of challenges and opportunities in regional economic development.

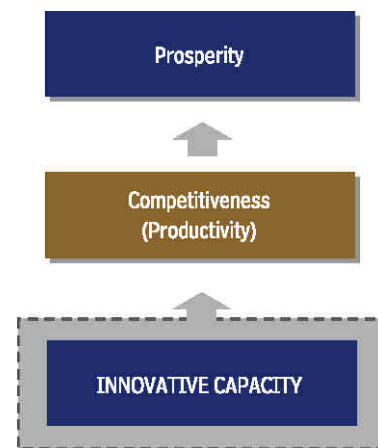
Data for the study were drawn from a number of sources, but the principal sources of data were the Cluster Mapping Project of the Institute for Strategy and Competitiveness, the Clusters of Innovation Initiative Regional Surveys™, and in-depth interviews of business and government leaders in each region.

A summary of the findings and implications is provided below:

### Regional Competitiveness and Innovative Capacity

- The economic goal for regions should be a high and rising standard of living.
- This depends upon creating a high-quality business environment that fosters **innovation** and rising **productivity**.
- **Strong** and **competitive clusters** are a critical component of a good business environment and are the driving force behind regional innovation and rising productivity.
- The prosperity of a region depends on the productivity of all its industries.
- Productivity does not depend on what industries a region competes in, but on how it competes.

### Innovation and the Standard of Living



- The most important sources of prosperity are created not inherited.
- Any regional economic development effort has to start with an assessment of regional economic performance.
- Economic performance is best measured on multiple levels to capture prosperity, productivity and innovative capacity.
- Regional economies are composed of three types of industries: traded, resource-driven and local industries. While local industries account for the majority of employment in regional economies, **traded industries are the dynamic core of a regional economy.**
- The evolution of regional economies is a lengthy process. While inherited factors, geography, climate, and population are important, other factors such as entrepreneurship, the presence of research and training institutions, the composition of the regional economy, and public and private sector actions are important influences.
- All levels of government can influence the business environment and the productivity of clusters.
- While government can help foster a favorable business environment, companies and industries must ultimately achieve and sustain competitive advantage.
- Formal and informal **institutions for collaboration** such as regional economic development organizations and alumni of large influential companies are important contributors to cooperation in advanced economies.

## Findings and Implications

### Economic Performance of Regions

- **Regions vary greatly in terms of economic performance:** Some regions have high average wages, while others have low average wages; some regions are growing rapidly, while others are shrinking.
- **A region's average wages must be assessed in the context of that region's cost of living:** Regions that exhibit high growth do not necessarily prosper due to cost of living increases that negate or diminish gains in average wages.

### Economic Performance Indicators

Overall Economy	Innovation Output
<ul style="list-style-type: none"> <li>■ <b>Employment Growth</b> Rate of employment growth</li> <li>■ <b>Unemployment</b> Percentage of persons unemployed</li> <li>■ <b>Average Wages</b> Payroll per person</li> <li>■ <b>Wage Growth</b> Growth rate for payroll per person</li> <li>■ <b>Cost of Living</b> Cost of living index</li> <li>■ <b>Exports</b> Value of manufactured and commodity exports per worker</li> </ul>	<ul style="list-style-type: none"> <li>■ <b>Patents</b> Number of patents and patents per worker</li> <li>■ <b>Establishment Formation</b> Growth rate of number of establishments</li> <li>■ <b>Venture Capital Investments</b> Value of venture capital invested per worker</li> <li>■ <b>Initial Public Offerings</b> Number of initial public offerings per worker</li> <li>■ <b>Fast Growth Firms</b> Number of firms on the Inc. 500 list vs. overall size of the regional economy</li> </ul>

- **Higher levels of innovation output lead to higher levels of prosperity:** Above-average economic performance measures are not enough to ensure regional prosperity. Maintaining, much less increasing, a region's standard of living requires the steady growth of productivity, which in turn requires innovation.
- **Innovation output varies greatly across regions:** Just as regional economies have different levels of average wages and job creation, so too do they have very different levels of innovation output.

- **The relative effectiveness of commercialization greatly affects the economic impact of research:** Commercialization of basic research is a difficult but important ingredient for generating entrepreneurship. Some regions have high levels of R&D investments and numerous specialized research centers, but still lag in terms of innovation output because knowledge is not effectively or rapidly transferred to companies.

**Implications:**

- **The need for a distinctive strategy:** No single policy or strategy will work for all regions. Each region must craft a distinctive approach based on its unique assets and relative strengths.
- **Growth vs. prosperity:** Growth is not the same as prosperity. Growth is only desirable if the standard of living of citizens rises. High growth per se often leads to a rising cost of living that erodes prosperity and degrades natural resources and physical infrastructure that support quality of life.
- **From efficiency to innovation:** Current economic performance does not assure future performance. Maintaining, much less increasing, a region's standard of living requires the steady growth of productivity. Innovation output leads to higher productivity levels, and is critically important if a region is to reach the upper quartile of high-performing regions.
- **Measuring multiple dimensions of performance:** Measuring only a few indicators of performance will not give an accurate view of a region's strengths and weaknesses. A number of performance measures need to be assessed, including economic performance, innovation output, and effectiveness of commercialization.

**Economic Composition of Regions**

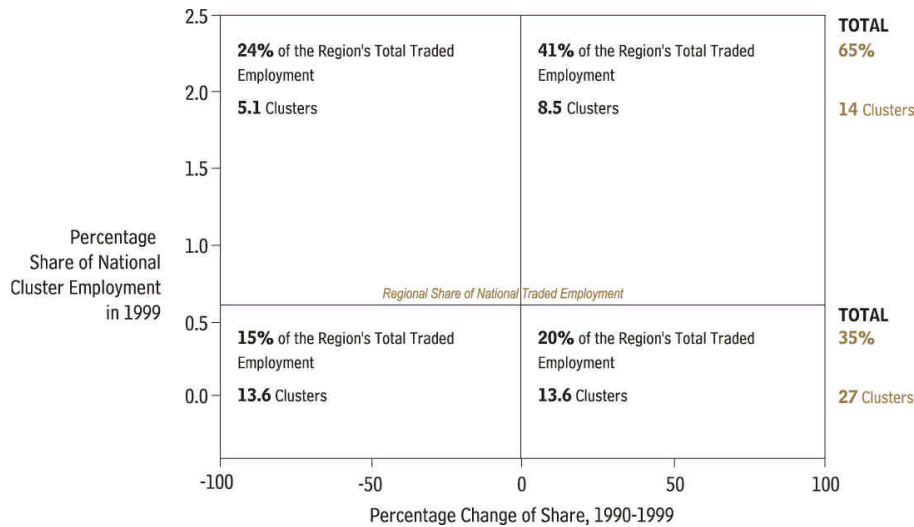
- **The composition of regional economies differs greatly:** The Cluster Mapping Project has identified 41 types of clusters in the U.S. economy. While any given region will have some employment in the vast majority of these clusters, regional economies are typically very strong in only a handful.
- **A wider geographic focus often identifies more available assets in a region:** Regions tend to focus on narrow geographic areas when devising economic development strategies. A broader geographic area is sometimes more appropriate.
- **Some regional economies are highly dependent on a few clusters or even companies:** Although all regional economies specialize in a few areas, some have especially narrow breadth. These economies have a disproportionate share of employment in one cluster, and even in a handful of companies, which makes them unnecessarily vulnerable.
- **“High-Tech” clusters account for a small percentage of jobs and wages in most regional economies:** Several types of clusters are especially innovative: communications equipment, analytical instruments, biotechnology/pharmaceuticals, and information technology. These clusters are very productive, and pay high wages, and regions with strength in these clusters certainly benefit from their presence. However, the overall impact of these clusters on a regional economy is usually relatively small.

- **Higher wages in traded clusters tend to pull up wages in local clusters:** The way to increase prosperity of an entire region is to increase average wages in traded industries.

**Implications**

- **Defining the right region:** The composition of regional economies can shift significantly depending upon the geographic area considered. Regions have a tendency to follow political jurisdictions and omit important surrounding areas and assets. A broader, geographic definition widens opportunities and brings constituencies together.
- **Building a strategy:** Successful regions build strategies on their unique assets and strong clusters, where they have the greatest advantages. Strength then spreads to additional clusters over time.
- **Clusters of clusters:** Focus on a few clusters exposes a regional economy to booms and busts. Regional strategies should encompass a wide range of clusters, and be attentive to clusters that overlap. Overlapping clusters offer potential synergies in skill, technology, and partnership.
- **Widen innovative capacity to many clusters:** The majority of traded jobs in any region are in clusters that are not generally perceived to be “high-tech” (e.g., business services, financial services, education and knowledge creation, transportation and logistics, and hospitality and tourism). In order to meaningfully increase overall regional prosperity, innovative capacity must be built in many clusters.

Specialization of Economic Areas, Narrow Cluster Definition



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

## Evolution of Regional Economies

- **Successful regions leverage their unique mix of assets to build specialized clusters:** Successful regions do not pick winners, but build on their inherited assets (e.g., geography, climate, population, research centers, companies, governmental organizations), to create specialized economies that both differ from other regions and offer comparative advantages to local companies.
- **Building strong regional economies takes decades:** There are many steps in building a regional economy—developing inherited assets, creating new assets, linking companies to these assets, attracting outside companies—and this process takes time.
- **Institutions for collaboration play an important role in building regional economies:** Institutions for collaboration help build regional economies by facilitating the flow of information, ideas, and resources among firms and supporting institutions.

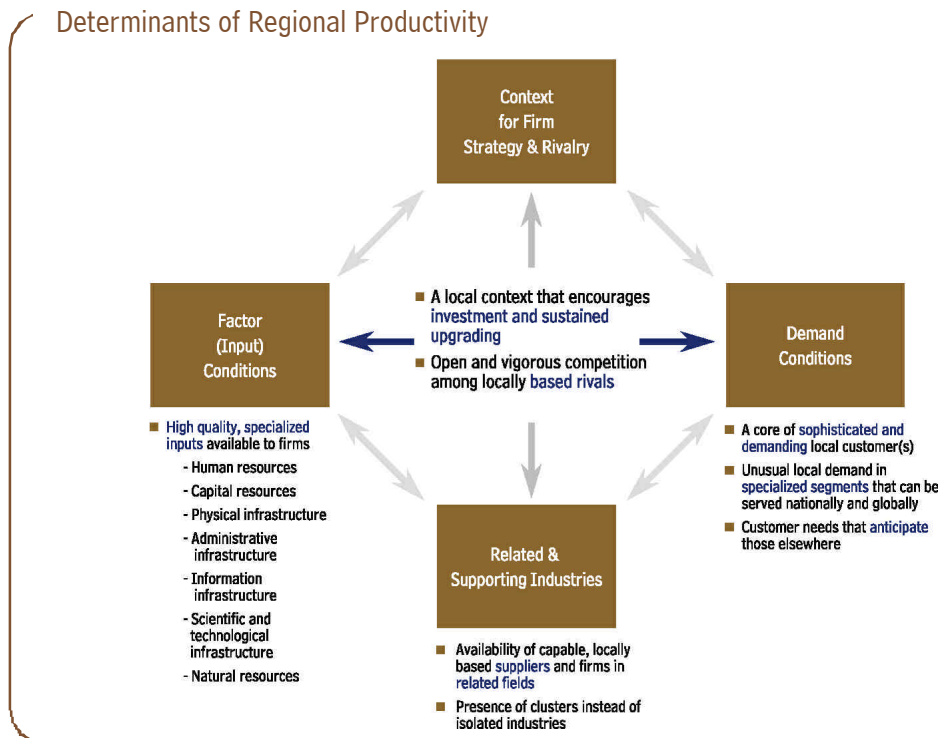
### Implications

- **Long time horizon:** Meaningful changes in regional development require investments that generally take decades before significant dividends are reaped. Long time horizons create challenges for leaders seeking reelection, and make it more difficult to mobilize community support behind an economic development strategy. These realities highlight the need for an institutional structure for regional development that goes beyond government, as well as the need for private sector involvement.
- **Building on traditional industries:** Inherited assets matter to a region's economic development. Established and already emerging clusters offer the greatest prospects for near term growth. Strengthening established clusters should be one of the early priorities in regional economic development.
- **Investing in unique and specialized assets:** Many inputs in regional prosperity often require substantial investments in specialized assets such as university campuses, research programs, logistical infrastructure, and the like.

## Regional Business Environment

- **A strong physical and information infrastructure is a baseline requirement to establish and sustain a prosperous regional economy:** Good quality roads, highways, airports, railroads, water, and power support the efficient movement of people, goods, and services as well as the quality of life of citizens.
- **A strong K-12 educational system is important for developing local talent and attracting outside talent:** The quality of K-12 education is growing ever more critical because it establishes the baseline of talent for entry-level jobs and the pool of specialized talent critical to cluster development. It also helps in the recruitment of individuals and companies.
- **Universities and specialized research centers are the driving force behind innovation in nearly every region:** Although companies and individuals do create a large number of innovations, universities and research centers institutionalize entrepreneurship and ensure a steady flow of new ideas.
- **Specialized talent and training are more important than abundant labor:** It is not abundant low wage labor that attracts innovative companies, but rather highly talented, specialized, and often expensive labor.
- **Government can have a significant influence on the business environment, both positively and negatively:** Government at all levels influences the business environment through policies and services that influence factor inputs, context for firm rivalry, demand conditions, and related and supporting industries.

- **Poor coordination among local jurisdictions impedes efforts to improve the business environment:** Regional economies encompass many political jurisdictions. Efficient coordination among them is important for maintaining and improving physical infrastructure (e.g., road, airports, water ports, communications systems), creating strong K-12 education, offering a business-responsive political environment, and promoting cross-cluster collaboration.



### Implications:

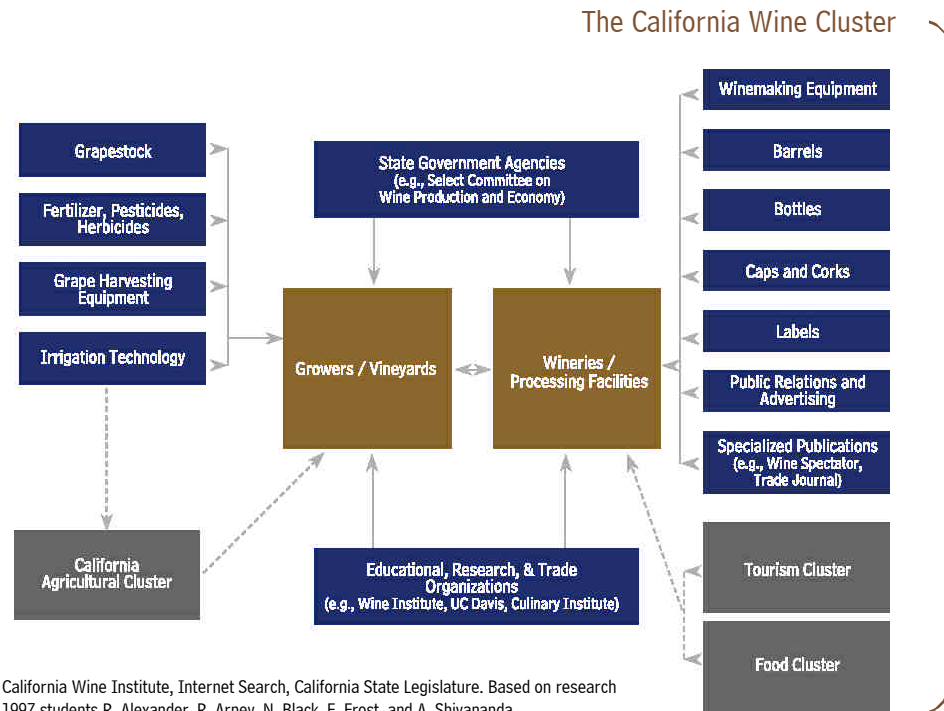
- **Challenges of success:** Successful regional economies tend to experience rapid growth, which stresses the physical infrastructure. Foresight and a conscious strategy are needed to maintain and improve infrastructure in advance of the strains caused by growth.
- **Recognize the need for strategic transitions:** Over time, regional development strategies run their course. Success at one strategy creates the challenges that need to be addressed by the next strategy.
- **Institutionalizing innovation:** Successful regions do not rely on chance, but rather seek to institutionalize the innovative process by building strong universities and research centers, and by attracting research divisions of major companies, to create continuous innovation and entrepreneurship.
- **Moving to commercialization:** Commercialization is a vital step in the innovation process. Some regions have high levels of R&D investments and numerous specialized research centers, but still lag in terms of innovation output because knowledge is not effectively transferred to companies. Having many different types of research institutions (e.g., public universities, private universities, for-profit research centers, non-profit research centers, etc.) appears to foster commercialization.

## Clusters

- **Proximity fosters productivity and innovation:** When members of a cluster are located in close proximity, they can capture synergies that increase productivity, innovative capacity, and new business formation.
- **Clusters often share common industries:** Some industries are in more than one cluster. Overlaps provide opportunities to use strength in one cluster and build new clusters.
- **Clusters with depth and breadth enjoy advantages over narrower clusters:** Clusters with strength across a broad range of subclusters have advantages over more narrow clusters due to the extensive market, technical, and other specialized information which accumulates within a regional cluster.
- **Cluster strength is often disproportionately concentrated in a few subclusters:** Clusters are composed of many subclusters. Even relatively weak clusters can often have strength in a few subclusters.
- **Cluster-specific institutions for collaboration facilitate the flow of information and resources throughout the cluster:** Diverse groups (e.g., rival firms, related and supporting industries, universities and research centers, training institutions, government, and so forth) contribute to cluster strength, but their contribution is not automatic. An organization dedicated to mobilizing these groups does much to strengthen a cluster.

### Implications:

- **Subcluster interactions:** Even if full clusters are relatively weak in a region, there may be a constellation of related subclusters that constitute a differentiating advantage.
- **Proximity:** Firms can be encouraged to locate near each other through zoning, and the provision of easily accessible infrastructure.



## The Development of Clusters

- **Clusters can be strengthened by increasing awareness of the cluster among local firms and organizations:** Not only must firms be aware of the presence of a local cluster, they must also get together and coordinate activities to improve the cluster's business environment. Acceptance of new companies is important if the cluster is to grow quickly and reach a critical mass.
- **New firm and cluster opportunities arise at the intersection of existing clusters:** Economic development strategies can leverage these opportunities to diversify a regional economy.
- **Anchor companies play a disproportionate role in seeding cluster development:** Anchor companies support cluster development by acting as magnets for other major companies; organizing other companies in the cluster for collective action; supporting projects that improve the local quality of life; and producing numerous spin-out companies, which strengthen key elements of the cluster.
- **Institutions for collaboration can significantly increase the success rate of start-up companies:** Cluster development depends in large part on generating new companies from within a region. Successful regions almost always have a hospitable environment for start-ups.

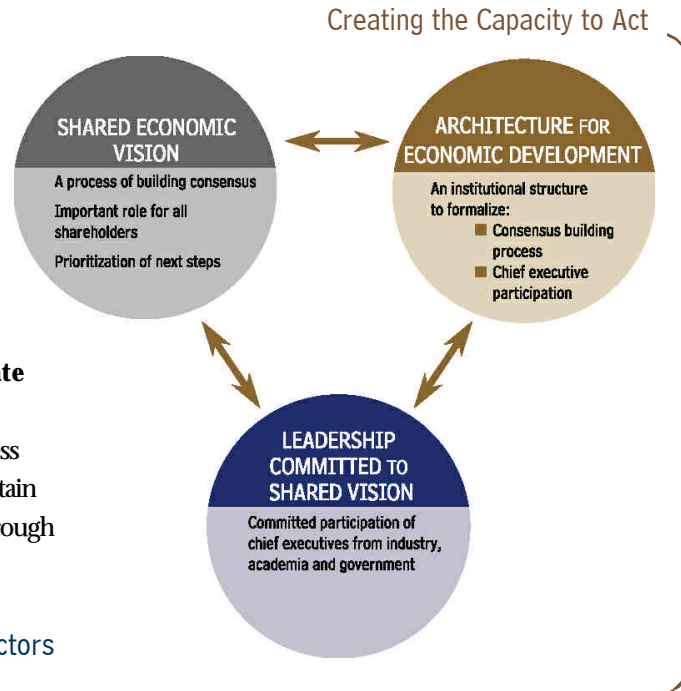
### Implications

- **An explicit cluster development program:** Although chance events play a role in the formation and development of clusters, conscious efforts to raise cluster competitiveness and innovative capacity can meaningfully influence the trajectory of cluster development.
- **Recruiting for clusters:** Recruitment strategies at the regional level should target clusters in which the region has strength, or clusters which overlap with other clusters. This allows the region to market its unique assets rather than compete on subsidies. In recruiting efforts, regions should also identify gaps within clusters, and seek to attract companies to fill them.
- **Opportunities at the intersection of clusters:** Opportunities for growth often arise at the intersection of clusters where a region has strength.

## Creating and Implementing a Regional Strategy

- **Regions often encounter a common set of pitfalls:** Because no single nationwide policy will be entirely appropriate for every region, policy setting at the regional level is especially important.
- **Regions need to overcome transition points in the development of their economies:** Regional leaders encounter transitional challenges as they develop their economies. Addressing these challenges should be targets of regional economic development strategies.
- **Broad-based collaboration is needed for development strategies to succeed:** Successful regional economies benefit from the contributions of a wide array of organizations. Organizing for action entails arriving at consensus and creating the capacity for regions to implement development strategies.
- **A shared economic vision helps elicit broad support and coordinate activities:** To achieve good coordination among many diverse groups, a shared vision of common objectives and methods is vital.

- **Strong leadership is a necessary part of any successful economic development strategy:** Strong leadership committed to regional economic development is needed to ensure that companies, knowledge centers, governments, and collaborative institutions contribute to their full potential.
- **An overarching organization for economic development helps coordinate and routinize the process:** A formal organizational structure and process for working on economic issues helps maintain a consensus behind an economic strategy through periods of economic and political change.



## Action Agendas for the Public and Private Sectors

### FEDERAL GOVERNMENT

- Invest in the foundations of science and technology.
  - Increase federal funding of research at universities and other research centers.
  - Establish federal overhead recovery rules, and other policies, to encourage investment in universities' science and technology infrastructure.
  - Provide federal support for specialized training programs in science and engineering.
- Improve the innovation policy context.
  - Fortify intellectual property protection.
  - Strengthen and enforce anti-trust laws with a greater weight on innovation.
  - Reinforce federal tax incentives that encourage business investment in R&D and industry-university collaboration.
- Allocate federal resources to reinforce cluster development.
  - Distribute federal research funding through a system of peer-reviewed competitive grants in a way that fosters cluster development
  - Encourage locally-based federal agencies to communicate and coordinate with local business, institutions for collaboration, and educational and research centers based around clusters.
- Provide better data for measuring regional economic composition and performance.
  - Collect more up-to-date data down to the county level.
  - Collect measures of both economic performance and innovation.
- Encourage the development of regional economic development strategies that stress innovation.
- Provide federal matching funds for innovation-focused state and regional economic development strategies.

## **STATE GOVERNMENT**

- Invest in the foundations of science and technology.
  - Recognize the state government's important role in supporting R&D funding at state universities.
  - Establish and maintain high levels of state support for community colleges and specialized training centers.
  - Create a strong university or college presence in all major regions of the state.
- Sponsor state programs that encourage cluster development.
  - Build cluster thinking into research parks and incubators.
  - Organize state systems of higher education around local clusters.
- Focus business recruitment around strong clusters.
  - Coordinate activities with firms, universities, and training centers to recruit anchor companies to their region.
- Create regional dimension to state economic development strategy.
  - Encourage and assist regions to develop economic strategies.
  - Cultivate attitudes toward collaboration and sharing of information among firms, universities, training centers, labor, institutions for collaboration, and government.
- Improve information systems to regularly collect data and measure progress.

## **REGIONAL AND LOCAL GOVERNMENT**

- Strongly support K-12 education, and create strong standards and accountability.
- Upgrade core business infrastructure.
  - Transportation infrastructure.
  - Communications infrastructure.
  - Ensure specialized training programs are a high priority in any economic development strategy.
- Develop a regional strategy that involves all stakeholders.
  - Support regional benchmarking initiatives.
  - Encourage a common vision and collaboration among firms, universities, and training centers.
  - Work with firms, universities, institutions for collaboration, and state government to create an organizational structure to help implement a regional strategy.
- Encourage cluster development.
  - Establish research and industrial parks that encourage innovation-based competition.
  - Implement cluster-focused and innovation focused recruitment efforts.

## **UNIVERSITIES AND RESEARCH INSTITUTES**

- Recognize the important role of universities in regional economic development.
  - Take the lead on, and participate in, regional and cluster development efforts.
- Create and support technology transfer offices.
  - Work with firms and venture capital to streamline the technology transfer process.
  - Benchmark the commercialization of university-created intellectual property using measures that promote efficient dissemination of knowledge.
- Actively participate in cluster development efforts.
- Align university curricula and research to meet the needs of local clusters.

- Create cluster-specific institutions to support collaboration between academia and industry clusters.
- Work with local industry to create areas of excellence within universities that differentiate the university and complement local industry strengths.
- Integrate research and training efforts with the needs of local industry.
- Participate in the recruitment of companies.
- Support company start-up efforts by professors and students through mentorship, entrepreneurial education, and financing.

### **CLUSTER-SPECIFIC INSTITUTIONS FOR COLLABORATION**

- Promote cluster awareness.
- Engage in ongoing diagnosis of cluster's competitive position.
  - Compare position relative to other regional clusters.
  - Identify constraints, obstacles, and advantages.
- Develop training and management programs.
  - Provide programs through institutions for collaboration.
  - Coordinate with local institutions to provide programs.
- Actively participate with government in recruitment efforts.
  - Communicate with firms in clusters to identify gaps in the cluster and recruit accordingly.
- Widen institutional membership to include all cluster constituents.

### **FIRMS**

- Recognize the importance of location to competitive advantage.
- Take an active role in improving competitive environment.
  - Consistently communicate your needs and desires (e.g., for talent, ideas, patents) to local universities, research institutes, and training centers.
- See their cluster as a competitive asset.
- Contribute actively to cluster development activities.
  - Actively participate in cluster activities to identify issues of common concern and opportunities for mutual gain (e.g., regulatory matters, new buyer needs, innovative supplier capabilities).
  - Support recruitment activities of local chambers and other regional economic development officials to bring in companies that will fill missing niches in the cluster (e.g., suppliers, services providers, competitors).
  - Contribute to programs that support new ventures (e.g., improving access to risk capital, mentoring programs, and specialized services) in order to build-out cluster.

## INTRODUCTION

### Why Innovation Matters

During the 1990s, Americans found a way to do what seemed no longer possible — grow the economy, create jobs, and increase the standard of living, without driving up inflation. Much of the credit goes to the nation's ability to develop and commercialize new technology. The result: one of the most robust periods of economic expansion and prosperity of the past century.

Today, the nation is experiencing an economic downturn. As business and government leaders wrestle with this new context, most of the attention has been focused on monetary stimulus through lower interest rates, and fiscal stimulus through lower tax rates and government spending. These are important tools to affect economic growth in the short run. However, neither addresses the fundamental causes of prosperity. Prosperity depends upon the productivity with which the U.S. economy uses labor and capital to produce goods and services. Productivity rises because of innovation. Moreover, sustained economic growth will require continued innovation at all levels of the U.S. economy, especially as we enter a new era when the workforce will be increasing more slowly.

While fiscal and monetary policies pump dollars into the economy to boost the level of activity, innovation infuses the economy with growth-incubating new ideas, new products and services, and new technologies. National policies and national investment choices have much to do with the growth and capacity of the American economy. For innovation, however, the real locus of innovation is at the regional level. The vitality of the U.S. economy then depends on creating innovation and competitiveness at the regional level.

### About the Clusters of Innovation Initiative

The Clusters of Innovation Initiative offers a new way of thinking about economies that has begun to take hold as communities across the nation confront the successes of California's Silicon Valley, and Massachusetts' Route 128, Austin, Texas and other areas. In healthy regions, competitiveness and innovation are concentrated in clusters, or groups of interrelated firms and industries, in which regions specialize. The nation's ability to produce high-value products and services that support high wage jobs depends on the creation and strengthening of these regional hubs of competitiveness and innovation.

The Clusters of Innovation Initiative was launched to help meet this challenge. Under the leadership of Professor Michael Porter, Harvard University; Duane Ackerman, BellSouth Corporation; and a national steering committee—and supported by a partnership of Monitor Group and its affiliate, ontheFRONTIER, the Institute for Strategy and Competitiveness at Harvard Business School, and the Council on Competitiveness—the Initiative has worked to understand how regional economies develop, how clusters form and gain or lose competitiveness, and how innovative capacity is built. It offers recommendations for government, universities, the private sector, and other regional institutions. It aims to inform key decision makers across the country and provide a methodology for analysis that any region can utilize.

The Initiative studied five regions around the country: Atlanta, Pittsburgh, the Research Triangle, San Diego and Wichita. These regions were selected to provide a diversity of size, geography, economic maturity, and perceived economic success. The regions were similar enough to allow interesting comparisons, yet diverse enough to encompass a wide variety of challenges and opportunities in regional economic development.

Data for the study were drawn from a number of sources, but the principal sources of data were the Cluster Mapping Project of the Institute for Strategy and Competitiveness, the Clusters of Innovation Initiative Regional Surveys, and in-depth interviews of business and government leaders in each region.

The Cluster Mapping Project is perhaps the most detailed data set related to economic composition and performance ever compiled. Comparing regional economies has historically been difficult because clusters have not been systematically defined and their incidence charted across all U.S. regions. The Cluster Mapping Project created a detailed statistical analysis using county-level business data, including detailed metrics on regional economic performance, and data defining 41 types of clusters (e.g., information technology, automotive, business services) that are found in regions throughout the U.S. economy. The Cluster Mapping Data also mapped regional economies by cluster and constituent industry and compared regions to others on various indicators of economic vitality and future competitiveness. One of the goals of the Cluster Mapping Project is to disseminate this data widely to practitioners. (To access the data over the Internet, go to [www.isc.hbs.edu](http://www.isc.hbs.edu).)

Monitor Group, its affiliate ontheFRONTIER, in concert with staff from the Council on Competitiveness designed and implemented a broad reaching survey—the Clusters of Innovation Initiative Regional Survey™—to study the business environment and cluster competitiveness in each region. Over 1025 business and government leaders were surveyed and 264 in-depth interviews were conducted to determine the historical growth, recent performance and composition of local economies. Fifteen clusters in the five regions were studied as well.

While many projects around the United States and elsewhere have studied one particular region or one particular cluster or groups of clusters, the Clusters of Innovation Initiative is unique in its coverage of five regions and 15 individual clusters using a common methodology, individually and comparatively. The Cluster Mapping Data, surveys and interviews provide a unique, outstanding information resource for these regions and the nation as a whole.

## Organization of the Report

This report is organized as follows:

- **Section 1** describes the fundamental determinants of regional economic performance and innovative capacity.
- **Section 2** builds upon this foundation to describe how economic performance can be determined and how U.S. regions compare.
- **Section 3** describes the composition of regional economies. It highlights the importance of industries that trade, and the specialization of regional economies by clusters. It describes how the mix of clusters and the performance of clusters combine to drive regional economic success.
- **Section 4** describes how regions develop and the factors that shape the trajectory of their development.
- **Section 5** describes a framework for analyzing the business environment in a region and how it shapes innovation and economic competitiveness.
- **Section 6** demonstrates the importance of industry clusters to regional and national competitiveness and innovation output, and how to assess the strength of a cluster.
- **Section 7** describes the process by which clusters develop and evolve and what forms of intervention positively or negatively influence their development.
- **Section 8** explains the process by which regions create and implement economic strategies.
- **Section 9** outlines a potential action agenda for multiple layers of government, universities, research centers, companies, and institutions for collaboration.

The **Appendices** includes a “how-to” guide for assessing economic performance and innovative capacity; a definition of measurements used; and detailed findings of the Clusters of Innovation Initiative Regional Survey.<sup>TM</sup>

This report summarizes a multi-year, multi-regional analysis. It aims to stimulate other efforts in regions across the nation to enhance innovation and, through it, lasting economic competitiveness.



A nation’s or region’s standard of living is determined by the productivity of its economy. Productivity is measured by the value of goods and services produced per unit of the labor and capital. It sets the wages that can be sustained and the returns earned by investors — the two principal components of a nation’s or region’s per capita income. (See Exhibit 1.)

Competitiveness then, is defined by the level of productivity. Productivity determines prosperity at all geographic levels, whether it is a nation, a region (metropolitan area), or an inner city. In this report, our focus will be on the *regional* level.

Thinking on regional competitiveness is undergoing a significant transition. In many regions, efforts to enhance competitiveness were bound on lowering the cost of inputs. The focus was on holding down wages, reducing taxes and recruiting new companies using financial incentives. However, this model has been superseded for advanced economies and is ultimately self-defeating. Inputs such as cheap labor and natural resources are widely available. Prosperity comes from the ability to utilize a region’s inputs more productively than other locations in producing goods and services. Low wages do not yield fundamental competitiveness, but they hold down the standard of living. Financial incentives are easily matched by competing regions, and erode the tax base needed to invest in education and local infrastructure. In the new model, the only path to sustainable prosperity is to build a regional business environment and corporate capabilities that support high productivity.

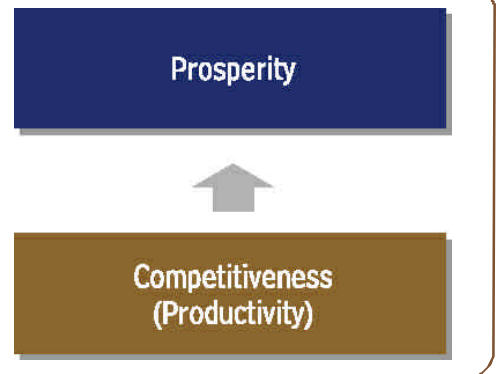
Productivity, contrary to popular usage, is more than just efficiency. It also depends on the *value* of the products or services that a region’s firms can produce as measured by the prices they can command. In advanced economies, productivity growth depends heavily on the ability to create higher value products and services, as well on as improving the efficiency of processes.

The central challenge in enhancing the prosperity of a region is to create the conditions for sustained productivity growth.

**Productivity does not depend on *what industries a region competes in*, but on *how it competes*.** There are no industries that are inherently the most productive and thus more attractive in generating prosperity. In shoes, for example, Northern Italy supports high wages and profits because of the high value that consumers place on its products because of their design, materials, brand recognition, and distribution channels.

Regions should not attempt to pick “winners,” or try to create new industries where there are no preexisting advantages to build

Exhibit 1: Prosperity and Productivity



upon. Instead, the challenge is to upgrade the sophistication and productivity of all the region's industries. Not *all* companies and industries in a region will be equally successful, but success should be determined by the skills and entrepreneurship of the companies in a field rather than selective intervention by government.

**The most important sources of prosperity are *created not inherited*.** Inherited competitive advantages such as natural resources, geographic location, or a supply of labor are becoming less important in determining prosperity. Globalization has expanded the supply of natural resources, and technology has created new substitutes for them as well as brought distant locations into the economy. A supply of labor is no longer an advantage in a world where workers are plentiful.

Prosperity depends not on inherited inputs themselves, but on creating the conditions that allow firms operating in the region to be highly productive in the use of inputs. A good example is the oil and gas cluster in Houston. Oil and gas is still produced in Texas but Texas accounts for only a small and declining fraction of world production. However, Houston has become the world's center of technology and knowledge creation in oil and gas exploration and production, as well as the leading source of most of the sophisticated equipment and services required. This supports high wages and a large base of thriving companies. The most prosperous regions do not export natural resources or even only physical products, but export intellectual capital in various forms.

**The prosperity of a region depends on the productivity of *all its industries*.** The productivity of a regional economy depends on the average productivity of all its companies and industries, not just those that sell outside the region. Local industries directly affect a region's impact on the standard of living because their productivity has a large influence on the local costs of living. However, local industries also affect the success of a region's industries competing with firms based elsewhere. For example, research on Japan<sup>1</sup> has shown that poor productivity of local industries such as transportation, construction, and wholesaling raised the cost of doing business and thus became a drag on the prosperity of the country despite the existence of some very productive exporting industries. Regional competitiveness, then, depends on ensuring that local companies in fields such as utilities, transportation, health care delivery, and other local services are competitive.

## INNOVATION AND THE GROWTH OF PRODUCTIVITY

Productivity today sets current competitiveness, but maintaining, much less increasing, a region's standard of on living requires the steady growth of productivity. Especially in advanced, high wage economies no region can maintain high wages, and hold its own in global markets, by producing standard products using standard methods because they will be imitated by other regions with lower wages.

In advanced regions, prosperity rests heavily on the *capacity for continuous innovation*. A high level of productivity itself is not enough when developing countries and regions are improving their skills, and can rapidly access modern technology. Advanced regions need to innovate to be able to produce products that lower wage regions cannot yet make, and to maintain the productivity advantage that supports their higher wages. (See Exhibit 2 on the following page.)

**Innovation is more than just scientific discovery.** Innovation stretches beyond science and technology, and includes all the activities involving the discerning of needs and the transformation of knowledge

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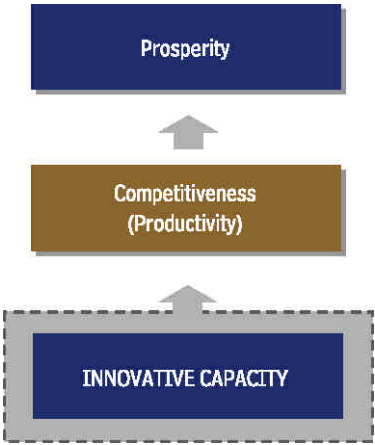
<sup>1</sup>Michael E. Porter, Hirotaka Takeuchi, Mariko Sakakibara, *Can Japan Compete*, New York: Perseus Books (2000).

into commercial products, processes, and services. Indeed, some of the most important innovations today occur in marketing, sales, services offered, and distribution; for example, innovation led to the revolution in the small-package delivery that occurred in the last 15 years and resulted in U.S. global preeminence in this industry.

**There are no low-tech industries, only low-tech firms.** Today, innovation can drive productivity improvement in virtually every industry. Although industry producing enabling technologies such as biotechnology, computers, software, and communications equipment and services have received much attention, opportunities to apply advanced technology are present in fields as disparate as textiles, machinery, and financial services. For example, the small-package delivery industry was transformed by advanced communication and information processing technologies which led to unheard of efficiency and the ability to integrate with customers.

In the modern economy, there are no “low-tech” industries, only low technology companies that fail to incorporate new ideas and methods in their products and services. Innovation can upgrade the sophistication of competition and future productivity throughout a region’s economy, not just in a few “high-tech” industries.

Exhibit 2:  
Innovation and the Standard of Living



WHAT IS A CLUSTER?<sup>2</sup>

Clusters are geographically close groups of interconnected companies and associated institutions in a particular field, linked by common technologies and skills. Clusters take varying forms depending on their depth and sophistication, but most include end product or service companies; suppliers of specialized inputs, components, machinery, and services; financial institutions; and firms in related industries. Clusters also often include firms in downstream industries, producers of complimentary products; specialized infrastructure providers; government and other institutions providing specialized training education, information, research, and technical support.

Drawing cluster boundaries involves a creative process informed by understanding the most important linkages across industries and institutions to competition. The strength of these “spillovers” and their importance to productivity and innovation determine the ultimate boundaries.

Why view economies through the lens of clusters, rather than groupings such as companies, industries, or sectors? Because clusters align better with the nature of competition and the sources of competitive advantage. Clusters capture important linkages and spillovers of technology, skills, information, etc., that cut across firms and industries. Viewing a group of companies and institutions as a cluster highlights opportunities for coordination and mutual improvement.

<sup>2</sup>Michael E. Porter, *On Competition* (Boston: Harvard Business School Press, 1996), pp. 199-205.

## DATA SOURCES

*The Clusters of Innovation Project* examines five regions: Atlanta, Pittsburgh, the Research Triangle, San Diego, and Wichita. For the purposes of this study, a region is defined as a metropolitan statistical area (MSA) using U.S. Department of Commerce boundaries, or, in some cases, the Economic Area (EA). The five regions were selected to provide a diversity of size, geography, economic maturity, and perceived economic success. The regions are similar enough to allow interesting comparisons, yet diverse enough to encompass a wide variety of challenges and opportunities in regional economic development.

Data for the study were drawn from a number of sources. Performance indicators were assembled from sources such as the County Business Patterns, Department of Commerce Trade Statistics, PriceWaterhouseCoopers Money Tree, and the Inc. 500 List.

The principal source of data for this study on the composition and performance of the overall regional economies and specific clusters was the **Cluster Mapping Project** of the Institute for Strategy and Competitiveness, the **Clusters of Innovation Initiative Regional Surveys™**, and the **Clusters of Innovation Initiative Regional Interviews**.

### The Cluster Mapping Project

The Cluster Mapping Project is one of the largest, if not the largest, data sets related to regional innovation analysis ever compiled and might well represent the first time this type of work has been conducted in such a systematic and detailed way. The Cluster Mapping Project created a detailed statistical analysis of county-level business data, including detailed metrics on regional economic performance, and data defining 41 types of clusters (e.g., information technology, automotive, business services) that are found in regions throughout the U.S. economy. Clusters can be defined using “narrow” or “broad” definitions. We use *narrow cluster definition* to refer to the subset of the industries that are *most correlated* with a given cluster. *Broad cluster definition* includes *all* industries with statistically significant locational correlations. This includes industries with stronger locational correlations with another cluster. The Cluster Mapping Data also maps regional economies by cluster and constituent industry.

At the broadest level, we compared regions on various indicators of economic vitality and standard of living such as employment growth, unemployment, wages, wage growth, cost of living, and exports. To assess potential future competitiveness, we examined measures of innovative output and entrepreneurship including patents, establishment formation, venture capital investments, the prevalence of fast growing companies, and initial public offerings. Wherever possible, we tracked both the level and the growth rate of each performance indicator. We compared the performance of regional economies to the national economy as a whole, as well as to other technologically intensive regions.

We also analyzed a regional economy’s composition, because differences in composition lead to differences in performance and innovation. Comparing regional economies has been difficult because clusters have not been systematically identified or mapped across all U.S. regions. To address this challenge, we defined clusters statistically and assembled detailed data by industry and cluster on employment, wages, establishments, and patenting over time for every region in the United States.<sup>3</sup>

The Cluster Mapping Project also provides an objective, quantitative way to profile and measure the strength, evolution, and performance of the most important clusters in a region’s economy, understand the

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<sup>3</sup>By traded, we mean that the location of the firms in these clusters is not driven by the need to be near a specific natural resource, or by population concentration. Instead, these industries are located in a specific area for some reason related to the region’s innovative capacity.

drivers of the region’s relative wages, employment growth, and formation of new establishments, assess the region’s patenting performance, and examine the region’s relative position versus other regions overall as well as in its leading clusters.

### Clusters of Innovation Initiative Regional Surveys

Professionals from Monitor Group, ontheFRONTIER, and the Council on Competitiveness also used a broad reaching survey—the Clusters of Innovation Initiative Regional Survey™— of 1025 business and government leaders to study the historical growth, and recent performance and composition of local economies, and selected clusters in the five regions studied (see Exhibit 3 below).

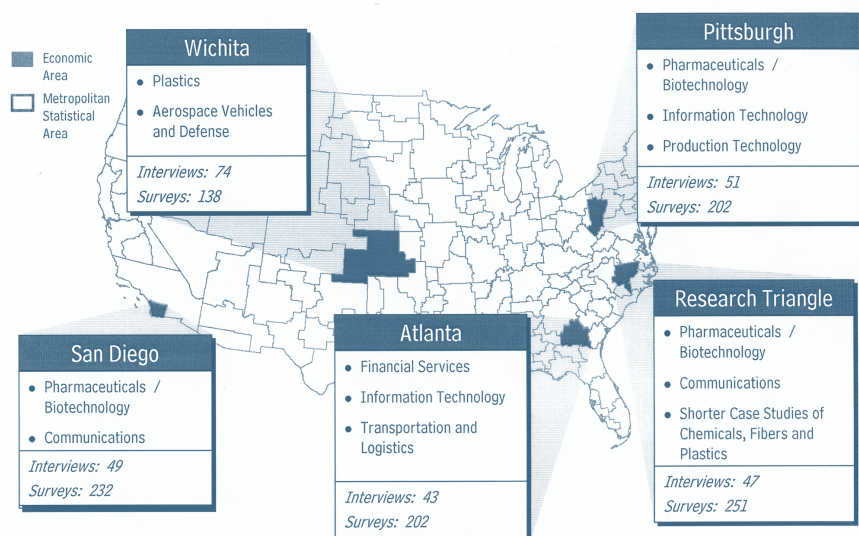
The survey protocol included questions regarding: (1) demand conditions in a region; (2) the context for firm strategy and rivalry in a region; (3) quality and availability of related and supporting industries; (4) government’s impact on the determinants of regional productivity; (5) roles and performance of institutions for collaboration; (6) present strengths and future threats to regional innovation; (7) idea generation and commercialization at regional institutions; (8) help given to entrepreneurs and established companies by regional institutions; and (9) other key influences on the regional business environment.

### Clusters of Innovation Initiative Regional Interviews

Over 264 follow-on in-depth regional interviews were conducted to enhance data from the surveys. The interviews allowed us to acquire a better, more in-depth understanding of key issues. The interview protocol included probing questions in the areas of: firm location/expansion, new venture support, regional development, network focus in development, innovation specific questions, university relations, government, and new business formation.

Samplings of questions asked in the interviews include: What barriers do you see to expansion in this region? Is there a strong group of local business support and strategic advising services for start-ups? Do you think the region has been successful over time, and if so why? What sort of networks or network organizations have helped the region develop? Do you partner in R&D with other companies in your industry? What are the major environmental or cultural factors are important to or have an impact on innovation in your region? How aggressive are the universities in commercializing applied research (licensing, equity investor, incubators)? How effective is your state and local government in fostering the development of innovative firms? How does new business formation happen in your region?

Exhibit 3: Regions and Clusters Studied



## 2 THE ECONOMIC PERFORMANCE OF REGIONS

The starting point for regional economic development is an assessment of regional economic performance. Performance should be measured on multiple levels to capture not only current prosperity and productivity but also innovative capacity. The ability to create and commercialize innovations, both in existing firms and new firms, will have a fundamental influence on productivity and prosperity in the future.

Prosperity, or the standard of living, is most strongly the result of the level and growth rate of average wages, and the proportion of a region's citizens that are employed. Standard of living is also influenced by the level of local living costs. These determine the actual purchasing power derived from income.

Productivity and productivity growth are the foundations of per capita income. At the regional level, available data and data disclosure limitations make productivity difficult to measure reliably. One indicator associated with high productivity that can be measured is export performance. High and rising exports are normally a reflection of high productivity. Exports allow a region to expand its market beyond serving only the U.S. market, raising regional productivity.

The foundation of future productivity and productivity growth is innovation. Innovation has an upstream technological or creative component, and a downstream, or commercialization, component. Technological innovation can be measured by the level of patenting. Patents are not a perfect measure of technological innovation, but numerous studies have demonstrated that patenting is the best available measure and correlated with non-patented innovative activity.<sup>4</sup> The ability of a region to commercialize new ideas and technologies can be measured by the extent of new company formation and the presence of high growth firms.

### PERFORMANCE MEASURES UTILIZED

Exhibit 4 shows the overall regional performance measures employed in our approach. Overall economic performance indicators were employment growth, the unemployment rate, average wages, wage growth, the cost of living, and exports per worker.

Measures of regional innovation and entrepreneurship included patents per worker, new establishment formation, venture capital investments, initial public offerings and the prevalence of fast growing companies. Wherever possible, we tracked both the level and the growth rate of each performance indicator.

We compared the performance of regional economies to the national economy as a whole, as other technologically intensive or otherwise salient regions.

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<sup>4</sup>Furman, J., Porter, M.E., and Stern, S., The Determinants of National Innovative Capacity, *Research Policy*, forthcoming

## FINDINGS

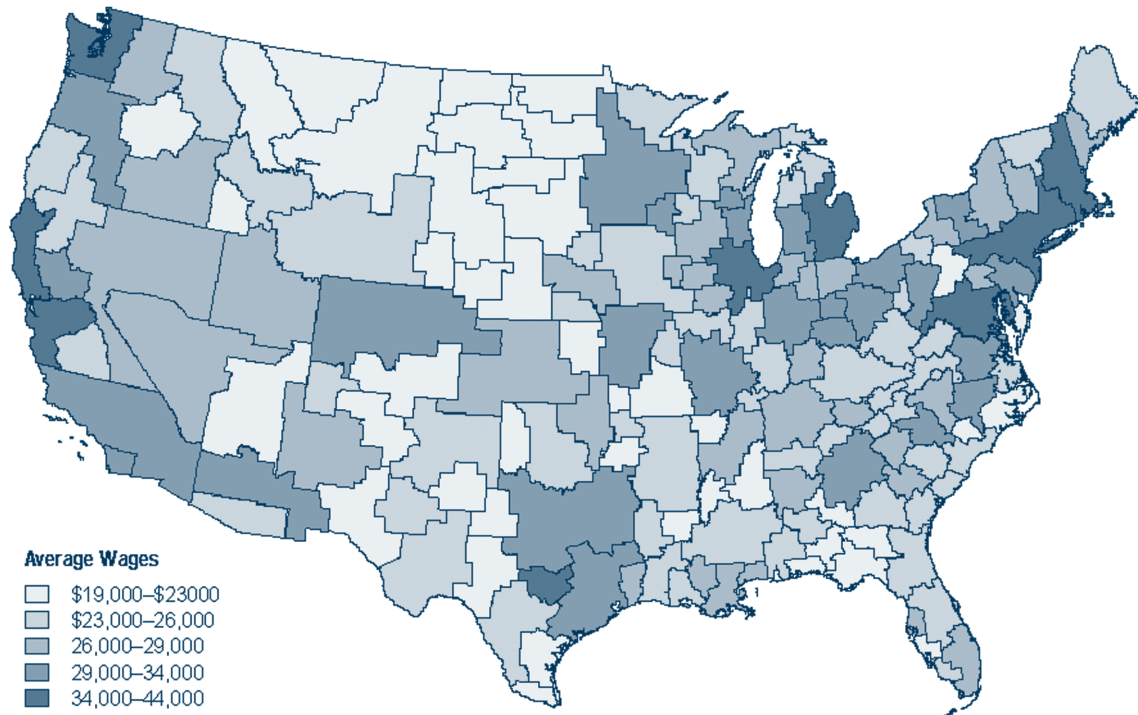
Regions vary greatly in terms of economic performance

Regional economies differ greatly from each other, and from the national economy, on a number of dimensions. An important one is economic performance. Some regions have high average wages, while others have low average wages; some regions are growing rapidly, while others are shrinking (see Exhibit 5 below and Exhibit 6 on following page).



Source: Bureau of Labor Statistics, Bureau of Economic Analysis; International Trade Administration; U.S. Patent and Trademark Office; PriceWaterhouseCoopers Money Tree; Hoover's IPO Central; Inc. Magazine, American Chamber of Commerce Researchers Association.

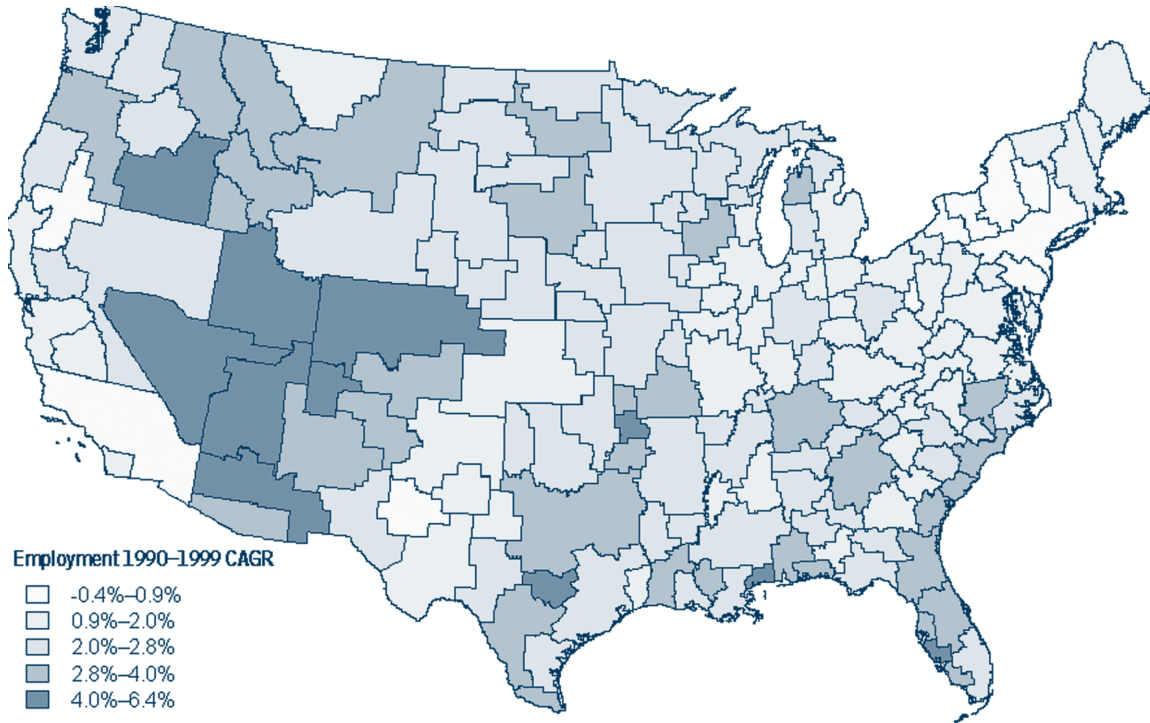
Exhibit 5: Variation in Average Wages across Economic Areas, 1999



Note: Narrow Cluster Definition

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Exhibit 6: Variation in Employment Growth across Economic Areas, 1990-1999



Note: Narrow Cluster Definition

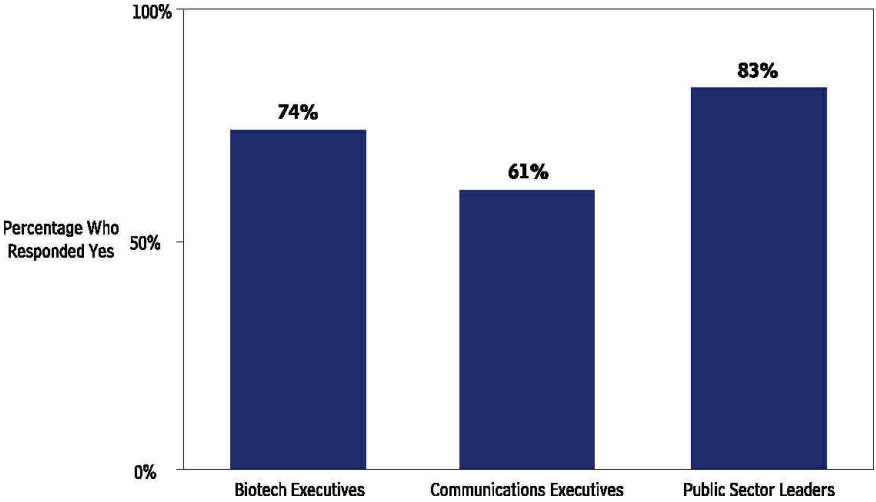
Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

A region's average wages must be assessed in the context of that region's cost of living

We found that regions exhibiting high growth do not necessarily prosper because cost of living increases can negate or diminish gains in average wages. Even if a region has a relatively high average wage, an equally high or higher cost of living will detract from that region's prosperity. Higher average wages then are not evidence enough of a region's prosperity.

**San Diego** Average wages in San Diego are just below those of the nation as a whole, while the cost of living in San Diego is significantly higher (25%) than the national average. In 1999 housing costs were estimated to be 50% higher than the national average. In essence, San Diego has a California cost of living but is competing with national average wages. This will make it more difficult for San Diego to compete successfully in the war for talent—one of the region's most important assets—and will continue to be an economic burden to its citizens for the foreseeable future. The majority of survey respondents in San Diego indicated that the rising cost of living has consequences for the region (see Exhibit 7 on following page).

Exhibit 7: Select Survey Results on the Consequences of the Rising Cost of Living, San Diego



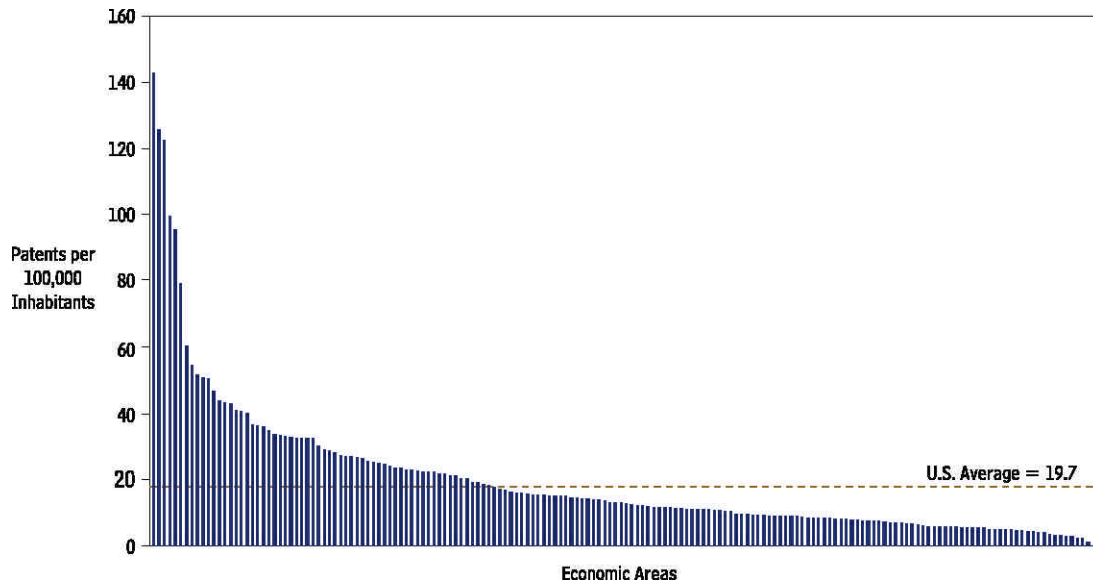
Source: Clusters of Innovation Initiative Regional Survey, San Diego

**Atlanta** The Atlanta region has been successful at creating many jobs. Average wages paid in the Atlanta cluster rank 15th among the largest 20 clusters, and have been increasing at more than 7% a year in the 1990s. The average wage in Atlanta in 1999 was \$35,382, slightly above the national average of \$32,100. However, the cost of living in Atlanta is an estimated 20% higher than the national average. The cost of living in the region, once a major draw to relocating companies, is now equivalent to the U.S. average, and the middle class, as in many U.S. cities, is struggling to find affordable housing. Atlanta's gains in average wages need to be measured in relation to its cost of living increases, especially for a region that is among the top ten fastest growing metropolitan areas in the nation.

**Innovation output varies greatly across regions**

Just as regional economies have different levels of average wages and job creation, so too do they have very different levels of innovation output. The highest per capita patent producing region (Boise City, ID) produces almost nine times the number patents per person of the median region (Eugene, OR). The top 10 patenting regions account for 51% of the nation's total patents (see Exhibit 8 on following page).

Exhibit 8: Variations in Patenting per Capita across Economic Areas, 1998



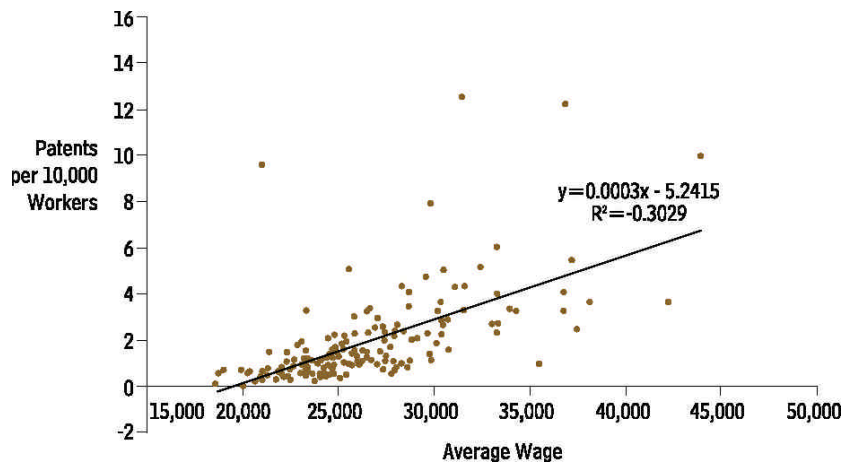
Note: Narrow Cluster Definition

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

### Higher levels of innovation output lead to higher levels of prosperity

We found that the more innovative regions in our study were also the more prosperous, while the regions that struggled to innovate also struggled in terms of economic performance. Moreover, the low-cost regions were not the more prosperous regions. We measured the number of patents issued per 10,000 workers compared to average wages in various Economic Areas across the nation for 1998 and found a correlation between patenting innovation and high average wages (see Exhibit 9 below).

Exhibit 9: Patents per 10,000 Workers vs. Average Wages in U.S. Economic Areas, 1998



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

**Research Triangle** In the late 1950s, the Research Triangle, North Carolina area was among the lowest in the country in terms of wage and employment levels. Despite having three strong local universities, educational levels were also quite low because university graduates left the area after receiving their degrees. One interviewee was advised not to go to college because the training would not enable him to find work after graduating (he disregarded the advice). Textiles and tobacco dominated the economy, and Research Triangle was on a trajectory of long-term economic stagnation.

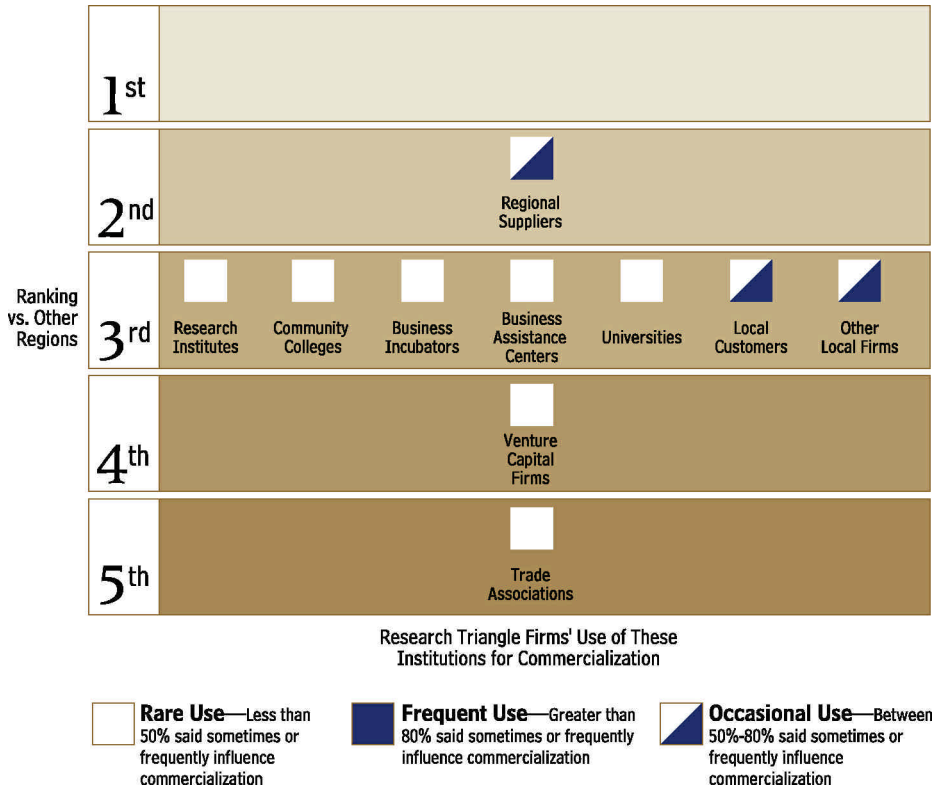
Then a group of business, academic, and government leaders worked together to create and develop Research Triangle Park. The Park offered companies easy access to physical infrastructure, human resources, and knowledge assets, and research-oriented companies began to locate in the region. Four decades later, Research Triangle has a growing, prosperous economy that is clearly the result of the successful commercialization of new ideas. In the 1950s, Research Triangle had an abundance of low-cost labor, but dim economic prospects. Innovation changed that.

The relative effectiveness of commercialization greatly affects the economic impact of research

A difficult and important ingredient for generating entrepreneurship is the commercialization of technology. We found that some regions have high levels of R&D investments and numerous specialized research centers, but still lag in terms of commercialization because knowledge is not effectively or rapidly transferred to companies. Regions with high levels of R&D, or even patenting, thus do not necessarily exhibit high levels of commercialization.

**Research Triangle** Although Research Triangle exhibits high levels of R&D, these investments have not been matched by high levels of commercialization in the region. The Research Triangle's leaders have been successful in attracting research institutions to the region—more than ten major specialized research centers are located in the Research Triangle. The Research Triangle consistently receives more than six to seven times the national average of R&D investment per worker as a result of having these specialized research centers. Yet surveys indicate that institutions for collaboration and research centers in the Research Triangle are not helping the region's firms as much as they could. We asked survey respondents at companies in the five regions how often they used various institutions in the commercialization process. The results indicate that companies in the Research Triangle area use these institutions and centers relatively infrequently. Of the five regions studied, Research Triangle ranks 3rd to 5th in all but one of the influences on commercialization of technology (see Exhibit 10 on following page).

Exhibit 10: Influences on the Commercialization of Technology in the Research Triangle



Note: August 2001, n=116  
 Source: Clusters of Innovation Initiative Regional Survey, Research Triangle Region

**Pittsburgh** Some of Pittsburgh’s most valuable assets are its research universities and institutes, with world-renown centers of research in transplantation, bioscience, computer science, and engineering acting as anchor firms in the region. Pittsburgh is a powerhouse for university research and development as it receives more than twice the national average on a per worker basis, but it requires better commercialization mechanisms. The universities are a tremendous source of innovation, and opportunities exist to capitalize on relationships, such as the University of Pittsburgh’s affiliation with the Healthcare/Hospital Industry. However, more of these institutions should ensure that their basic research find its way to commercial applications. It is apparent from the surveys and interviews that university technology commercialization needs to be better supported and improved.

## IMPLICATIONS

- **The need for a distinctive strategy:** No single policy or strategy will work for all regions. Each region must craft a distinctive approach based on its unique assets and relative strengths.
- **Growth vs. prosperity:** Growth is not the same as prosperity. Growth is only desirable if the standard of living of citizens rises. High growth per se often leads to a rising cost of living that erodes prosperity or a degradation of natural resources and physical infrastructure that supports quality of life.
- **From efficiency to innovation:** Current economic performance does not assure future performance. Maintaining, much less increasing, a region's standard of living requires the steady growth of productivity. Innovation output leads to higher productivity levels, and is critically important if a region is to reach the upper quartile of high-performing regions.
- **Measuring multiple dimensions of performance:** Measuring only a few indicators of performance will not give an accurate view of a region's strengths and weaknesses. A number of performance measures need to be assessed, including economic performance (e.g., job growth, wages, wage growth, exports, and export growth); innovation output (e.g., patents, new company formation, fast-growing firms, venture capital investments, and IPOs); and commercialization.

# 3 COMPOSITION OF REGIONAL ECONOMIES

Regional economies are composed of three broad types of firms and industries. Each is important to a region's prosperity, but in different ways.

The first type is industries that compete across locations. In the US, this competition often occurs between domestic regions but may also include foreign locations. Grouped into clusters, this type of industries is called "traded."

The second type is industries that are resource-driven.

The third type is industries that compete only within their region. This type of industries is called "local." Local industries are intrinsically tied to the traded industries located in their region: they directly serve the needs of the traded industries as suppliers and service providers, and they indirectly depend on the success of the traded industries through its influence on final consumer demand.

## TYPES OF CLUSTERS

**Traded clusters have a disproportionate influence on regional prosperity and economic growth.** Traded industries can, in principle, be located anywhere. But similar traded industries tend to concentrate in specific locations. Because they grow beyond the size and the needs of the local market, they can become much more sophisticated and productive. Their high productivity can support high wages that support the prosperity of their employees but also support the prosperity of others through the consumer demand they create.

**Resource clusters can support high wages but have limited scope in advanced economies.** Resource-driven industries also compete across regions but their location is tied to local resources. Their performance is much more dependent on the way the industries use technology and innovative processes than on the direct value of the natural resources they process. For example, despite virtually identical natural conditions, the pulp & paper industries in Finland with their sophisticated use of technology achieve much higher productivity than their less advanced competitors in Canada.

**Local clusters account for the majority of employment in regional economies.** Because local industries serve only the local market and most are services, they have more limited opportunities for productivity growth. This means that local industries tend to account for an increasing share of regional employment.

Traded industries seem to be more dispersed than they really are because firms most establish distribution centers, sales offices, service facilities, and other supporting functions in almost every region. The locations where truly competitive firms are based are usually limited in number.

**The traded economy is specialized by cluster.** Clusters are geographically proximate groups of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities (see section 6). Regional economies can be profiled on the mix of clusters present. It is on the level of individual clusters that regional economies specialize.

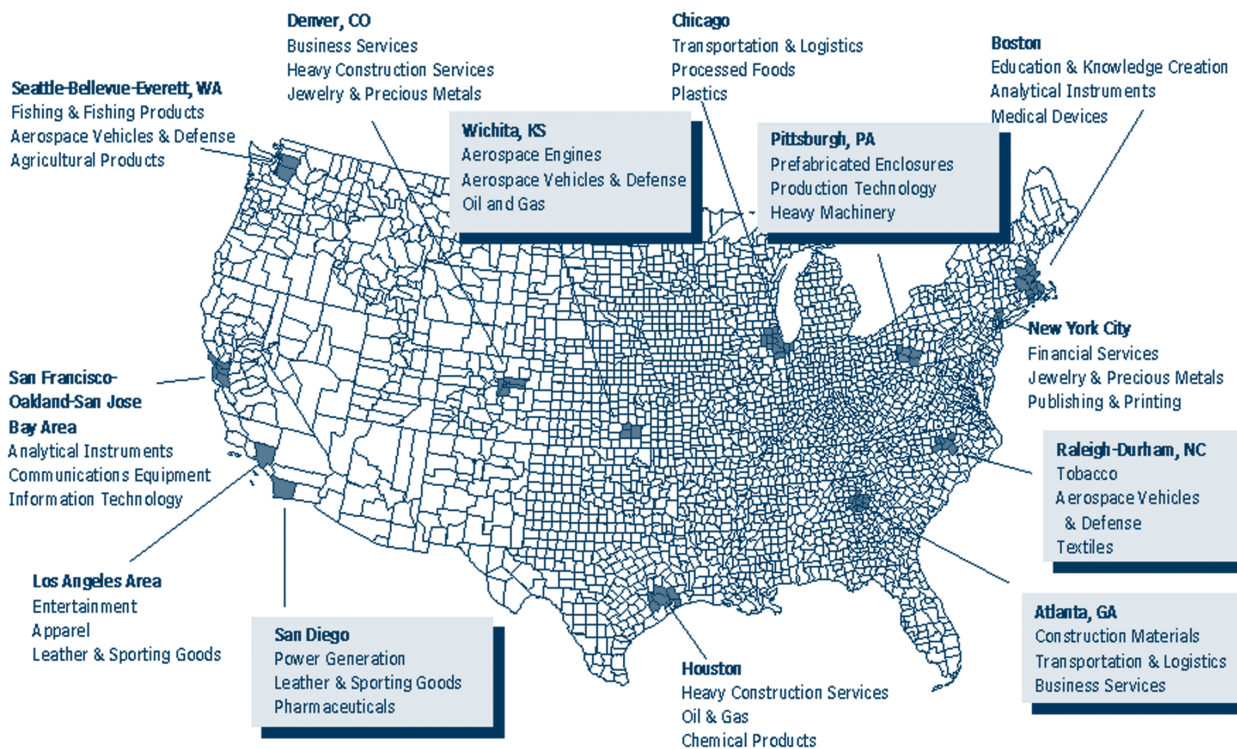
**Specialization in a series of strong clusters with a significant national position enhances a region's performance.** Clusters that can attain the critical mass gain productivity and innovative benefits. A region which depends heavily on just one or very few clusters for much of employment, however, can be exposed to shocks and instability both in those clusters and the local industries which depend on them. For example, the recent downturn in the information technology cluster has been especially detrimental to Singapore, a city-state with an economy heavily dominated by this cluster.

## FINDINGS

The composition of regional economies differs greatly

Regions differ greatly in terms of the clusters that compose the economy. The Cluster Mapping Project has identified 41 types of clusters in the U.S. economy. While any given region will have some employment in the vast majority of these clusters, regional economies are typically very strong in only a handful. In other words, regional economies are highly specialized (see Exhibit 11 below).

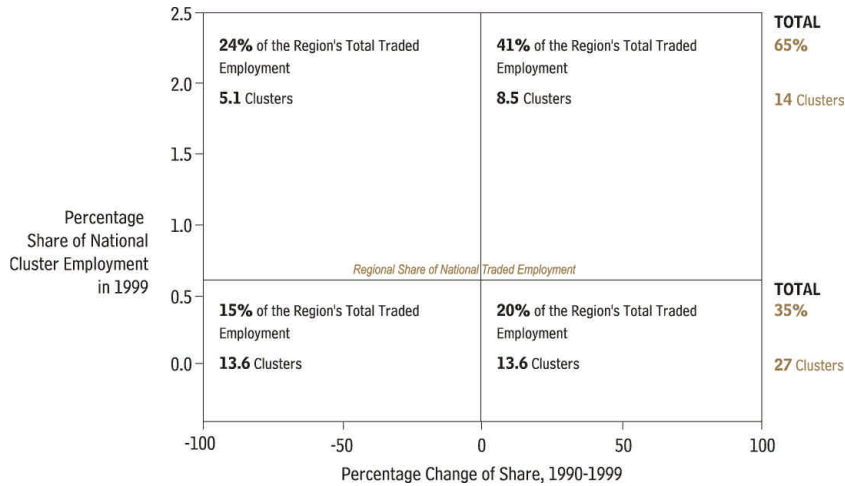
Exhibit 11: Top Clusters in Select Geographic Areas



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Exhibit 12 below provides a benchmark for assessing the specialization of an economic area in the United States. Every region has some clusters that are relatively more concentrated than what would be expected based on the region's total employment, and these would be located above the horizontal axis. Regions will generally have some clusters growing faster than the national average for that cluster. These clusters would be located to the right of the vertical line. The chart below identifies the average percentage of traded employment, the number of clusters, and the percentage of total wages accounted for by each quadrant.

Exhibit 12: Specialization of Economic Areas, Narrow Cluster Definition

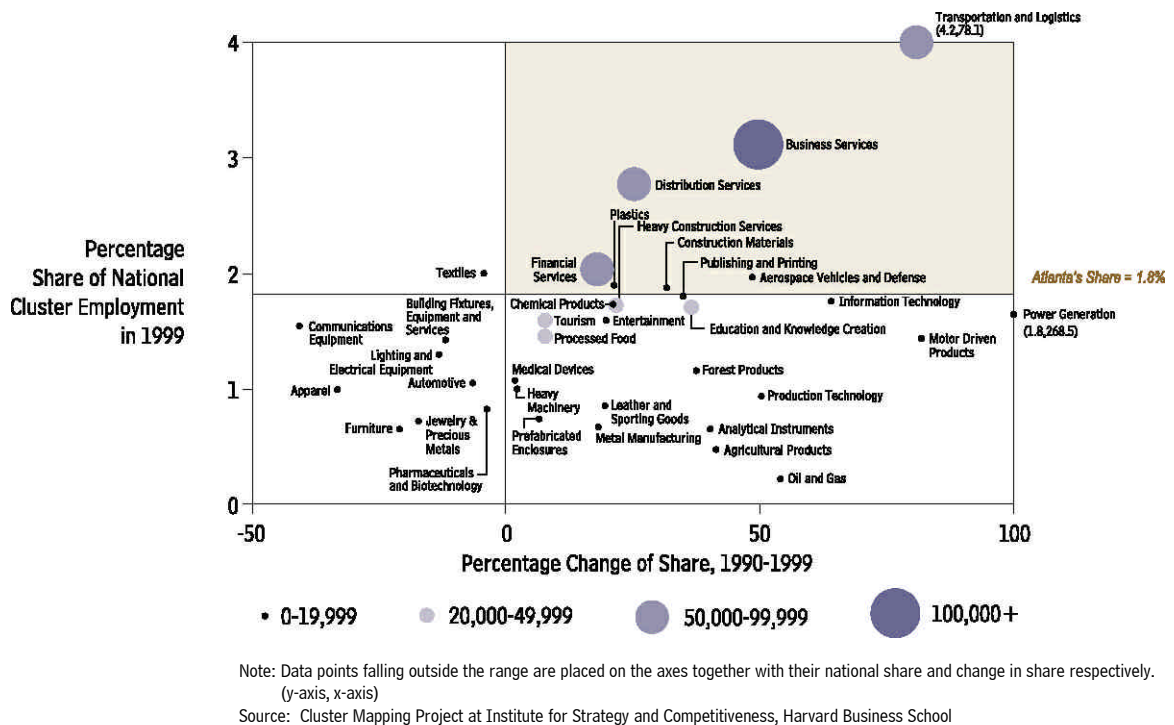


Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

**Atlanta** For more than a century, business, government, and university leaders have consistently positioned Atlanta as a center for commerce. The composition of the Atlanta economy reflects their efforts. Roughly 50% of the metro area's traded employment is in four clusters: transportation and logistics, distribution services, financial services, and business services. Public and private sector collaboration has produced a highly differentiated, specialized, and above all successful economy.

Exhibit 13 on the following page shows the Atlanta Metro Area's employment share and growth in share of the 41 traded clusters in the United States economy. Atlanta had 1.8% of total national employment. Clusters above the horizontal axis are relatively concentrated in Atlanta and clusters to the right of the vertical axis have grown over the 1990 to 1999 period. The upper right quadrant represents clusters that have disproportionate share of national employment in Atlanta and are growing their share.

Exhibit 13: Differentiation and Specialization of the Atlanta MSA, Narrow Cluster Definition



**Pittsburgh** Pittsburgh was the center of steel production for the entire world and flourished because of that specialization. The early mills were initially attracted to Pittsburgh by natural factors. Local ore deposits and the rivers that allowed for cheap transportation provided the basis for the development of the industry and the region. During the early 1800s, iron-smelting factories took advantage of the region's hard-working people, waterway and railroad networks, and abundant coal reserves. Pittsburgh flourished due to low-cost ore, and proximity to the world's largest demand, with rail and water transportation advantages.

### A wider geographic focus often identifies more available assets in a region

When devising economic development strategies, regions tend to focus on the immediate geographic area, usually a metropolitan statistical area. In some cases this is appropriate. For example, the Atlanta MSA is large and encompasses 20 counties. Commute times make it difficult to easily reach a wider geography in one working day. In other cases, however, a focus on the metro area neglects a wide range of assets that are readily accessible and part of the regional economy.

**Research Triangle** The Research Triangle area, for example, has considerable assets in regions just outside the metro area. Exhibit 14 on the following page shows the Research Triangle's Metro Area employment share and growth in share of the 41 traded clusters in the United States economy. The upper right quadrant represents clusters that have a disproportionate share of national employment in Research Triangle and are growing their share.

**The Research Triangle** has 34% of its MSA employment in six clusters (communications equipment, pharmaceuticals / biotechnology, distribution services, business services, power generation, heavy construction services) that have a relatively higher share of national employment and are growing in share of national employment.

Exhibit 14: Research Triangle Metropolitan Statistical Area, Narrow Cluster Definition

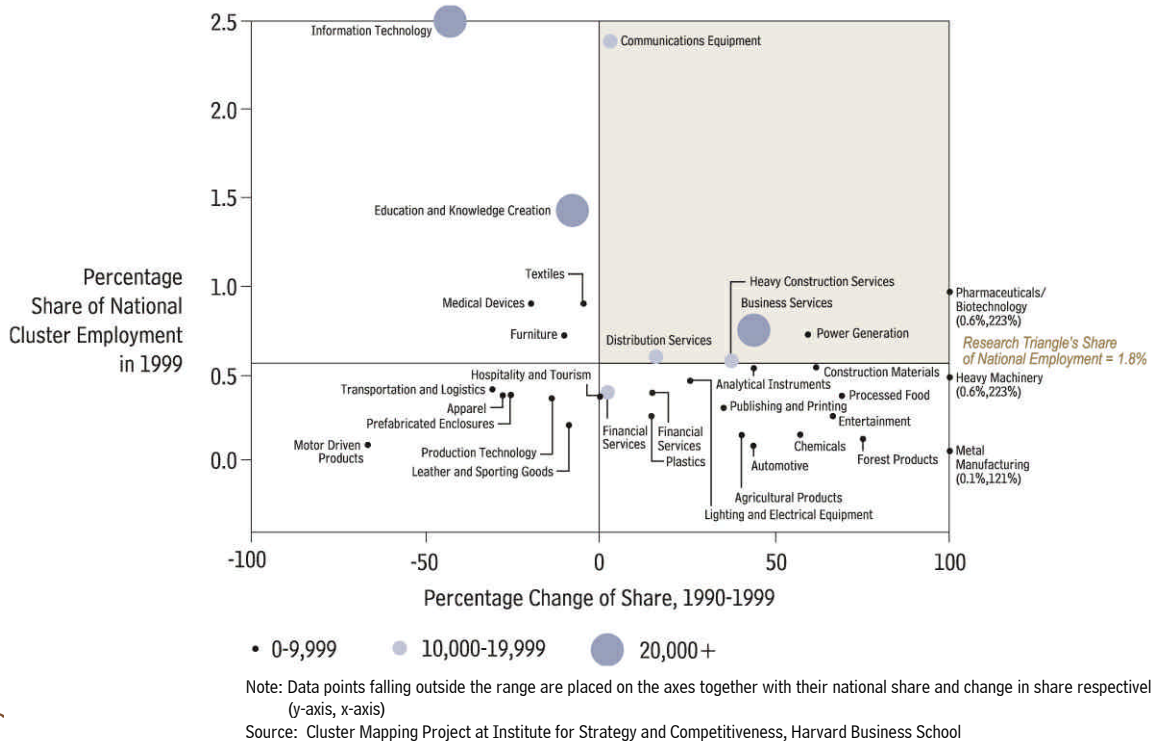
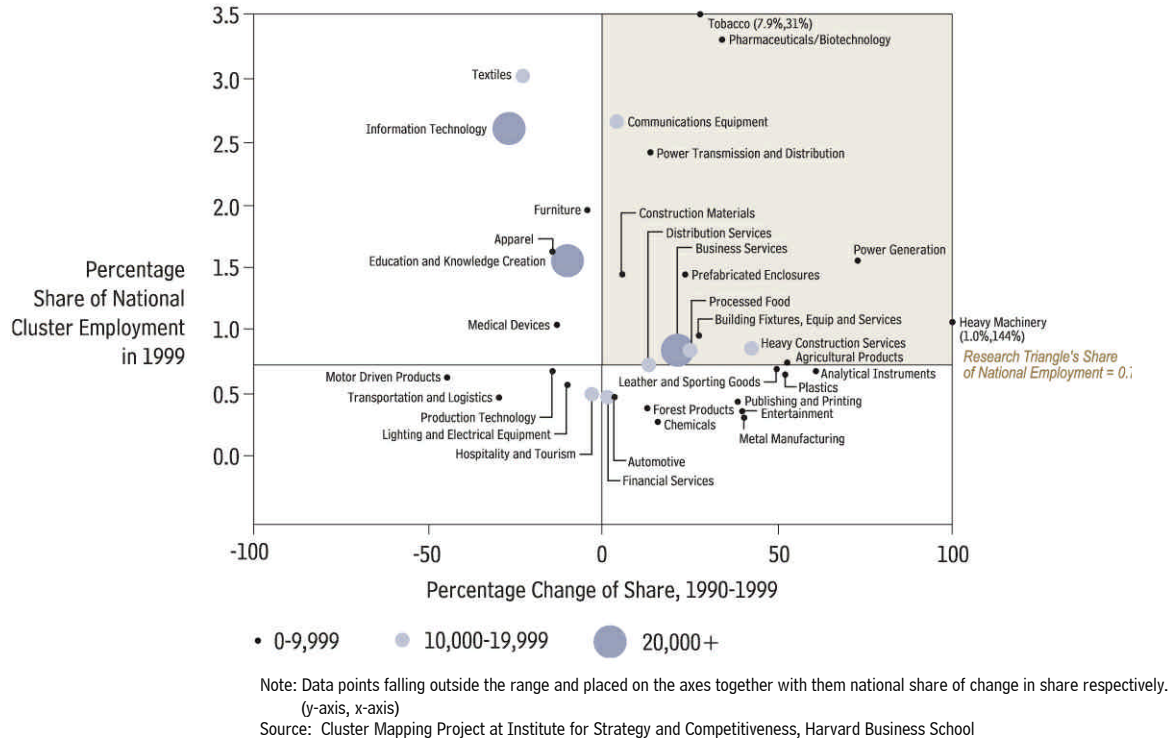


Exhibit 15 on the following page is the same graphic, but for the Research Triangle *Economic Area*. The region has 43% of its EA employment in 12 clusters that have a relatively higher share of national employment and are growing in share of national employment. These additional six clusters (power transmission and distribution, construction materials, prefabricated enclosures, agricultural products, heavy machinery, and building fixtures, equipment and services) represent an additional opportunity for the Research Triangle to integrate itself more efficiently into broader economy. Moreover, out of these six clusters, the Research Triangle's national employment share is ranked 34<sup>th</sup> or better in three of these: power transmission and equipment (15<sup>th</sup>), prefabricated enclosures (14<sup>th</sup>), and construction materials (26<sup>th</sup>).

Exhibit 15: Research Triangle Economic Area, Narrow Cluster Definition



Some regional economies are highly dependent on a few clusters and sometimes on a small number of companies

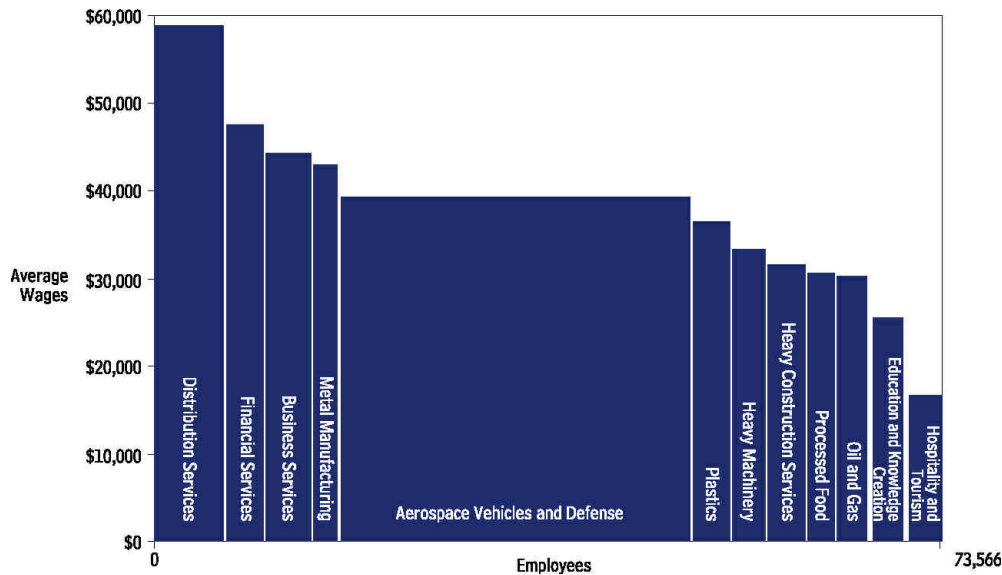
Although all regional economies specialize in a few areas, some have especially narrow breadth. These economies have a disproportionate share of employment in one cluster, and even in a handful of companies. Over reliance on a few industries and clusters is dangerous. Excessive narrowness exposes a regional economy to having only a handful of clusters with high wages. While no region can have high wages in all 41 types of clusters, some diversification is important.

**Wichita** Although Wichita has diversified its economy during the last ten years, a disproportionate number of workers are found in one cluster—aerospace vehicles and defense—and within only a few large companies. In 1998, the aerospace vehicles and defense cluster alone employed close to 20% of narrow traded cluster employment in the Wichita Economic Area. Furthermore, the majority of workers in the aerospace vehicles and defense cluster are found in only two industries within one subcluster.

In addition, the region is heavily reliant on fewer than ten companies (see Exhibit 16 on the following page). The four aerospace vehicles and defense manufacturers (Boeing, Beech, Cessna, and Lear), the Coleman Company, and Koch together employed approximately 50% of 1998 narrow traded employment in the Wichita MSA. The Milken Institute ranked Wichita fourth in terms of metro areas sensitive to “high-tech recession” because of its concentration in aerospace vehicles and defense.<sup>5</sup>

<sup>5</sup>Ross C. DeVol, “America’s High-Tech Economy: Growth, Development and Risks for Metropolitan Areas,” Milken Institute, July 13<sup>th</sup>, 1999.

Exhibit 16: Diversification of the Wichita Metro Area Economy



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

**Pittsburgh:** Despite having positions in oil and gas and defense industries, Pittsburgh was primarily a steel town throughout most of the 20th century. Then, in the 1980s, a major downturn struck the steel industry. Pittsburgh lost approximately 150,000 jobs in the steel industry alone. This was close to 90% of the steel and steel related jobs, and almost 15% of the total jobs in the region. As a result, Pittsburgh experienced a steep recession.

Today, Pittsburgh has a much more diversified economy and has grown in more than 25 of its 41 traded clusters during the past ten years. This has not only made the economy less vulnerable to the up-and-downs of a single cluster, but has also opened up opportunities at the intersections of multiple clusters in which Pittsburgh has a relatively strong position (e.g., metal manufacturing, construction materials, power generation, education and knowledge creation, transportation and logistics, production technology, etc).

“High-Tech” clusters account for a small percentage of jobs and wages in most regional economies

Several types of clusters are especially innovative: communications equipment, analytical instruments, biotech/pharmaceuticals, and information technology. These clusters are very productive, and pay high wages, and regions with strength in these clusters certainly benefit from their presence. However, the overall impact of these clusters on a regional economy is usually relatively small (see Exhibit 17 on following page). Clusters usually referred to as “high-tech” make up only 8.0% of traded employment, and 2.5% of total U.S. employment.

Exhibit 17: U.S. Traded Employment by Cluster, 1999

Cluster	Employment 1999	%Traded Employment	%Total Employment
Business Services	4,274,191	12.46	3.86
Financial Services	2,917,886	8.50	2.64
Hospitality and Tourism	2,503,673	7.30	2.26
Education and Knowledge Creation	2,166,036	6.31	1.96
Distribution Services	1,879,554	5.48	1.70
Heavy Construction Services	1,822,944	5.31	1.65
Transportation and Logistics	1,571,872	4.58	1.42
Metal Manufacturing	1,400,303	4.08	1.26
Processed Food	1,380,446	4.02	1.35
Automotive	1,305,053	3.80	1.18
Entertainment	992,893	2.89	0.90
Publishing and Printing	963,626	2.81	0.87
Plastics	866,552	2.53	0.78
Information Technology	846,322	2.47	0.76
Analytical Instruments	745,157	2.17	0.67
Production Technology	682,714	1.99	0.62
Medical Devices	674,882	1.97	0.61
Building Fixtures, Equipment and Services	648,453	1.89	0.59
Apparel	624,278	1.82	0.56
Chemical Products	447,246	1.30	0.40
Communications Equipment	439,990	1.28	0.40
Textiles	430,270	1.25	0.39
Aerospace Vehicles and Defense	426,312	1.24	0.39
Motor Driven Products	425,640	1.24	0.38
Heavy Machinery	418,058	1.22	0.38
Forest Products	395,372	1.15	0.36
Furniture	373,708	1.09	0.34
Oil and Gas	361,382	1.05	0.33
Lighting and Electrical Equipment	337,148	0.98	0.30
Prefabricated Enclosures	318,240	0.93	0.29
Agricultural Products	279,659	0.82	0.25
Power Generation	268,604	0.78	0.24
Pharmaceuticals and Biotechnology	258,089	0.75	0.23
Leather and Sporting Goods	203,944	0.59	0.18
Construction Materials	203,169	0.59	0.18
Jewelry and Precious Metals	154,349	0.45	0.14
Aerospace Engines	98,383	0.29	0.09
Power Transmission and Distribution	83,478	0.24	0.08
Fishing and Fishing Products	51,971	0.15	0.05
Tobacco	43,924	0.13	0.04
Footwear	27,042	0.08	0.02
<b>Total</b>	<b>34,312,814</b>	<b>100.00</b>	<b>30.99</b>

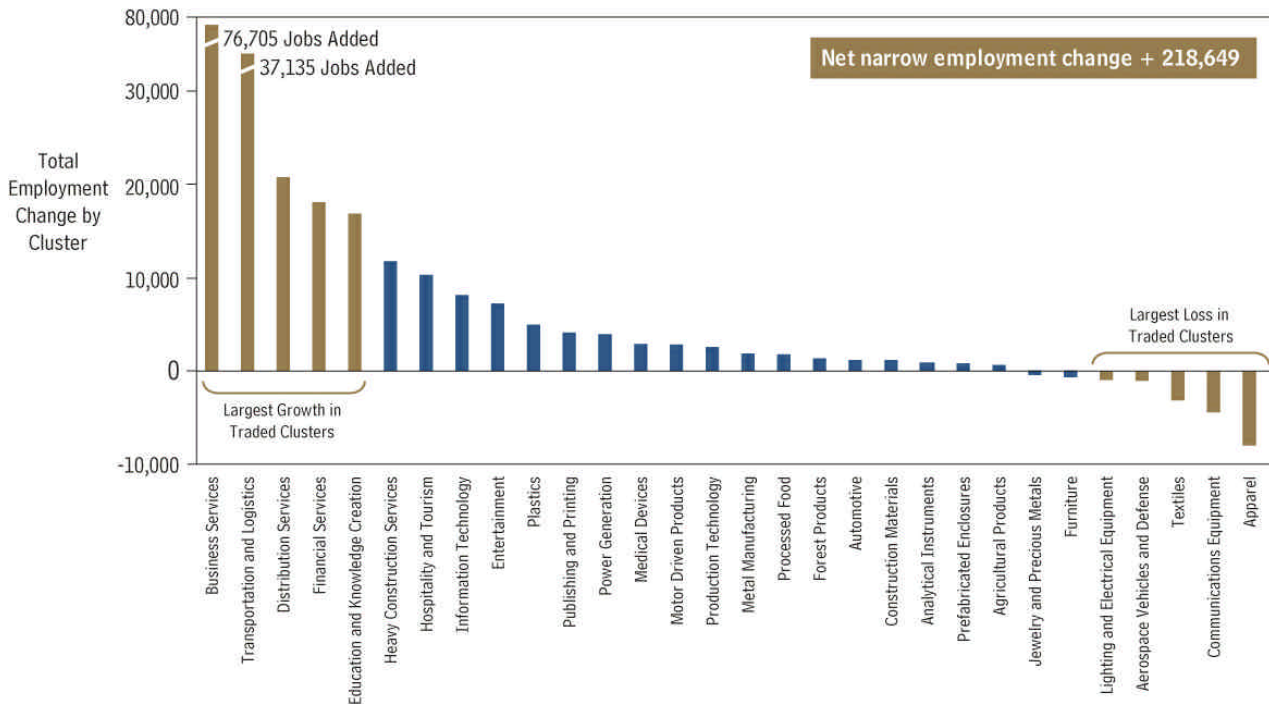
Clusters usually referred to as "high tech" make up only 8.0% of traded employment and 2.5% of total U.S. employment

Note: Shaded clusters are normally considered "high tech"

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

**Atlanta** For example, in Atlanta, information technology added less than 5% of the new jobs over the 1990s. Traditionally strong clusters such as business services, financial services, transportation and logistics, and distribution services added nearly 70% of the new jobs over the decade (see Exhibit 18 below). Even if Atlanta was twice as successful at creating information technology jobs in the future, it would do little to increase the prosperity of Atlantans in general.

Exhibit 18: Job Creation by Cluster in the Atlanta Metro Area, 1990-1999, Narrow Cluster Definition

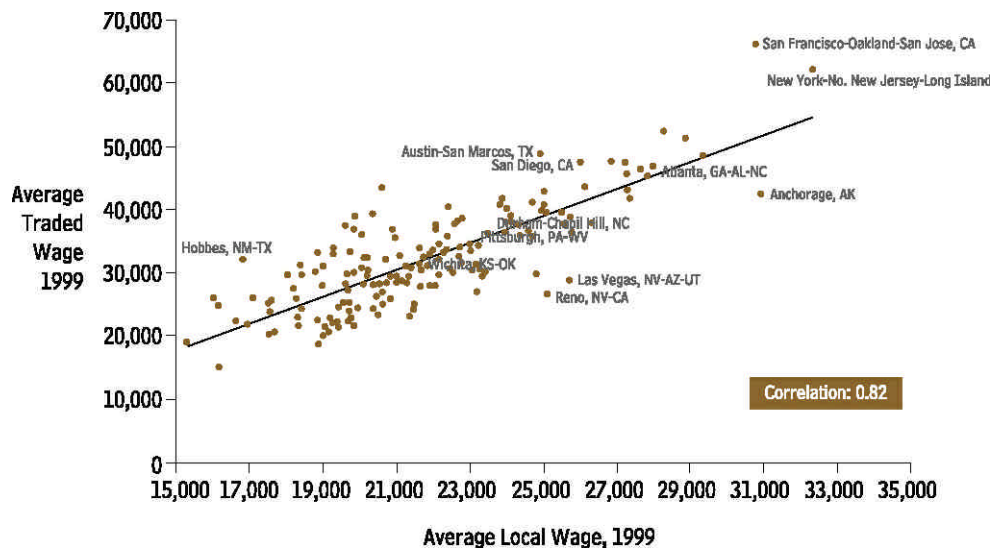


Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

### Higher wages in traded clusters tend to pull up wages in local clusters

It is difficult to increase the percentage of employment in traded clusters, because local clusters are generally service providers. As the number of traded jobs increases, so too does the number of local jobs that service them. The way to increase overall prosperity of a region is to increase average wages in traded industries (see Exhibit 19 on following page).

Exhibit 19: Traded Wages vs. Local Wages by Economic Area, 1999



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

## IMPLICATIONS

- **Defining the right region:** The composition of regional economies can shift significantly depending upon the geographic area considered. Regions have a tendency to follow political jurisdictions and to omit important surrounding areas and assets. A broader, geographic definition widens opportunities and brings constituencies together.
- **Building a strategy:** Successful regions build on their unique assets and strong clusters, where they have the greatest advantages. Strength then spreads to additional clusters over time.
- **Clusters of clusters:** Focus on a few clusters exposes a regional economy to the booms and busts, as Raleigh-Durham is now discovering. In extreme cases, such as Wichita, a regional economy can be dependent the fortunes of a handful of companies. The case of Pittsburgh shows how a regional economy overly dependent on one or a handful of industries can be severely affected. Regional strategy should encompass a wide range of cluster, and be attentive to clusters that overlap. Overlapping clusters offer potential synergies in skill, technology, and partnership.
- **Widen innovative capacity to many clusters:** The majority of traded jobs in any region are in clusters that are not generally perceived to be high-tech (e.g., business services, financial services, education and knowledge creation, transportation and logistics, and hospitality and tourism). In order to meaningfully increase overall regional prosperity, innovative capacity must be built in many clusters. The same tools apply as in IT or biotechnology: strong university programs in cluster related skills and technology; efficient knowledge commercialization from local universities; effective cluster trade associations; the presence of anchor companies; an environment that supports start-up companies.

# 4

## THE EVOLUTION OF REGIONAL ECONOMIES

The evolution of regional economies is a slow process that takes a significant amount of time. Change, be it intentional or not, takes years to materialize and produce results.

Because the evolution process takes so much time, the influence of inherited endowments such as natural resources or geographic locations is often still recognizable in the current composition of regional economies. For example, Pittsburgh's proximity to oil fields in nearby parts of Pennsylvania and its access to river transport routes set the region up for developing a strong production technology cluster around the steel industry.

While inherited factors are important, they do not determine the evolution of a regional economy. The evolution process has multiple equilibria and which one of them materializes depends on initial conditions as well as on other influencing factors:

- **Entrepreneurship.** One important factor can be the entrepreneurial influence of an individual. An idea becomes a firm, a firm becomes an anchor for spin-offs, and over time a cluster develops.
- **Specialized Assets.** Another important factor is the presence of a research/training institution, for example a university. Specialized research and training provide a fertile ground for cluster development.
- **Government Policies.** A broader influencing factor is public policy. Political choices and prioritizations, for example the decision to invite the US Navy to port in San Diego, have a significant impact on regional development.
- **Past Trajectory.** Finally, the opportunities for economic development are at every point in time strongly influenced by the current composition of an economy. New activities often emerge out of existing ones. For example, in Wichita earlier oil & gas activities and the presence of aircraft manufacturers created an environment conducive for the emergence of a plastics cluster.

Often the evolution process occurs under its own momentum without any intervention. But given the existence of path-dependency and multiple outcomes there is also clear evidence that this process can be affected by leadership and choices made in the private and/or public sector. For example, in Wichita the city made the decision to build one of the first airfields in the US. Wichita still is one of the leading locations of the nation's aerospace cluster. In the Research Triangle, the decision was made to develop a strategy based on the competencies of the three universities in the region. The Research Triangle now is one of the leading locations for the nation's biotechnology and communications clusters.

## FINDINGS

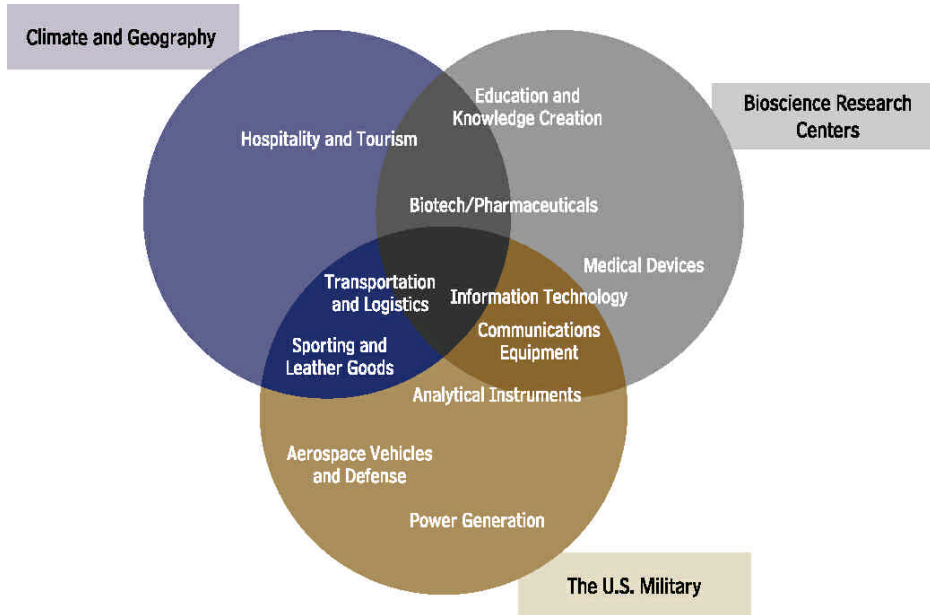
### Successful Regions leverage their unique mix of assets to build specialized clusters

Successful regions build on their relative strengths, creating specialized economies that both differ from other regions and offer comparative advantages to local companies. These relative strengths could be inherited characteristics (e.g., geography, climate, population), or man-made assets (e.g., research centers, companies, governmental organizations), that differentiate the region. Companies then draw on these differentiating assets to produce innovative goods and services, and generate and sustain innovative strategies that make them more competitive.

**San Diego** The San Diego economy benefits from three sets of specialized assets in the region: the climate and geography, the military presence, and the constellation of bioscience research centers. The good weather and beachfront location are obviously inherited assets, but local leaders judiciously used them to create other specialized assets. In the military's case, the harbor and the city's geographic location proved critical, and the City helped by dredging the Bay. For the research institutes, climate and the availability of land were central, and again the City accommodated through zoning and land grants. Local government and business leaders teamed up to lobby and get a University of California campus built in La Jolla. In all cases, the region's natural endowments were useful to the companies and also led to a high quality of life which attracted talented people. Irwin Jacobs, a founder of Linkabit and now Qualcomm, came to San Diego on sabbatical and chose to stay; Jonas Salk visited the region and decided to set up his research center on the Torrey Pines Mesa (see Exhibit 20 on next page).

Virtually every strong and growing cluster in San Diego leveraged these specialized assets. The hospitality and tourism cluster benefits from the climate, beach, and proximity to Mexico. The military presence sparked growth in clusters such as aerospace engines, analytical instruments (primarily navigation equipment in San Diego), communications equipment, information technology, and power generation (technology used to drive ships was adapted to moving oil and gas through pipelines). The presence of research institutions contributed to the development of the above clusters and drove growth in clusters such as education and knowledge creation, medical devices, biotechnology / pharmaceuticals, and printing and publishing. Other clusters grew out of the intersection of existing clusters. Transportation and logistics benefited from the naval presence and the need to accommodate shipping, from the inflow of tourists, and from the flow of goods going to and from Mexico. Sporting and leather goods, San Diego's fastest growing cluster, began because of the presence of military industries and tourism.

## Exhibit 20: The Military, Climate, and Research in San Diego



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

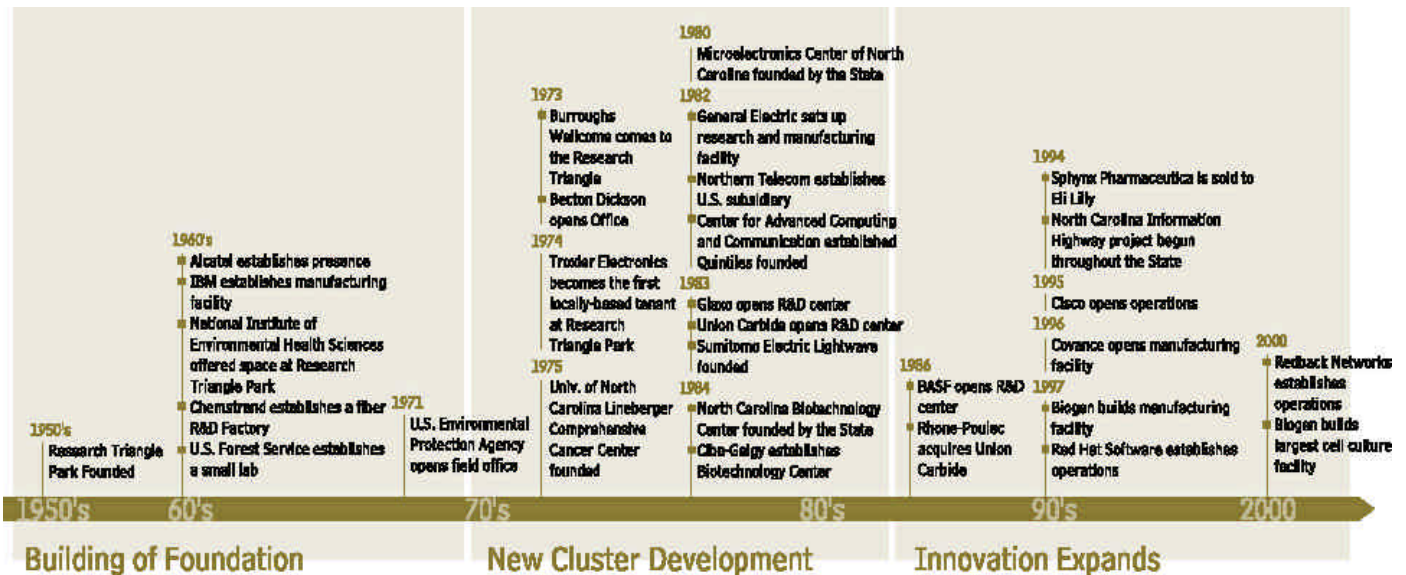
**Research Triangle** The Research Triangle also used and enhanced the specialized assets they had to attract large multinationals and research institutions. In the Research Triangle's case, those assets centered around educational institutions established by benefactors in the late 1800s and early 1900s, assets which set the stage for a successful creation of the Research Triangle Park in the mid-1900s. North Carolina State University in Raleigh (NCSU), the University of North Carolina at Chapel Hill (UNC-Chapel Hill), and Duke University in Durham formed the pillars of the region's knowledge-based economy by providing world-class research facilities as well as a critical mass of scientists, researchers and technicians. Their research capabilities helped in the development of a large number of clusters in the region. These include not only biotechnology /pharmaceutical and communications, but also plastics, chemicals, fibers, medical devices, analytical instruments, and education and knowledge creation.

### Building strong regional economies takes decades

There are many steps involved in building a regional economy, and inevitably this takes time. Regions inherit assets (e.g., geography, universities, workforce pool, successful companies) which public and private sector leaders can leverage. Companies develop from these assets. The activity attracts other companies to locate in the region. Human talent, as well as related and supporting industries are then attracted. Finally, this process is repeated across a number of clusters.

**Research Triangle** For example, it took 20 years to build a large corporate R&D presence in the Research Triangle, and another 20 to see significant economic consequences flow from it. The Research Triangle Institute opened in 1958, but the biotechnology / pharmaceutical cluster did not take off until the late 1980s. In both cases, local leaders had to commit significant resources to assemble a critical mass of facilities and institutions, and then wait many years to witness the economic returns (see Exhibit 21 below).

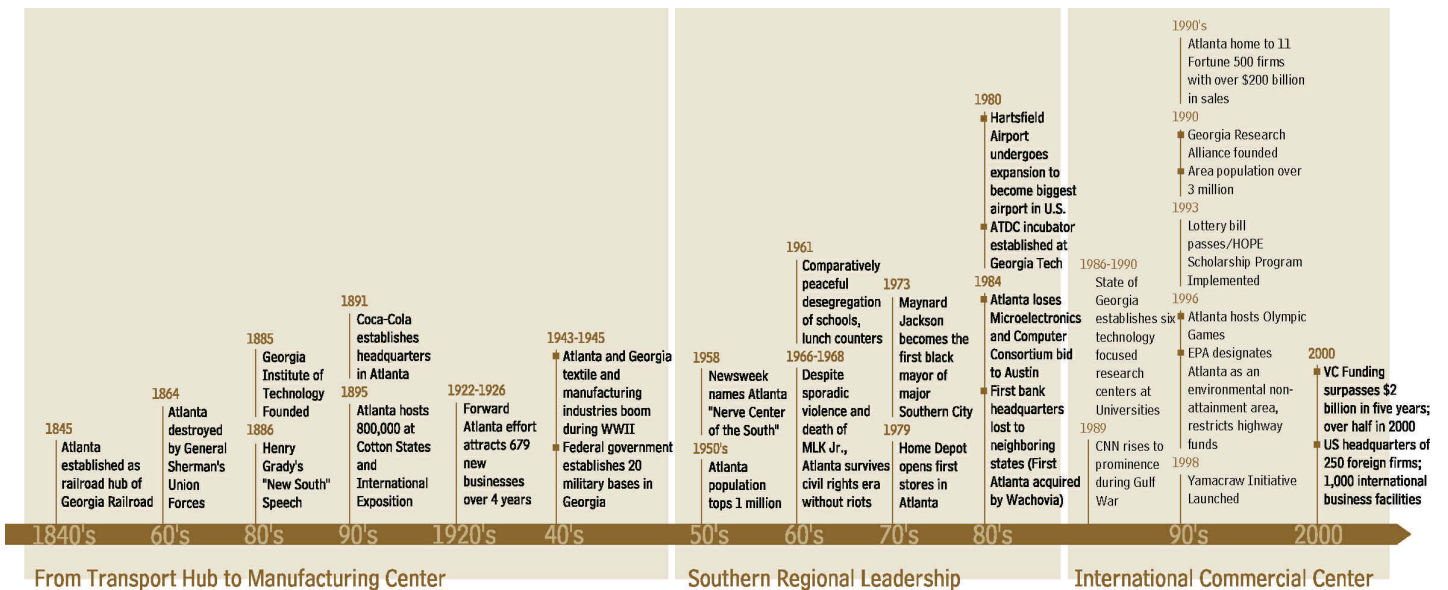
Exhibit 21: Four Decades of Development in the Research Triangle Region



Source: Clusters of Innovation Initiative Interviews, Research Triangle Region

**Atlanta** With the selection of Atlanta to be the hub for the Georgia Railroad more than 150 years ago, the region began its ascent from a transportation hub to an international commercial center. The success enjoyed today is the result of a history of proactive business and government leadership. In 1885, heavily concentrated in textiles, the Georgia Institute of Technology was founded by the city and state to train the new generation of industrial engineers and business leaders. In 1980, due to intense private sector lobbying, Georgia Tech President Joseph Petit and Governor Mike Bushee opened the Atlanta Technology Development Center—designed to spur technology firm development. In the wake of an unsuccessful bid for the Microelectronic and Computer Consortium, Governor Joe Frank Harris provided state funds to open six research centers through the University of Georgia from 1986 to 1990. Again the private sector played a pivotal role when they encouraged Governor Zell Miller and the state assembly to sponsor the Georgia Research Alliance, an organization that brings together business, government, and the six regional research institutions. By the late 1990s, this sustained, long-term effort resulted in Atlanta being able to claim 11 Fortune 500 companies that generated more than \$200 billion in sales. (See Exhibit 22 on next page.)

## Exhibit 22: Timeline of Atlanta's Economic Development



Source: Clusters of Innovation Initiative Interviews, Atlanta

**Wichita** Wichita's mature aerospace vehicles and defense cluster is the result of 80 years of purposeful planning, investing, and coordination from the large manufacturers and the local, state, and federal government. The U.S. government invested hundreds of millions in Wichita's aircraft companies in terms of facilities, training, and research in order to scale up to meet the needs of wartime (World War II and the Korean War) aircraft production. The local government also had the foresight to invest a great deal of funds to improve the local transportation infrastructure around the aircraft production sites and offer hundreds of millions in industrial bonds for the development of the sites themselves. The state and federal government invested in the National Institute for Aviation Research (NIAR), Wichita's only research institution. More investment is needed from state and federal sources for NIAR but it is an extraordinarily important driver of innovation in the region. The most demonstrable example of local leaders' long time-horizon was the well-coordinated push for an expensive K-12 bond vote. Recognizing that the labor pool was one of the region's most important but undeveloped assets, the private sector worked closely with the city of Wichita and the Chamber of Commerce to convince citizens that new investment was needed for the schools. Also, the region's economic development leaders are stepping up to create a new workforce development program in concert with the aircraft manufacturers, although this might not yield results for years to come.

## Institutions for collaboration play an important role in building regional economies

There were many different types of institutions for collaboration present in every region we studied. These institutions for collaboration include formal organizations and informal networks that facilitate the flow of information, ideas, and resources among firms and supporting institutions. Examples of collaborative institutions that we found include chambers of commerce, local branches of nationwide industry associations, region-specific industry associations, and university technology transfer offices.

Survey respondents indicated that these types of institutions of collaboration were critical in these regions because their presence means that several important functions—promotion of the region, recruitment of companies interested in relocating to the area, lobbying on behalf of business interests, and ensuring the legal transfer of intellectual property from universities to companies—are performed. Not all of these institutions for collaboration were effective and not all regions had effective institutions for collaboration. In fact, most regions had only a handful of truly effective institutions for collaboration. (See Section 5, Exhibit 26.)

**San Diego** In response to private-sector efforts to better integrate with the University of California at San Diego, University President Richard Atkinson asked Mary Walshok, Dean of Extended Studies and Public Programs, to develop a program that would facilitate university-business interaction. After coordinating with both university researchers and private sector managers, UCSD CONNECT was established in 1985. Initial programs included:

- **Business Environment Assessment.** CONNECT sponsored a study to determine what business leaders felt were the major gaps hindering their success in San Diego.
- **Meet the Entrepreneur and Meet the Researcher Events.** Entrepreneurs and scientific researchers had very little understanding about the issues that each faced, or the way each conducted their operations. There was almost no connection between the two groups, but as initial events that attracted hundreds of participants showed, there was a lot of interest in learning about each other.
- **Financial Forums.** These forums brought leading capital providers to the region and educated them about San Diego companies in order to encourage investments. The forums also connected entrepreneurs with business support services (law, accounting, and marketing firms) to help them develop and present more effective business proposals.

**Research Triangle** The Centennial Campus is North Carolina State University's (NCSU's) "technopolis", a planned mix of university, corporate and government R&D facilities and business incubators, with a town center, executive conference center and hotel, housing, and recreational facilities. This 1,334-acre site, adjacent to NC State's main campus, separates buildings into R&D neighborhoods with multidisciplinary themes based on the University's strengths in advanced research and client-driven training programs: Advanced Communications Technologies, Biosciences and Biotechnology, Advanced Materials, Environmental Technologies, and Pre-College Education. The campus, home to well over 100 large and small companies, government agencies and NCSU units, received high praise from our survey and interview respondents.

## IMPLICATIONS

- **Long time horizon:** Meaningful changes in regional development require investments that generally take decades before significant dividends are reaped. Long time horizons create challenges for leaders seeking reelection, and make it more difficult to mobilize community support behind an economic development strategy. These realities highlight the need for an institution structure for regional development that goes beyond government, as well as the need for private sector involvement.
- **Building on traditional industries:** Inherited assets matter to a region's economic development. Established and already emerging clusters offer the greatest prospects for near term growth. Strengthening established clusters should be one of the early priorities in regional economic development.
- **Investing in unique and specialized assets:** Many inputs in regional prosperity often require substantial investments in specialized assets such as university campuses, research programs, logistical infrastructure, and the like.

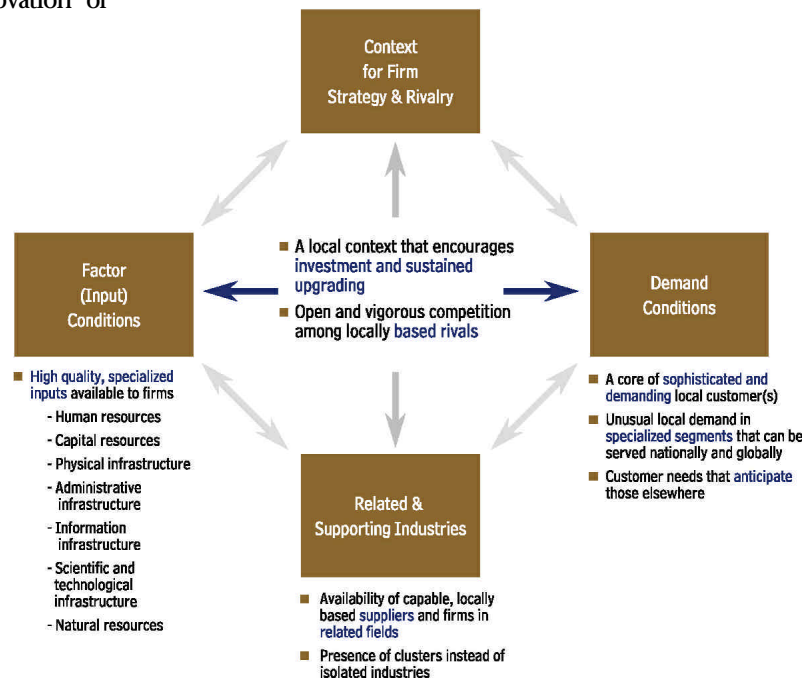
The productivity and innovativeness of a regional economy benefit from overall conditions such as a sound fiscal policy, an effective political decision making process, and sound legal institutions. However, broad regional attributes such as these are increasingly preconditions, not sources of competitive advantage.

Prosperity in a region is actually created by the microeconomic foundations of competitiveness, rooted in the sophistication with which individuals, firms, and industries based there compete. This is what gives rise to productivity. Competitiveness requires ongoing improvement in the quality of corporate management and in the sophistication of company strategies and operating practices. However, the sophistication with which firms compete rests heavily on the quality of the regional business environment in which they operate. For example, the productivity of companies is affected by such things as the specific skills of employees they can attract, the efficiency of the local logistics and transportation system, and the extent to which local regulations impede productivity and innovation or encourage them.

**DETERMINANTS OF REGIONAL PRODUCTIVITY**

The quality of a region’s business environment is embodied in four broad areas (see Exhibit 23). Each of them affects the level of productivity that can be achieved as well as the rate of innovation.<sup>6</sup>

Exhibit 23: Determinants of Regional Productivity



<sup>6</sup> See Michael E. Porter, *The Competitive Advantage of Nations*, New York: The Free Press (1990).

**Factor conditions:** Achieving high levels of productivity depends on the presence of high quality and specialized pools of human resources, applied technology, infrastructure and even sources of capital that are tailored to the needs of particular industries. The quality of more generic and basic factors such as high school graduates or the local transportation system are foundations that every region must have. Increasingly, competitiveness depends on the presence of advanced and more specialized factors. For example, both Wichita and the Research Triangle offer comparable basic infrastructure. However, the Research Triangle region has achieved superior innovation performance due to much better advanced factor conditions in the form of a highly developed and specialized university research and advanced training capability at Duke, North Carolina State University, and the University of North Carolina.

**Demand conditions:** The quality of demand in a region has a strong influence on the process of creating and improving products and services. Sophisticated customers in the region press firms to improve and offer insights into existing and future customer needs.

Traditionally, regions and countries focused on the size of their local market. A large local market, it was believed, would allow local companies to exploit economies of scale and improve competitiveness. When productivity drives competitiveness and firms can easily access national and international markets, however, the quality rather than the quantity of local demand becomes important because it is crucial for innovation. For example, the high state of medical practice in Boston has triggered a stream of innovation in Boston-based biotechnology and medical device companies.

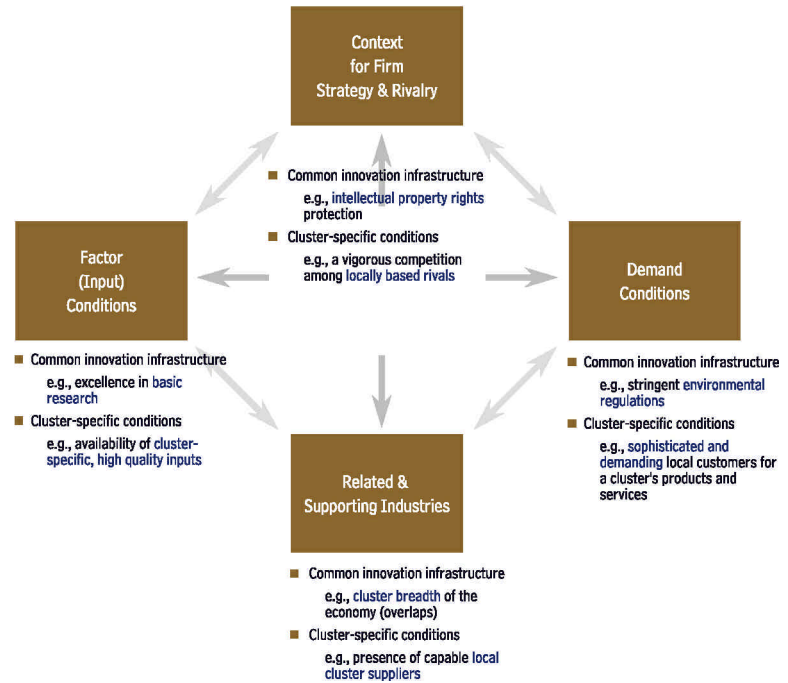
**Context for firm strategy and rivalry:** The rules, incentives and pressures governing the competition in a region have a fundamental influence on productivity. Policies that encourage investment, protect intellectual property, and open the local market for trade, for example, foster productivity growth and competitiveness. Also exerting a strong influence on productivity is the presence of competing rivals in a region and the intensity of local industry. Spirited local rivalry among Wichita's Beach, Cessna, Lear, and Boeing subsidiaries, for example, drove the emergence of the region as the world's center for general aviation aircraft. Local rivalry pressures companies to improve, while attracting suppliers and otherwise improving the overall business environment.

**Related and supporting industries:** Local sourcing from capable suppliers based in the region can enhance productivity and improve the capacity for innovation through allowing quicker and less costly communication, fostering the flow of ideas, and enhancing flexibility through local outsourcing. Traditionally, many regional development programs have focused on attracting individual companies and industries. However, isolated companies cannot be productive without the presence of related and supporting industries. The presence of related and supporting industries gives rise to new clusters. For example, the plastics cluster in Wichita developed from the presence of petrochemical producers combined with local aircraft manufacturers who became customers for plastic parts.

These four areas of the regional business environment are self-reinforcing and act as a system. Regional rivalry, for example, stimulates the development of unique pools of specialized skills and the formation or attraction of specialized suppliers. Active local rivalry also upgrades regional demand by creating more demanding customers. Weaknesses in any part of the business environment, then, can erode the competitiveness of regions.

All parts of the business environment affect a region's productivity and competitiveness. A subset of the overall environment has particular importance in determining a region's capacity for innovation (see Exhibit 24 on following page).

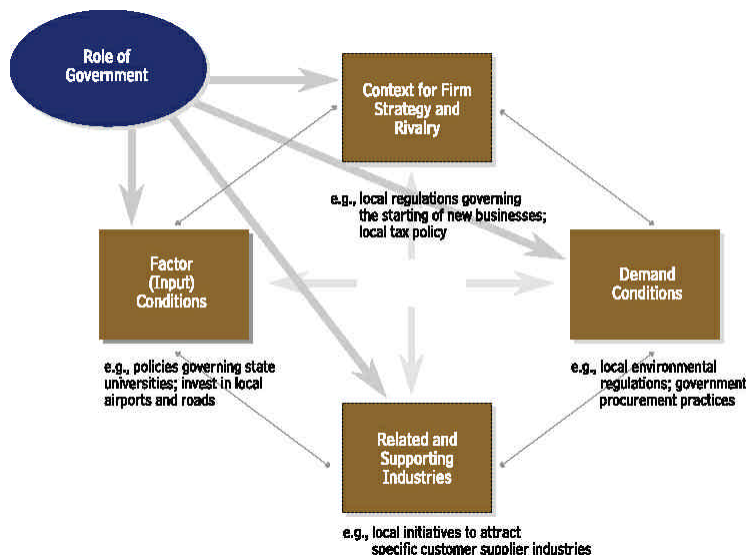
Exhibit 24: Innovation and the Microeconomic Business Environment



### Government

Government affects competitiveness through its influence on the business environment (see Exhibit 25). Government at all levels influences (positively or negatively) the business environment and the productivity of clusters. Government is not monolithic, and its influence occurs through a myriad of distinct departments and entities. While the Federal government is often seen as having the greatest impact on competitiveness, policies at the regional and even local level are often equally if not more important. Each level of government affects various aspects of the business environment, and the policies of different units of government can frequently be conflicting.

Exhibit 25: Government's Impact on Regional Productivity



**Government plays five distinct types of roles in competitiveness, some of which are often overlooked:**

- 1) Establish a stable macroeconomic, political, and legal environment.
- 2) Improving the availability, quality, and efficiency of generalized inputs, infrastructure, and institutions, such as roads and schools.
- 3) Setting the overall rules and incentives governing competition such as investment incentives, antitrust laws, and intellectual property protection rules.
- 4) Facilitating cluster development and upgrading; and
- 5) Establishing and participating in an ongoing process for defining regional competitive priorities and implementing them across constituencies.

Most governments realize the first three roles. Few governments have effectively addressed the fourth and fifth roles and the second role as far as basic factor conditions are concerned. Advanced factor conditions, incentives, and the institutions and processes of cluster development have become much more important roles of government.

**Government’s proper role is to improve the business environment rather than to intervene directly in the competitive process.** Government should not subsidize individual companies but work to raise the productivity and innovativeness with which companies can operate. Many U.S. regions, for example, have traditionally sought to attract industry through tax incentives and driving down the cost of doing business in terms of payroll taxes, unemployment insurance, utilities and the like. This approach may be necessary in uncompetitive regions, but it is ultimately self-limiting. Pushing down costs can reduce the revenue necessary to improve education, infrastructure and services. Improving the productivity of the region, and boosting its innovative capacity, is more effective in increasing standard of living in the long run.

**The traditional separation between the public and private sector no longer applies.** In the old model, the public sector was to provide the infrastructure while the private sector focused on competition. In the new model, the level of co-dependence of public and private sector has hugely increased: The public sector needs to set policies in close interaction with the private sector while the private sector derives key sources of its competitive success from outside the firm. The new model also includes a much broader set of institutions such as universities, regulatory bodies, and trade associations.

Exhibit 26: Examples of Institutions for Collaboration

General	Cluster-specific
<ul style="list-style-type: none"> <li>■ Private sector                             <ul style="list-style-type: none"> <li>- Chambers of Commerce</li> <li>- Professional associations</li> </ul> </li> <li>■ Public sector                             <ul style="list-style-type: none"> <li>- Economic development agencies</li> </ul> </li> <li>■ Jointly private / public                             <ul style="list-style-type: none"> <li>- Advisory councils</li> <li>- Competitiveness councils</li> </ul> </li> <li>■ Informal networks                             <ul style="list-style-type: none"> <li>- School networks</li> <li>- Religious networks</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Industry associations</li> <li>- Specialized professional associations and societies</li> <li>- Alumni groups of core cluster companies</li> <li>- Incubators</li> </ul>

### Institutions for Collaboration

Institutions for collaboration are formal and informal organizations and networks that (1) facilitate the exchange of information and technology; and (2) foster various kinds of local coordination and collaboration that can improve the business environment in the overall economy or in a cluster. Institutions for collaboration, then, create and amplify the arrows and feedback loops (See Exhibit 26).

Institutions for collaboration take various forms (see Exhibit 26). Some are economy-wide or address broad sectors, while others are cluster-specific. Institutions for collaboration affect productivity and innovation in a number of ways. First, they create relationships and enhance the level of trust in these relationships. Second, they facilitate the organization of collective activity. Third, they encourage the definition of common standards, rules, and norms that stimulate competition or boost productivity. Finally, they can be mechanisms to develop a common economic or cluster agenda.

### Economic Attitudes, Values and Beliefs

A final influence on regional competitiveness and innovative capacity is more intangible. Attitudes, values and beliefs towards the economy—which are often termed “culture”—bear on the behavior and aspirations of individuals, firms, and other institutions in a region. Of particular importance is an advanced economy like the U.S. are beliefs about the importance of entrepreneurship, attitudes towards collaboration, and civic mindedness.

## FINDINGS COMMON ACROSS REGIONS

Regions differ substantially in the relative strengths and weaknesses of the business environment. Nevertheless, a number of issues are common across regions. Our research found that a number of factors in the business environment were important in all regions. Strength in these factors is a basic ingredient to the success of any regional economy. These factors include: a strong physical infrastructure, quality primary and secondary education, excellent universities and specialized research centers, a deep pool of specialized talent, a business-responsive government, and reasonably efficient coordination among local political jurisdictions.

### A strong physical and information infrastructure is a baseline requirement to establish and sustain a prosperous regional economy

Roads, highways, airports, railroads, water, and power support the efficient movement of people, goods, and services as well as the quality of life of citizens. All five regions we studied exhibited survey results indicating that physical infrastructure was one of the most serious challenges facing regions. A deteriorating physical infrastructure was cited as the leading cause of a deteriorating quality of life by a majority of survey respondents and interviewees (see Exhibits 27 and 28 on following page).

While communication infrastructure was not cited as a problem in any of the regions studied, there was solid support for the government to make its improvement a priority. Communication, including Internet access, not only impacts the information technology sector, but affects the efficiency of new business practices, like e-commerce and logistics. Atlanta is an excellent example of a region that has enjoyed greater economic success due to major investments in their communications backbone to support the 1996 Olympics and the media giants CNN and Cox Communications.

Exhibit 27: Government Priorities — Selected Survey Results and Representative Quotes from Interviews

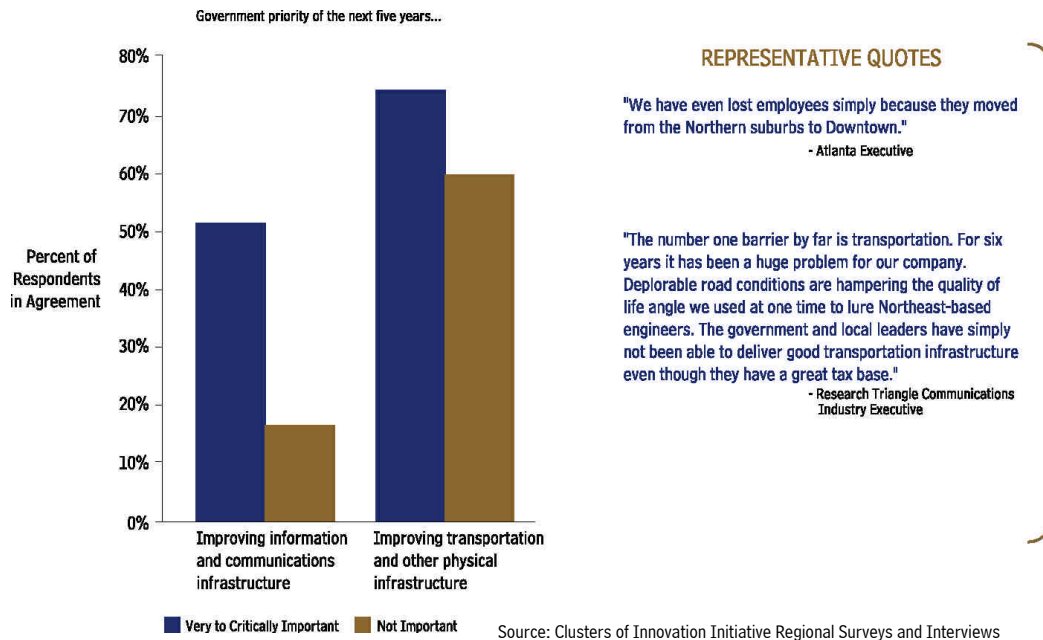
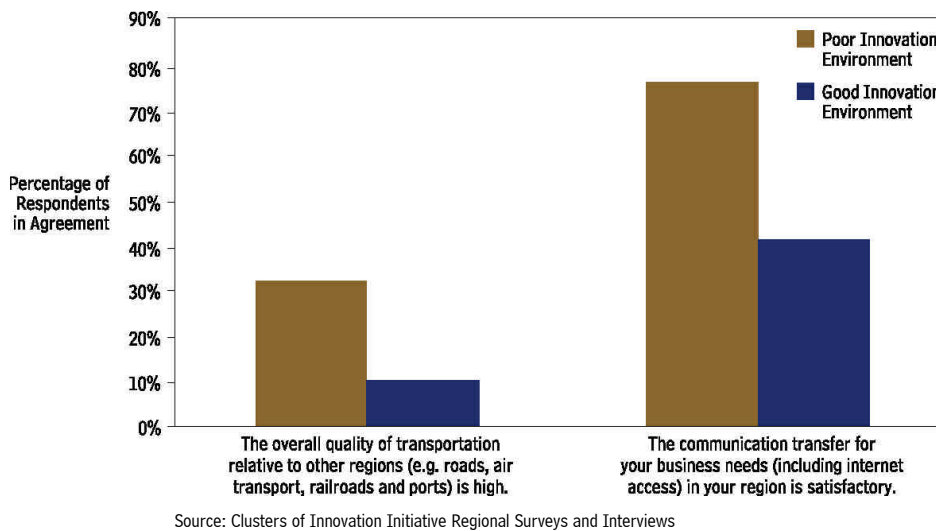


Exhibit 28: Physical Infrastructure — Good vs. Poor Innovation Locations



**San Diego** Sixty five percent of biotechnology/pharmaceutical executives and 56% of communications executives listed the quality of transportation as the second greatest threat to their business expansion. This issue consistently emerged in both surveys and interviews as a high priority problem, with individuals citing the need to increase air transport capacity for both passengers and cargo to support many large and fast growing clusters, such as transportation and logistics, business services, hospitality and tourism, biotechnology/pharmaceutical, communications, and information technology.

Although San Diego International Airport is centrally located, it lacks both frequent and direct flights to many destinations. Population and economic growth has exceeded the airport capacity and will continue to do so. A recent study estimated that by 2030, the cumulative opportunity cost of not expanding the regional facilities was between \$29.6 billion and \$93.8 billion. In 2030, there would be 34,000 to 56,000 fewer jobs. More than half of the job losses, and more than 75% of the lost gross production would occur in innovative clusters. For example, a number of biotech firms now anticipate the need for air transport as their products become ready for commercial distribution.<sup>7</sup>

A second weakness of the physical infrastructure, as discussed by interviewees, is ensuring reliable, cost-competitive access to power and water. Southern California is dry, heavily populated, and growing rapidly. Water is a perennial issue in the state and demographic shifts guarantee that it will remain an issue. More recently, deregulation of the state's energy industry has led to short supplies, higher energy prices, and even rolling blackouts throughout the state. Although Northern California has been hit the hardest, rising utility prices affect the entire state.

**Atlanta** Throughout its history the geographic location and physical infrastructure of the Atlanta region have served as a strong economic asset. More than 200 million people, 80% of U.S. consumers, are within two hours' flight time from Atlanta, or one day's trucking by highway. However, Atlanta's road transportation infrastructure has not been able to keep up with its population growth. While the state has been actively building new roads throughout the decade, traffic and congestion have increased significantly. According to the Texas Transportation Index, the average Atlanta driver experienced delays of 68 hours per year in 1997, fourth worst in the country. In 1990, the average Atlanta driver experienced only 27 hours of delay. While Atlanta does have a rail transit system, MARTA, it presently only serves two counties in the 17 county metro area, too few to make a significant dent in the congestion. Atlanta business leaders say that they sometime have trouble attracting workers from within the metro area because the traffic is so intense within the area. As one business person said, "we have even lost employees simply because they moved from the Northern suburbs to downtown."

The rapid growth in some communities has also outpaced the regional authorities' ability to provide appropriate sewer services. According to a real estate executive, the problem is particularly acute in the Buckhead business district where there are "five commercial buildings ready to come out of the ground waiting for the capacity to expand." Parts of Southwest Atlanta that lie well within the city limits are forced to rely on septic systems.

While water has not been a significant problem to date, the State of Georgia is in a battle with Alabama and Florida over the flow from the Chattahoochee River. For now, Georgia has captured the quantity it needs.

In contrast, thanks to significant capital investments by the city, state and Delta Airlines, Hartsfield International Airport has grown to take advantage of the region's location. In 2000, it was the busiest airport in the world for passenger travel and handled more than 650,000 metric tons of cargo. Hartsfield has a \$16 billion regional economic impact annually<sup>8</sup>, and 44,800 airport employees, making it the largest employment center in GA.<sup>9</sup> While some Atlanta leaders complain that parking at Hartsfield is difficult, most recognize that the airport, which supports more than 1,000 flights a day, provides the region significant economic benefits.

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<sup>7</sup> "The Impacts of Constrained Air Transportation Capacity on the San Diego Regional Economy," Hamilton, Rabinowitz, and Alshuler, Inc., January 5, 2001. The lower estimate assumed maximum expansion of SDIA, while the higher estimate assumed no change to existing facilities.

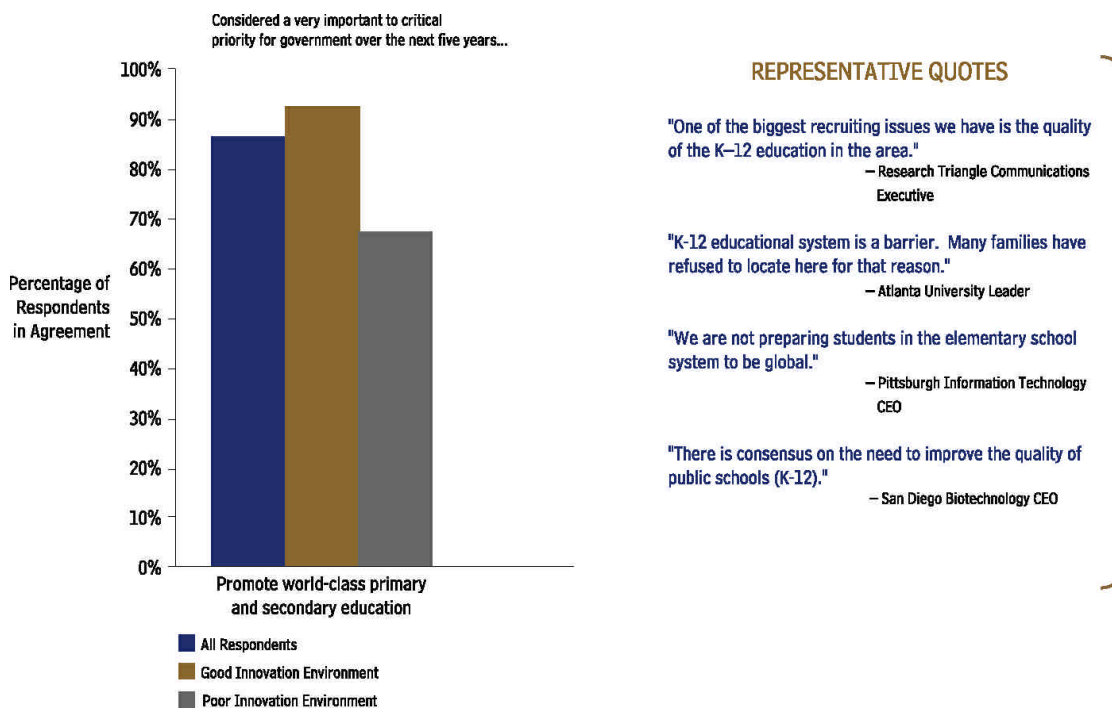
In addition, Atlanta has an excellent communications infrastructure, thanks to major investments made to support the Olympics and the major media companies like CNN and Cox Communications. Building on its reputation as a transportation hub, the region has also become a major Internet connection hub. Leading Internet Service Providers (ISPs) like firms like Mindspring and BellSouth offer services to take advantage of the high-speed Internet connectivity. Eighty-seven percent of our survey respondents said that the communications and Internet infrastructure fully satisfied their business needs.

### A strong K-12 educational system is important for developing local talent and attracting outside talent

Community leaders across all five regions placed a high premium on quality K-12 education and expressed concern about the quality of public schools in their region. The importance of K-12 education is growing ever more critical because it establishes both the pipeline of talent for entry-level jobs and the pool of specialized talent critical to cluster development (see Exhibit 29 below).

Demands on the K-12 system have changed in some fundamental ways over the past decade. First, with greater national and international mobility of capital and companies, the quality of a region's K-12 system has become a key differentiator in attracting business investment. Second, most jobs now require a higher level of technical and reasoning skills among the workforce at large, not just those requiring advanced degrees. Third, every high school graduate needs a working knowledge of computers and software to succeed in the marketplace as well as in higher education.

Exhibit 29: Government Priorities — Selected Survey Results and Representative Quotes from Interviews



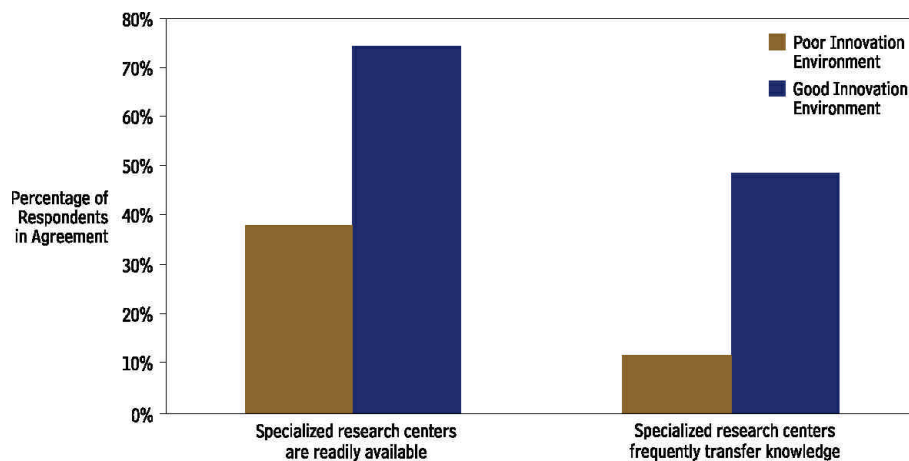
<sup>8</sup> "Mayor's Statement" [www.atlanta-airport.com](http://www.atlanta-airport.com)

<sup>9</sup> Airport Statistics [www.atlanta-airport.com](http://www.atlanta-airport.com)

## Universities and specialized research centers are the driving force behind nearly every region

Universities and specialized research centers were instrumental in providing the driving force for innovation in nearly every region we studied (see Exhibit 30 below). In San Diego, the University of California at San Diego, the Salk Institute, the Scripps Research Institute, the Navy's SPAWAR, among others were instrumental in generating new ideas and technologies. In Pittsburgh, the most important sources of innovation were Carnegie Mellon University, the University of Pittsburgh, and Duquesne University. In Research Triangle, many companies (e.g., IBM, Glaxo-Wellcome) were strong innovators. Nevertheless, the underlying source of talent and ideas are Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University. In Atlanta, Emory University, and the Georgia Institute of Technology were prominent.

Exhibit 30: Specialized Research — Good vs. Poor Innovation Locations



Source: Clusters of Innovation Initiative Regional Surveys

**San Diego** This region not only makes considerable investments in R&D, it also excels at commercializing the knowledge it generates. Part of the reason is the presence of many different types of research institutions. The University of California at San Diego, a large public university, contains numerous specialized research centers. In addition, there are many non-university research centers such as the Scripps, Salk, and Burnham Institutes. Yet another model is the joint university-industry research institution. Examples of this include the Center for Wireless Communications and the California Institute for Telecommunications and Information Technology. Finally, there are also government research centers such as the Navy's Space and Naval Warfare Systems Command (SPAWAR).

**Pittsburgh** The region's research workforce has been depleted since the mid 1960s, when it had 14,500 private sector researchers. The number dropped to 8,000 in the 1970s and has stagnated at that number through the 1990s, making it difficult to improve innovation levels. In fact, Pittsburgh's patenting numbers have been regressing through the 1990s, compared to the national averages. Although local universities increased their researchers to more than 5,500 and have more than double the national per capita expenditure on research, difficulties with commercialization limit their impact. There is a great opportunity to mobilize these resources, and university leaders understand this and have made strong improvements. Now, they must continue to escalate this effort and bring in more private sector firms.

Exhibit 31 — Specialized Talent and Training: Good versus Poor Innovation Locations

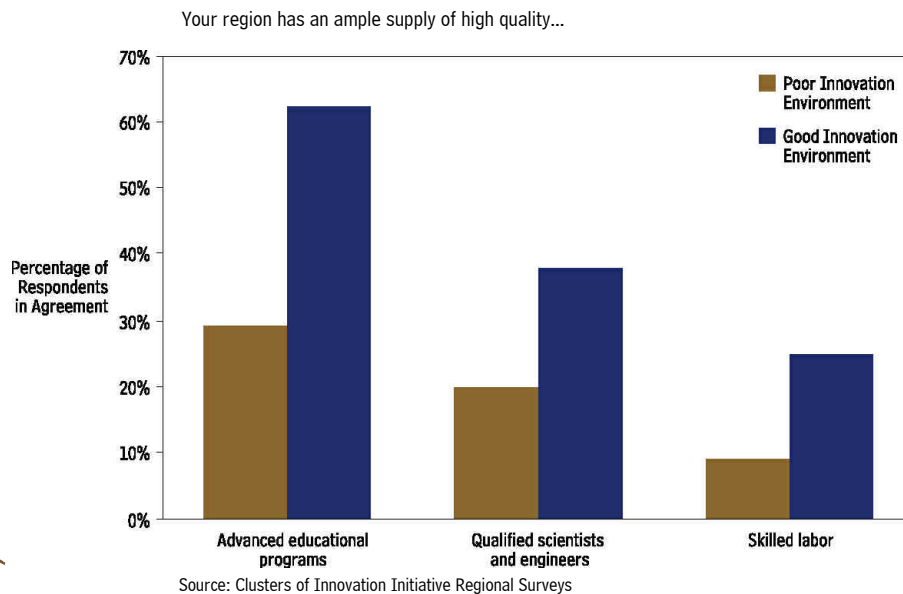
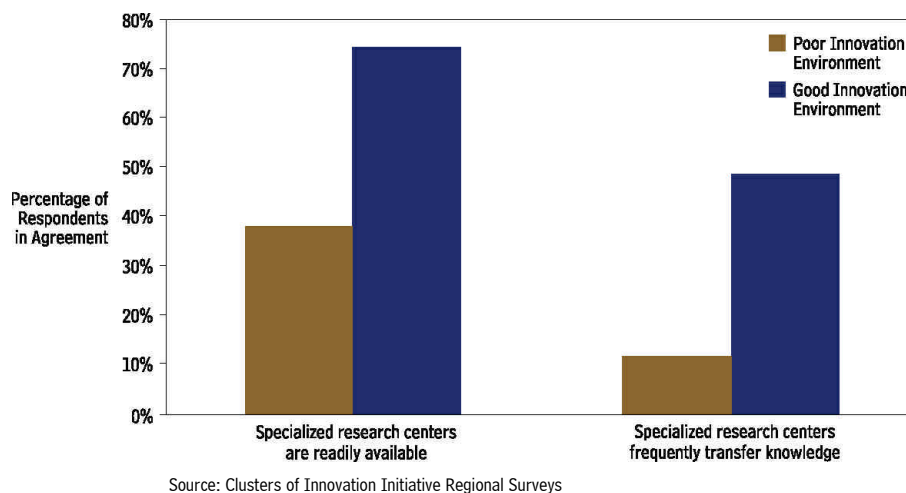


Exhibit 32 — Specialized Talent and Training: Good versus Poor Innovation Locations



## Specialized talent and training are more important than abundant, low-wage labor

In interview after interview, executives report that they move operations to particular locations in large part because of the local talent pool. However, it is not abundant, low-paying labor that attracts innovative companies, but highly talented, specialized, and often expensive labor. This type of labor tends to pool in various regions around the country, and hence regions with an abundance of specialized workers offer advantages to companies that other regions cannot match. There are at least four reasons for this: a mass of specialized workers appears because specialized training institutions already exist; the numerous companies in a regional cluster offer specialized training to their workers; outside companies are attracted to the region because of the labor and their relocation brings more specially trained workers to the region; and people from outside the region who happen to get the specialized training are more willing to move to the region because they know there are more employment opportunities in the region (see Exhibits 31 and 32).

**Wichita** Aside from flat land and good wind, the Wichita region has fewer natural assets or endowments as compared to other regions studied. What attracted Bill Lear and dozens of suppliers to set up operations in the region, earned Wichita the title of “Air Capital of the World,” and has recently attracted the Airbus company to investigate the creation of a possible design facility, is not hospitable flying conditions but rather the existence of specialized talent. To the benefit of the aerospace vehicles and defense cluster, workers proficient in building aircraft tend to circulate from one large manufacturer to another and from manufacturer to small supplier. The region’s thick aircraft labor market has seeded the development of other manufacturing-oriented clusters in the region, transforming Wichita from an aerospace cluster to a major manufacturing center. In fact, demand for specialized labor is so important in the region that it has become the aerospace vehicles and defense cluster’s Achilles heel. Availability and cost of labor topped the list of concerns among those surveyed both within the cluster and throughout the region as a whole. In response to labor shortage concerns, the cluster is embarking on a state-of-the-art workforce-training program.

**San Diego** UCSD, San Diego State University, local private universities, and the region’s community colleges offer a variety of general courses and specialized programs at the undergraduate, graduate, and continuing education levels. One example is the SDSU Center for Bio/Pharmaceutical and Biodevice Development, which recently launched its first program, a Master of Science in Regulatory Affairs. Interviewees report satisfaction with local training and talent.

**Research Triangle** UNC, NC State University, Duke University, local private universities, and the region’s community colleges offer a variety of general courses and specialized programs at the undergraduate, graduate, and continuing education levels. Interviewees report satisfaction with local training and talent as far as quality, but not quantity. The Research Triangle is home to a comparatively large number of skilled workers in the communications cluster. According to the Bureau of Labor Statistics, in 1998 there were 4,480 electrical or electronic engineers and more than 2,900 electrical or electronic engineering technicians in the region, well above the national average. In recent years, the Research Triangle has improved its academic and training infrastructure to support specialized research in communications

related fields. For example, the optical networking companies are developing partnerships with educators to train technicians to support their growth. Nortel premiered its Optical Internet Technology training program that it is offering in conjunction with Wake Technical Community College. Students who successfully complete the 15-week pilot program, held at the Raleigh Technical Education Center, a Nortel facility, can become candidates for Nortel certification – and employment. Competitor Cisco offers its own brand of optical network training through its Networking Academy Programs. In recent years Cisco has enrolled students in classes at community colleges, high schools, homeless shelters, and juvenile centers, and near military installations for outgoing personnel. And Lucent, with its growing optical networking center on NCSU's Centennial Campus, is taking advantage of the people-power and research available through this type of partnership.

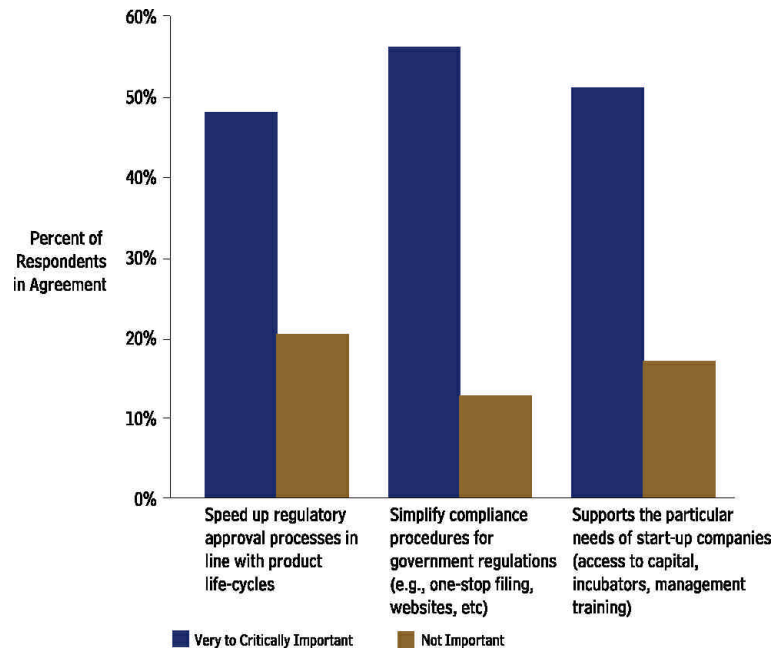
### Government can have a significant influence on the business environment, both positively or negatively

In general, government's influence on innovation comes through its impact on factor inputs, context for firm rivalry, demand conditions, and related and supporting industries. Federal and state governments control much of the legal, fiscal, and regulatory framework (e.g., fiscal policy, competition policy, protection of intellectual property, and liability law) that affects demand conditions and the context for firm rivalry. Taken together, these policies create the incentives (or disincentives) for the high levels of investment and commercialization that characterize an innovation economy. According to our survey, business and community leaders in the regions identified three primary areas in which local governments must be—or become—highly effective (see Exhibit 33 and 34 on next page):

- 1) Speed up regulatory approvals wherever possible, including zoning and licensing, and simplify compliance procedures.
- 2) Support for local entrepreneurial activity, including catalyzing partnerships, stimulating funding for incubators, and supporting start-up ventures.
- 3) Catalyze the linkages between government and business communities that create the groundwork for collaboration.

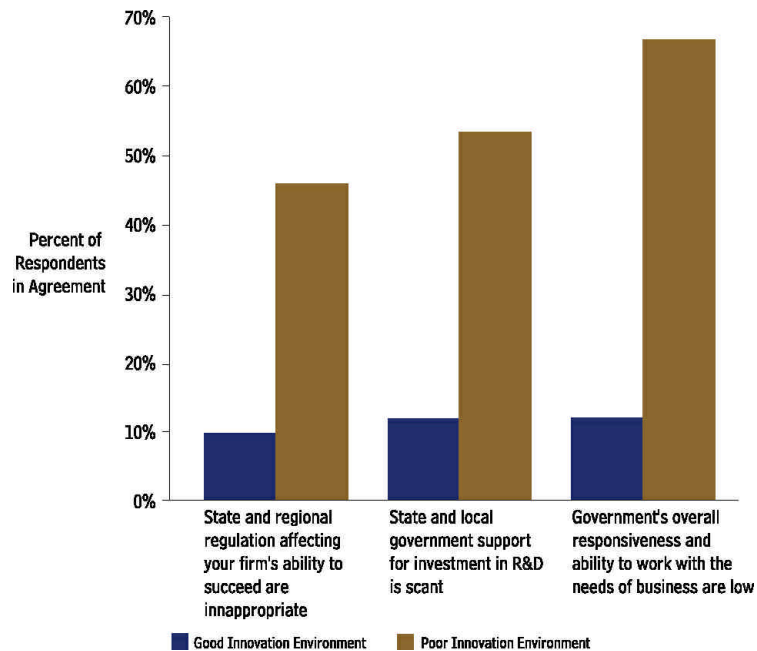
In highly innovative regions, the private sector plays an active role in identifying challenges and working collectively with government to address them. In innovation-poor regions, by contrast, the prevailing business attitude is less collaborative and perception that government simply needs “to get out of our way.”

Exhibit 33: Government Priorities—Selected Survey Results



Source: Clusters of Innovation Initiative Regional Surveys

Exhibit 34: Government Priorities—Selected Survey Results



Source: Clusters of Innovation Initiative Regional Surveys

**Wichita** Local government played an important catalytic role in the establishment of the important aerospace vehicle and defense cluster and has provided economic development assistance since the 1960s. The seeds of Wichita's success were sown around the turn of the last century when citizens passed a \$200,000 bond and helped Wichita beat out other cities to attract a railroad. Real estate speculation, aggressively promoted by the city's two newspapers, followed the railroad. The city's economic development organization, the Board of Trade, encouraged manufacturers to come to Wichita with incentives of land titles. Wichita also funded a landing field to capitalize on the interest in aviation and recruited Clyde Cessna and Bill Lear. Beginning in 1962, Wichita floated its first industrial bonds. Local government conducted aggressive firm recruitment in the 1970s, following a downturn in the economy. Since 1979, local government has offered \$3 billion in revenue bonds.

More recently, the state of Kansas is widely credited for setting in motion a number of economic development programs that followed intensive statewide strategic planning during the mid-1980s. These strategies were prepared in response to a recession in the aerospace vehicles and defense, oil and gas, and agriculture clusters and a collective fear that Kansas was losing its competitive edge. As a result, the Kansas Technology Enterprise Corp. (KTEC) was created to stimulate economic development by fostering innovation and development of technology. KTEC offers seed capital as exemplified through the Wichita Technology Corporation, research funding for such institutions as the National Institute for Aviation Research, and support for technical assistance. In addition, Kansas Venture Capital, Inc. was created to attract private venture capital in the state through tax credits and a matching public fund of \$5 million.

**Research Triangle** In 1958, with the economy of central North Carolina still dependent on maturing industries such as tobacco and textiles, the state's government and business leaders, including North Carolina Governor Luther Hodges, set out to foster economic development through far-sighted investments in universities, research centers, and infrastructure. Governor Hodges, who earned the reputation as the "businessman's governor," led education reform, devoted significant resources to post-secondary education, built vocational schools, and embarked on an persuasive industrial recruitment and incentive program.

Alongside these state-led efforts, the local government responded by providing land, special tax zones, and other incentives aimed at luring large, high-tech companies and organizations to the area. Challenged by discontinuities, cluster-generating companies and crusading individuals (e.g., former Governors Hodges, Sanford and, later, Hunt) forged inter-relationships, promoted the development of supportive institutions (e.g., the Research Triangle Foundation), and pioneered the growth of the present clusters. As mentioned by a prominent economic development official in one of the cluster interviews, "The shift from an agricultural focus took real leadership. As a result, the aspirations and expectations of the citizenry have changed a lot over the last 20-30 years."<sup>10</sup>

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<sup>10</sup> Clusters of Innovation Initiative Interview, Research Triangle, November 6, 2000

## Poor coordination among local jurisdictions often impedes efforts to improve the business environment

One of the keys to successful regional development is a long-term vision for sustainable growth and shared understanding and coordination between public and private sector leaders about the strategies and goals. The multiplicity of local jurisdictions encompassed by a growing local economy often impedes this process.

Historically, the location of county seats was determined by a day's mule drive. Today, sprawling regional economies cut across these narrow political boundaries, often complicating the process of regional planning for "smart" growth. Communities face challenges in workforce development, education, transportation, housing, and land zoning that require a more coordinated metro-wide approach. Yet, local political leadership is often fragmented and disconnected. Local jurisdictions do not routinely coordinate their policies and planning. In rapidly expanding areas, local political leaders may not even know each other. At the same, however, interviewees indicated that mayors and other locally elected officials lack the authority to make sound regional policy that affects their economic prospects and quality of life (see Exhibit 35 below). As a result, a number of the regions studied are experimenting with new forms of regional coordination but new regional structures are still in the formative stages.

### Exhibit 35: Government Collaboration — Representative Quotes from Interviews

REPRESENTATIVE QUOTES	REPRESENTATIVE QUOTES
<p>The Metro Atlanta local government system is fragmented. There is still a lot of in-fighting. Counties fight against each other rather than working together.</p> <p>— Atlanta Financial Services Executive</p>	<p>One of the major barriers to Pittsburgh's economic prosperity is the high number of municipalities — we have 131 in Allegheny County, which were never coordinated</p> <p>— Pittsburgh Economic Development CEO</p>
<p>The Research Triangle is comprised by three main regions with three different cultures, and three different styles of government, whereas Charlotte is hierarchical, with a single corporate culture where a few individuals can make things happen.</p> <p>— Research Triangle University Leader</p>	<p>Regional government is weak and ineffective with regard to the planning and implementation of regional development.</p> <p>— San Diego Biotechnology Chairman of the Board</p>

Source: Clusters of Innovation Initiative Interviews

**Atlanta** Atlanta developed a regional solution to address the critical shortfalls in its transportation system. In 1999, the Georgia Regional Transportation Agency was created to address multi-jurisdictional sprawl in the metro Atlanta region. The new agency was given the power not only to build or veto new road and transit systems, but to affect development patterns by controlling the way new office parks or residential development ties into the transportation network.

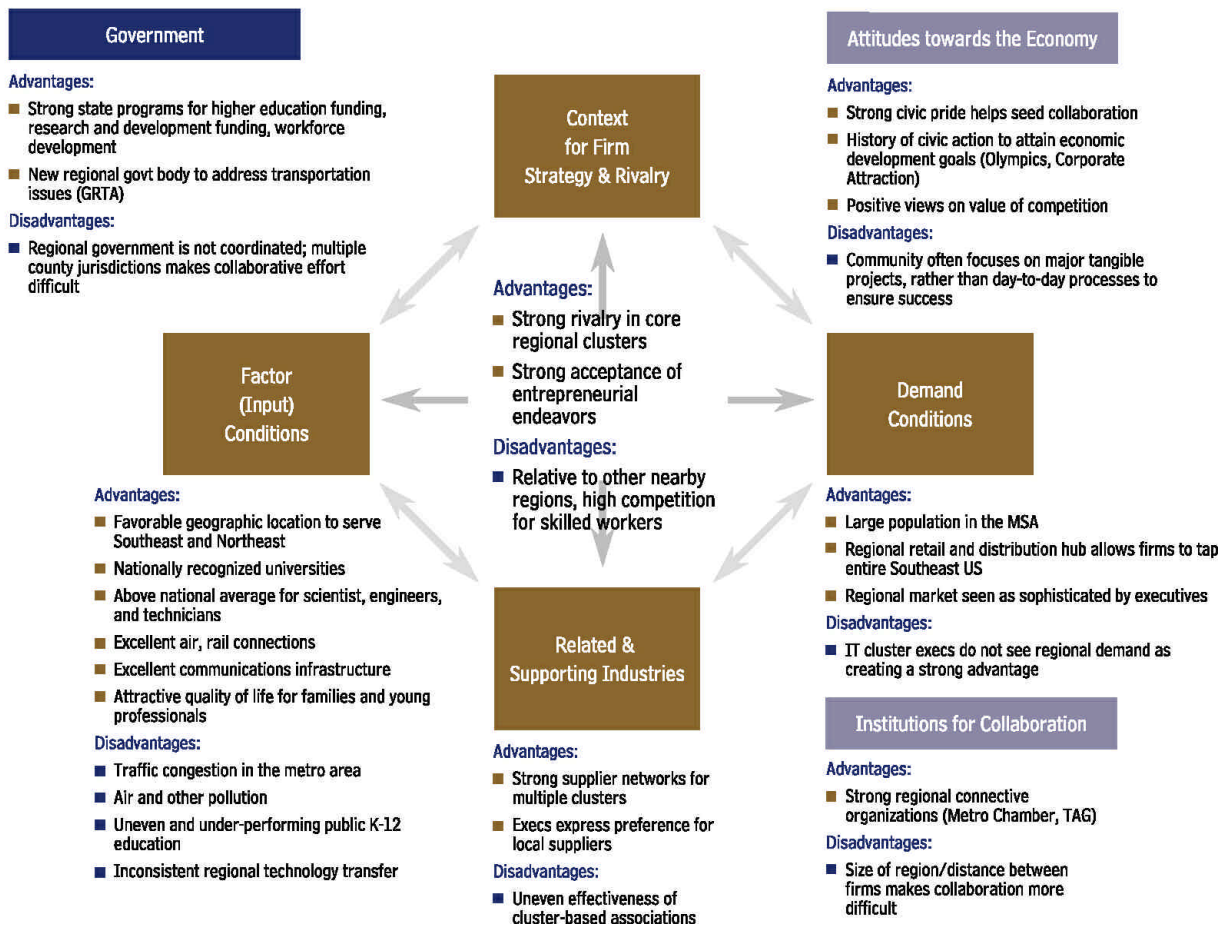
**Pittsburgh** Allegheny County in Pennsylvania described itself in the mid-nineties as having the most fragmented government structure of any metropolitan county in the United States with 130 municipalities, the smallest with a population of 100, and 43 school districts. Looking at its prospects for the 21st century, recommended the creation of a county-wide executive to coordinate economic development and planning among the local municipal jurisdictions.

**Research Triangle** The Research Triangle region has been the 12th fastest growing MSA in the U.S. over the last decade. Growth has spurred the increase in the political independence of local jurisdictions that used to go along with more regional economic development plans. The former vision of the region as a growing center of research excellence (built around Research Triangle Park and the metropolitan area) has reached its limits in terms of being able to generate consensus behind regional economic development programs. Collaboration among local leaders and institutions for collaboration in the area is more difficult today. This has made it hard to push through economic development strategies that benefit all jurisdictions and not just one.

### Overall Regional Strengths and Weaknesses

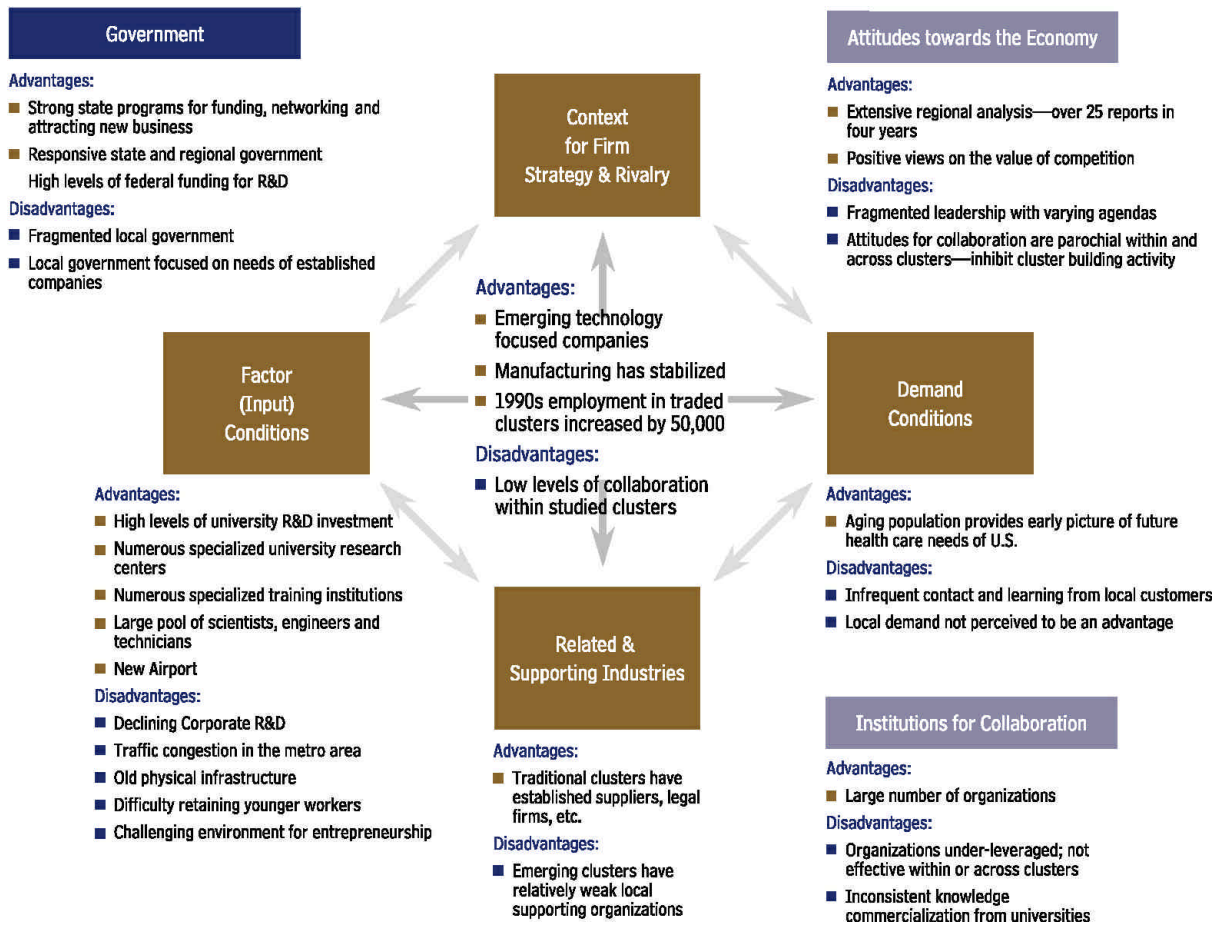
In addition to issues of concern across all regions, business environments have their own unique strengths and weaknesses. When we examine a region, we look at a complex set of regional business environment data. These additional factors in the business environment differentiate regions. Although strength in these factors confers an advantage on a region, weakness is not necessarily crippling. Other strengths can compensate for these weaknesses.

Exhibit 36: Determinants of Regional Competitiveness: Atlanta's Relative Position



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School, Clusters of Innovation Initiative Regional Surveys and Interviews, Atlanta

Exhibit 37: Determinants of Regional Competitiveness: Pittsburgh's Relative Position



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School, Clusters of Innovation Initiative Regional Surveys and Interviews, Pittsburgh

**Atlanta** Atlanta has a strong business environment overall. Particular assets that have differentiated Atlanta, however, include its historically high quality of life, strong regional institutions for collaboration, the state government, and a history of public-private-university collaboration. Institutions like the Metro Chamber, and the Technology Alliance of Georgia take an active role in pushing economic development. The State government has initiated programs such as ICAPP (Intellectual Capital Partnership Program) to partner with firms and educational institutions to provide focused workforce development; and the Georgia Research Alliance. (See Exhibit 36 on the previous page.)

**Pittsburgh** The main assets in Pittsburgh's business environment are its numerous specialized research and training institutes and high levels of R&D spending. However, slippage in knowledge commercialization limits the impact these research centers have on the economy. Furthermore, the environment for start-ups is challenging, due to lack of networking, lack of mentorship opportunities, lack of experienced entrepreneurial talent, and limited VC. Perhaps the most important challenge in the business environment involves the level of collaboration across diverse groups in the region. (See Exhibit 37 above.)

## IMPLICATIONS

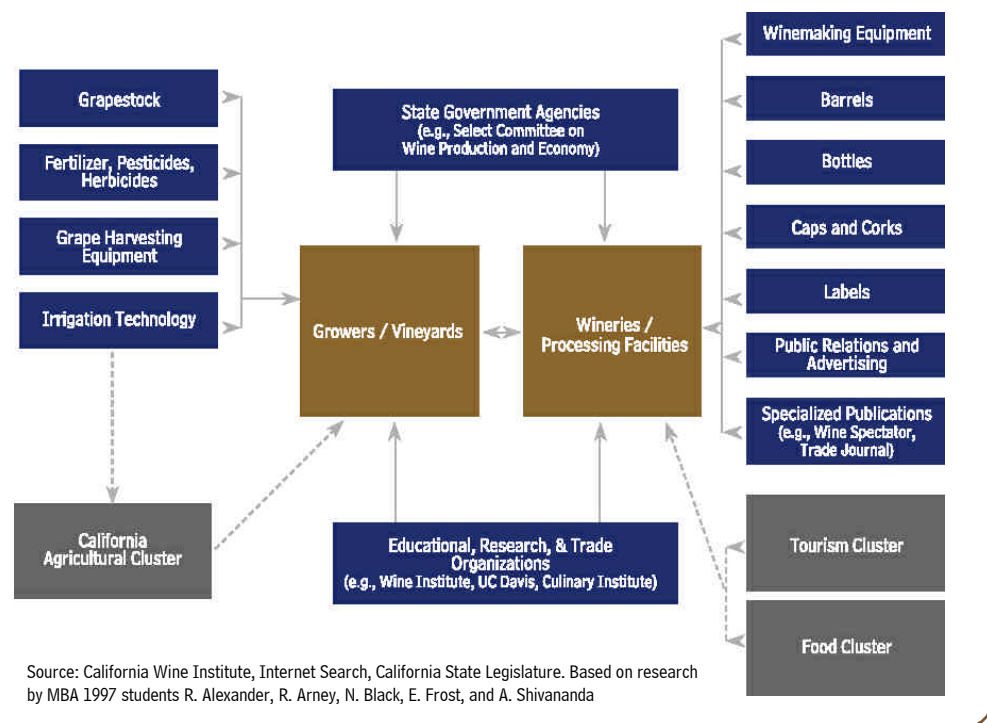
- **Challenges of success:** Successful regional economies tend to experience rapid growth, which stresses the physical infrastructure. Foresight and a conscious strategy are needed to maintain and improve infrastructure in advance of the strains caused by growth.
- **Recognize the need for strategic transitions:** Over time, regional development strategies run their course. Success at one strategy creates the challenges that need to be addressed by the next strategy. For example, Research Triangle's strategy of focusing development inward on a research park, amidst three strong local universities proved a great success. Now, however, it is time to use these assets to reach outward to surrounding communities to leverage their assets with the knowledge resources proximate to Research Triangle Park.
- **Institutionalizing innovation:** Regions often prosper from the efforts of great individual entrepreneurs. Andrew Carnegie's innovations in production technology, combined with the specialized assets of southwestern Pennsylvania, were instrumental in making Pittsburgh the steel capital of the world. Similarly, the innovations of Stedman, Cessna, and Beach made Wichita the air capital of the world. This model of regional development, however, leaves success almost entirely to chance. Successful regions do not rely on chance, but rather seek to institutionalize the innovative process by building strong universities and research centers, and by attracting research divisions of major companies, to create continuous innovation and entrepreneurship.
- **Moving to commercialization:** Commercialization is a vital step in the innovation process. Some regions have high levels of R&D investments and numerous specialized research centers, but still lag in terms of innovation output because knowledge is not effectively transferred to companies. Having many different types of research institutions (e.g., public universities, private universities, for-profit research centers, non-profit research centers, etc) appears to foster commercialization. Different types of research centers interact with companies in different ways, with varying approaches to deploying intellectual property, varying incentive structures for researchers to work with companies, and varying cultures toward commercialization. This gives companies a range of options for interacting with research centers. Second, a diversity of local research institutions often generates competition among these institutions, improving effectiveness in knowledge transfer.

# CLUSTERS 6

Clusters are geographically proximate groups of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. Clusters are normally contained within a geographic area where ease of communication, logistics, and personal interaction is possible. Clusters are normally concentrated in regions and sometimes in a single town.

**Clusters cut across traditional industry classifications.** Clusters take various forms depending on their state of development. Well-developed clusters, however, normally include end product or service companies; suppliers of specialized inputs, components, machinery, and specialized services; financial institutions; and firms in related industries. Clusters also often include firms in downstream or customer industries; producers of complementary products; specialized infrastructure providers; government, universities, and other institutions providing specialized training, education, information, research, and technical support; and standard setting agencies. Finally, many clusters include trade associations and other private sector collective bodies that support cluster members (see Exhibit 38 below).

Exhibit 38: The California Wine Cluster



Source: California Wine Institute, Internet Search, California State Legislature. Based on research by MBA 1997 students R. Alexander, R. Arney, N. Black, E. Frost, and A. Shivananda

**Clusters enhance competitiveness in three ways.**<sup>11</sup> First, they *improve productivity* because firms have ready, efficient access to specialized suppliers, skills, information, training and technical in a demanding competitive environment. Extensive market, technical, and other specialized information accumulate within a regional cluster. Specialized inputs can be assembled, and relationships are forged among cluster participants. Firms can access trained people and technology at much lower cost than developing it internally. The presence of a full range of knowledge, inputs, machinery, and services makes experimentation easier and promotes greater efficiency and flexibility than vertical integration of relationships with distant suppliers.

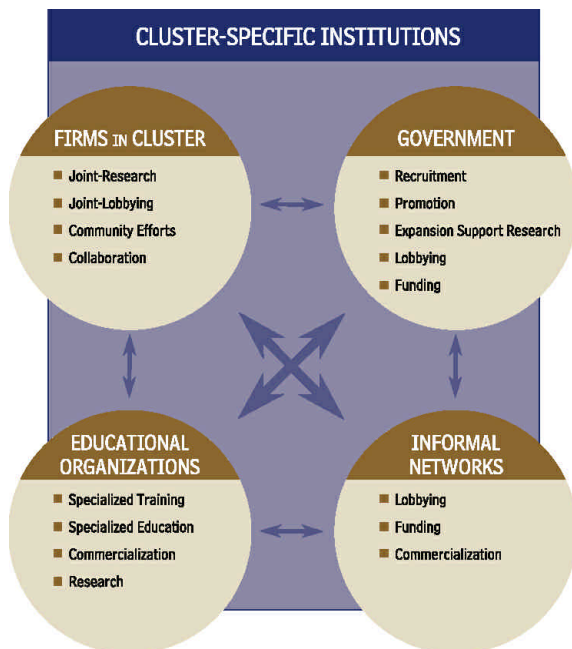
Second, clusters *foster innovation* by increasing the ability to perceive opportunities for new products, new processes, and for meeting new needs. The presence of a full range of local suppliers and research institutions encourages knowledge creation and makes experimentation easier.

Third, clusters *facilitate the commercialization of innovation* by easing the creation of new firms via startups, spin-offs and new business lines of established firms. Establishing a new business in a cluster location is easier than elsewhere because all the needed inputs are locally available there as is cluster awareness and expertise among capital providers such as banks and venture capitalists. The creation of new firms and business units reinforces productivity and encourages innovation.

**Clusters draw on both general and cluster-specific aspects of the business environment.** Clusters benefit from general national and regional attributes such as intellectual property laws, transportation infrastructure, and education system. However, the competitiveness of a cluster, and its uniqueness usually owes much to the specialized circumstances of the location for the particular cluster.

Exhibit 39:  
Tasks of a Cluster Specific Institution for

## CLUSTER-SPECIFIC INSTITUTIONS FOR COLLABORATION



Institutions for collaboration at the cluster level include trade associations, university incubators and institute advisory boards, and alumni networks of schools and companies. Many of these institutions have traditionally been lobbying or social organizations, but most refocus their roles towards enabling cluster activation and development.

Exhibit 39 gives examples of the roles that various institutions can perform.

Source: Clusters of Innovation Initiative Regional Surveys, Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Interviews

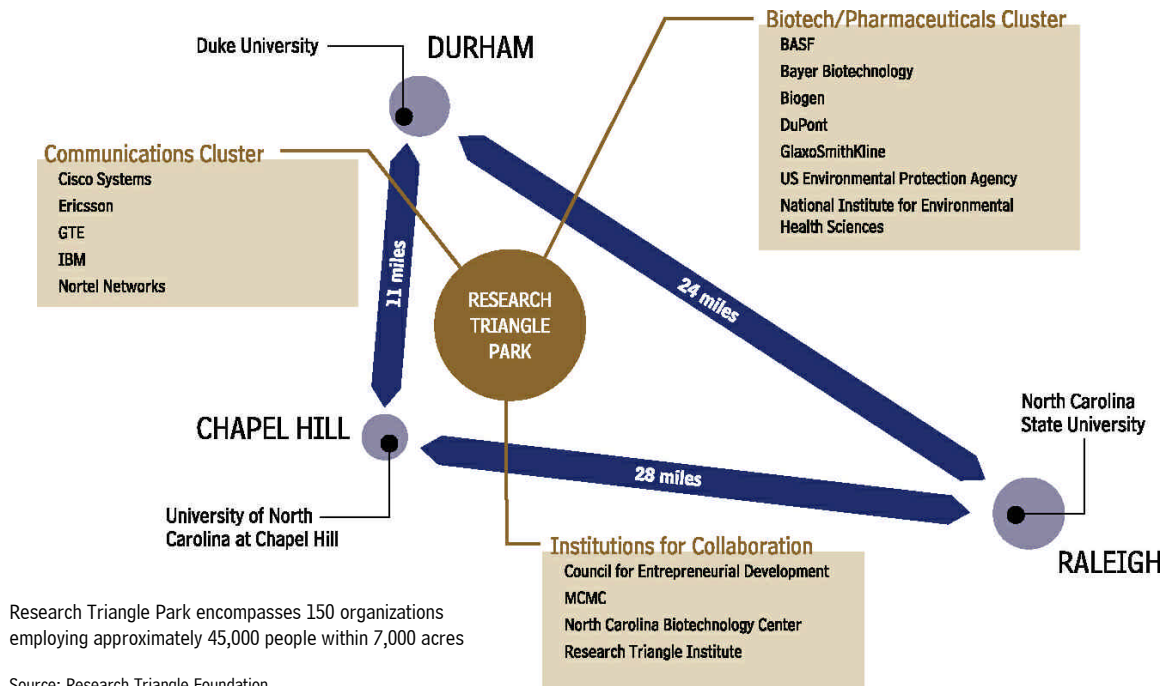
<sup>11</sup> For an expanded treatment, see Chapter 7 in Porter, *On Competition*.

## FINDINGS

### Proximity fosters productivity and innovation

Firms and industries located in a cluster enjoy commonalities and complementarities that enhance productivity, innovative capacity, and new business formation. Capturing these synergies often relies on “personal relationships, face-to-face communication, and close interaction among networks of individuals and institutions.”<sup>12</sup> When firms are located in the same city or region, it becomes possible for them to forge these connections. Innovation is further encouraged when members of a cluster are located in close proximity to each other. Numerous interviewees in regions such as San Diego and Raleigh-Durham mentioned this advantage.

Exhibit 40: Research Triangle Park, North Carolina



**Research Triangle** Leaders from the Research Triangle region’s universities, business, and government cooperated to create what has become one of the most successful planned science parks in the world, the Research Triangle Park. The 7,000-acre “Triangle” is defined by three universities located less than 30 miles apart: North Carolina State University in Raleigh (NCSU), the University of North Carolina at Chapel Hill (UNC-Chapel Hill), and Duke University in Durham. These three educational institutions formed the pillars of the region’s knowledge-based economy by providing world-class research facilities as well as a critical mass of scientists, researchers and technicians. Their research capabilities complement other important research institutions located inside the Park, including the North Carolina Biotechnology Center (NCBC), the Microelectronics Center of North Carolina (MCNC), the US Environmental

<sup>12</sup> Michael E. Porter, *On Competition* (Boston: Harvard Business School Press, 1996), pp. 213-214

Protection Agency (USEPA), the National Institute of Environmental Health Sciences (NIEHS), and the Research Triangle Institute. Over time these geographically proximate educational and research institutions have been able to undertake major joint-efforts, such as the Triangle Universities Center for Advanced Studies Inc., and the shared nuclear laboratory at Duke, research luxuries that no school could justify on its own. Uncharacteristically close cooperation between these three geographically proximate institutions helps the region win more federal research dollars than would otherwise be the case. But the “if we will build it, they will come” story is only half of the reason for the Research Triangle Park’s success. There is an equally important private sector presence that helps explain the region’s ability to compete. The growing presence of research-oriented companies has promoted, often consciously and deliberately, the development of needed supporting and institutions for collaboration (see Exhibit 40 on previous page).

**San Diego** Jonas Salk came from Pittsburgh on a visit to San Diego, and decided the city would be a good location for a research institute. San Diego encouraged him by zoning the Torrey Pines Mesa as a research site. Salk built his Institute on the Mesa, and subsequently numerous research centers located there as well, including the University of California, the Burnham Institute, and the Sidney Kimmel Cancer Center. Interviewees comment on how the close proximity encourages the flow of information and ideas throughout the institutions on the Mesa, a real advantage given the worsening traffic problem in San Diego.

### Clusters share common industries

Some industries are in more than one cluster. Exhibit 41 shows the 43 clusters in the U.S. economy, and the extent to which they have overlapping clusters. These overlaps provide opportunities to use strength in one cluster to build new (overlapping) clusters.

Exhibit 41: Cluster Overlap in the U.S. Economy; Number of Clusters with Common Industries

High Overlap	Modest Overlap	No Overlap
<ul style="list-style-type: none"> <li>■ Education and Knowledge Creation (8)</li> <li>■ Analytical Instruments (7)</li> <li>■ Aerospace Vehicles and Defense (6)</li> <li>■ Communications Equipment (6)</li> <li>■ Information Technology (6)</li> <li>■ Medical Devices (6)</li> <li>■ Lighting and Electrical Equipment (4)</li> <li>■ Pharmaceuticals and Biotechnology (4)</li> <li>■ Production Technology (4)</li> <li>■ Chemical Products (3)</li> <li>■ Automotive (3)</li> <li>■ Metal Manufacturing (3)</li> </ul>	<ul style="list-style-type: none"> <li>■ Plastics (2)</li> <li>■ Oil and Gas (2)</li> <li>■ Heavy Machinery (2)</li> <li>■ Motor Driven Products (2)</li> <li>■ Aerospace Engines (2)</li> <li>■ Hospitality and Tourism (2)</li> <li>■ Transportation and Logistics (2)</li> <li>■ Financial Services (2)</li> <li>■ Publishing and Printing (2)</li> <li>■ Power Generation (1)</li> <li>■ Entertainment (1)</li> <li>■ Processed Food (1)</li> <li>■ Agricultural Products (1)</li> <li>■ Apparel (1)</li> <li>■ Leather and Sporting Goods (1)</li> <li>■ Building Fixtures, Equipment and Services (1)</li> <li>■ Furniture (1)</li> </ul>	<ul style="list-style-type: none"> <li>■ Business Services</li> <li>■ Distribution Services</li> <li>■ Fishing and Fishing Products</li> <li>■ Footwear</li> <li>■ Forest Products</li> <li>■ Heavy Construction Services</li> <li>■ Jewelry and Precious Metals</li> <li>■ Construction Materials</li> <li>■ Power Transmission and Distribution</li> <li>■ Prefabricated Enclosures</li> <li>■ Textiles</li> <li>■ Tobacco</li> </ul>

Note: Two clusters are defined to overlap if they share at least 20% of their industries by number in both directions. Numbers in brackets indicate the number of clusters overlap exists with.  
 Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Cluster strength is often disproportionately concentrated in a few subclusters

Clusters are typically composed of many subclusters, and even relatively weak clusters often have strength in a few subclusters. Cluster development strategies should attempt to fill out the cluster by building off of strong subclusters. Moreover, strong subclusters from different clusters (e.g., farm machinery from the heavy machinery clusters and motor vehicles from the automotive cluster) may share commonalities and complementarities. Regional development strategies should link firms and institutions in these subclusters.

**Wichita** Wichita is widely known as an international center of aircraft production. Locals recognize its strong positions in the oil and gas cluster, due to Koch Industries, and the plastics cluster, due to the Coleman Company. But Wichita also has relatively high rankings in share of national employment in many manufacturing related subclusters. These include construction machinery, farm machinery, mining machinery, and equipment and parts (heavy machinery cluster); appliance, specialized pumps, and motorized vehicles (motor driven products cluster); mobile homes, trucks and trailers, and elevators (prefabricated enclosures cluster); and process equipment and subsystems, production machinery, and transportation equipment (production technology cluster)—see Exhibit 42 below.

Cluster with depth and breadth normally enjoy advantages over narrower clusters

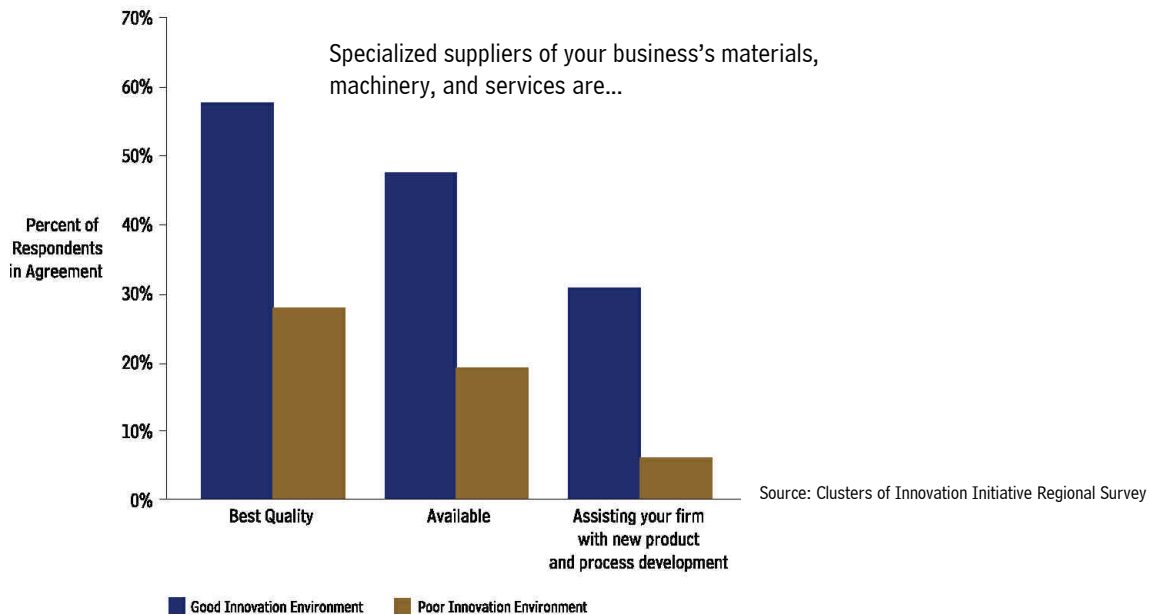
Clusters with strength across a broad range of subclusters tend to have advantages over narrower clusters. Extensive market, technical, and other specialized information accumulate within a regional cluster. Specialized inputs can be assembled, and relationships are forged among cluster participants. Firms can access trained people and technology at much lower cost than developing it internally. The presence of a full range of knowledge, inputs, machinery, and services makes experimentation easier and promotes greater efficiency and flexibility than vertical integration of relationships with distant suppliers (see Exhibit 43 below).

Exhibit 42: Select Subcluster Cluster Rankings by Share of National Employment, Wichita Economic Area, 1998

Clusters	Subclusters	National Ranking
Aerospace-Engines	Aircraft Engines and Engine Parts	16
Aerospace Vehicles and Defense	Aircraft	4
Heavy Machinery	Construction Machinery	22
	Farm Machinery	3
	Mining Machinery	22
	Equipment and Parts	24
Lighting and Electrical	Electric Lamps	8
	Batteries	8
Motor Driven Products	Motorized Equipment	36
	Appliances	27
	Specialized Pumps	12
	Motorized Vehicles	29
Oil and Gas	Oil and Gas Machinery	12
Prefabricated Enclosures	Mobile Homes	28
	Trucks and Trailers	30
	Elevators	14
Production Technology	Production Machinery	16
Textiles	Specialty Components	32

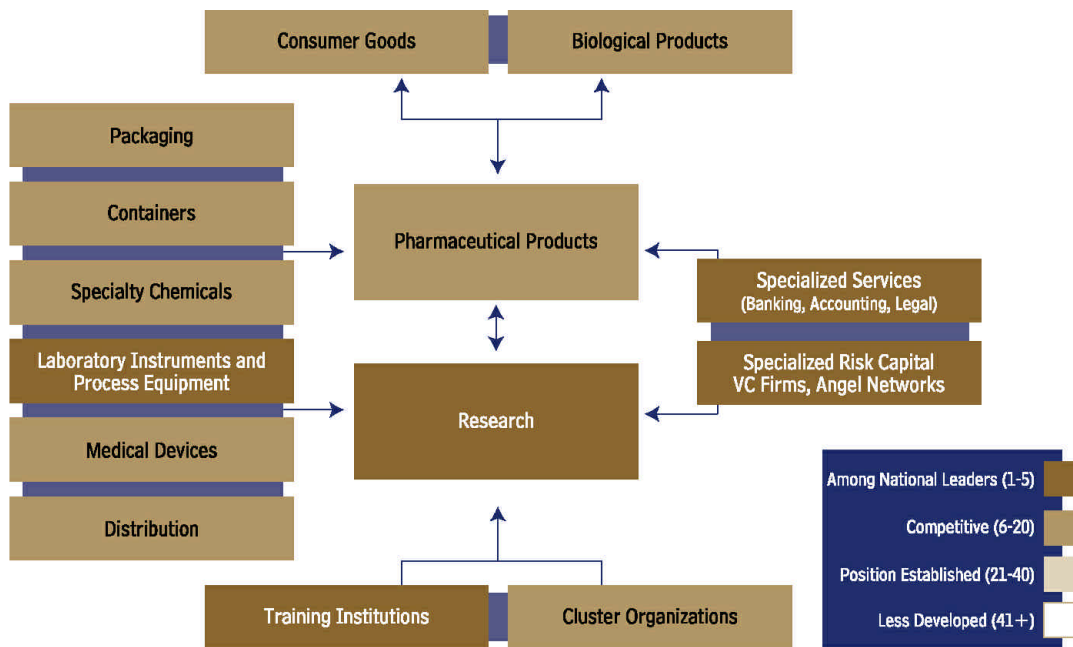
Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Exhibit 43: The Advantages of Cluster Breadth and Depth



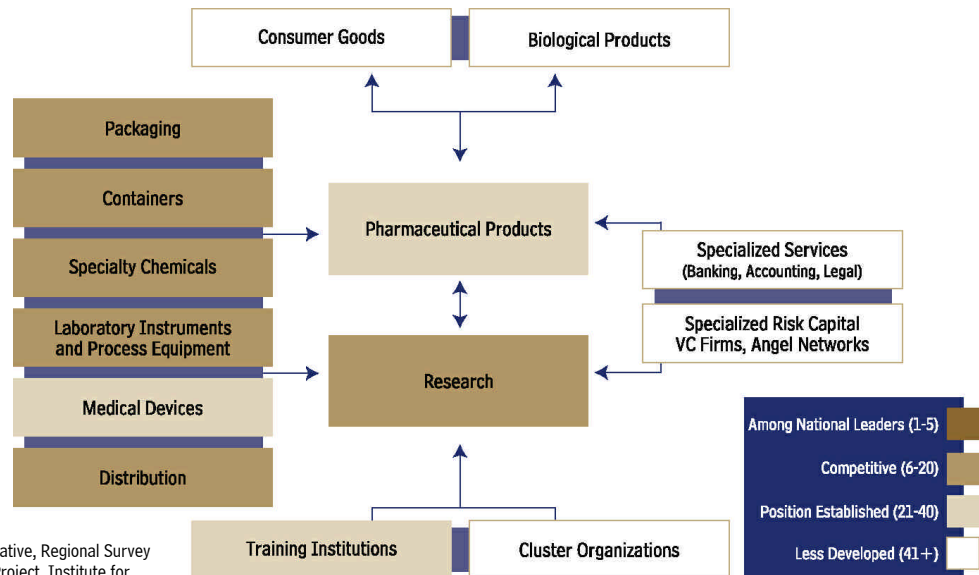
**Boston and Pittsburgh** Massachusetts adopted pro-active policies and tax incentives to attract bio-manufacturing. This helped the Boston area biotechnology / pharmaceuticals cluster develop strength across all subclusters. In contrast, the Pittsburgh biotechnology / pharmaceutical cluster is much younger than Boston's, and inevitably not as strong. Companies in the region have not yet occupied all niches along the value-chain, but are instead somewhat stronger in research, instruments and equipment, and chemicals (see Exhibits 44, 45, and 46).

Exhibit 44: Composition and Competitive Position of the Boston Biotechnology / Pharmaceuticals Cluster, Economic Area, 1999



Source: Clusters of Innovation Initiative, Regional Survey and Interviews ; Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Exhibit 45: Composition and Competitive Position of the Pittsburgh Biotechnology / Pharmaceuticals Cluster, Economic Area, 1999



Source: Clusters of Innovation Initiative, Regional Survey and Interviews ; Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

Exhibit 46: Pharmaceuticals / Biotechnology Cluster Establishments and Patents of the 15 Largest Economic Areas, Narrow Cluster Definition

Economic Area	Total Establishments 1999	CAGR of Establishment 1990-1999	Total Patents 1988	CAGR of Patents 1990-1998	Patents per 1,000 Employees 1998
New York-No. New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	467	0.5	542	7.0	7.1
Los Angeles-Riverside-Orange County, CA-AZ	278	3.1	148	16.0	7.4
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	78	3.0	238	11.0	18.6
Grand Rapids-Muskegon-Holland, MI	16	1.1	19	7.0	2.8
Indianapolis, IN-IL	31	4.0	89	12.0	9.5
Raleigh-Durham-Chapel Hill, NC	24	7.0	61	19.0	7.3
Chicago-Gary-Kenosha, IL-IN-WI	101	1.8	110	7.0	11.6
Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT	80	4.2	311	19.0	43.4
Dallas-Fort Worth, TX-AR-OK	64	1.4	32	9.0	4.3
San Francisco-Oakland-San Jose, CA	88	5.2	403	18.0	50.5
St. Louis, MO-IL	44	3.2	60	14.0	11.1
Washington-Baltimore, DC-MD-VA-WV-PA	45	6.7	189	22.0	37.0
Syracuse, NY-PA	21	1.8	14	8.0	5.6
Cleveland-Akron, OH-PA	26	2.3	25	6.0	6.1
Atlanta, GA-AL-NC	48	3.5	42	15.0	13.7
Pittsburgh, PA-WV (29 <sup>th</sup> )	17(29 <sup>th</sup> )	6.3(52 <sup>nd</sup> )	24(26 <sup>th</sup> )	12.0(70 <sup>th</sup> )	16.1(68 <sup>th</sup> )

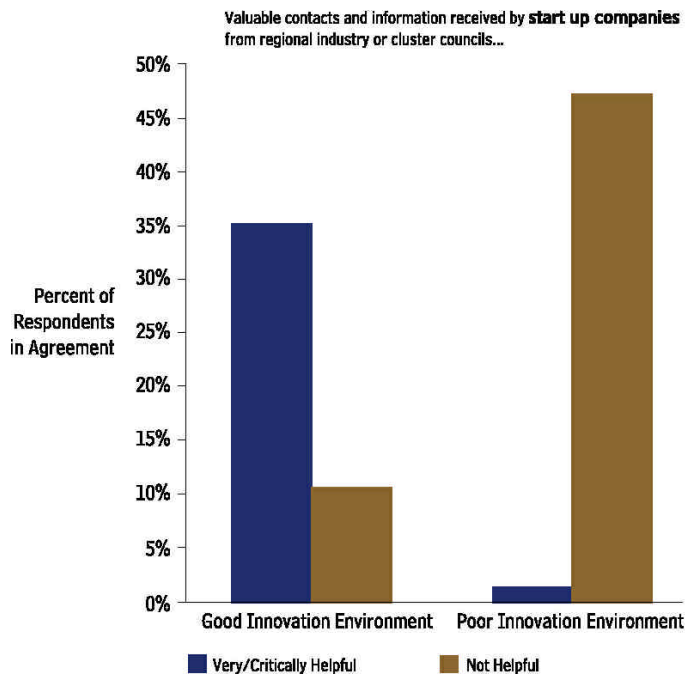
Source: Clusters of Innovation Initiative, Regional Survey; Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School; Interviews

### Cluster-specific institutions for collaboration facilitate the flow of information and resources throughout the cluster

One type of institution for collaboration that is often missing in a region are cluster specific institutions. The task of such an institution is to link all members within a given cluster to all assets of use to that cluster. Diverse groups (e.g., rival firms, related and supporting industries, universities and research centers, training institutions, government, and so forth) contribute to cluster strength, but their contribution is not automatic. An organization dedicated to mobilizing these groups does much to strengthen a cluster (see Exhibits 47 and 48).

**Pittsburgh:** The Commonwealth of Pennsylvania provided funding for the Pittsburgh Digital Greenhouse, an economic development initiative started in June of 1999 to build an industry cluster around the application of System On Chip (SOC) technology in the digital multimedia and digital networking markets. With the support of Pennsylvania's universities, private foundations, regional development organizations, state and local government, and private industry the Greenhouse is focusing on economic expansion and job creation in the 21st century. The Greenhouse is creating jobs by attracting new companies to the region, helping local members grow, and fostering start-ups. Its private sector participants include Benchmark Photinics, Bridge Semiconductor, Cadence, Casio, CDT (Cable Design Technologies), Cisco Systems, Compunetix, inc., IMD (Intelligent Micro Designs), and Laural Networks. Each is a leader in designing, developing, or utilizing SOC technology in digital multimedia or digital networking applications. These companies direct Greenhouse research, provide input to its education and training programs, and collaborate with other Greenhouse members and partners.

Exhibit 47: Cluster-Specific Institutions for Collaboration Facilitate Networking



Source: Clusters of Innovation Initiative Regional Survey

**Massachusetts:** The Massachusetts Biotechnology Council (MBC), formed in 1985 out of a softball league consisting of teams from local biotechnology firms, serves as an important source of cluster collaboration in the region. The MBC provides a forum for biotechnology companies to discuss common concerns and potential solutions, and links the industry to related and supporting industries (e.g. lab equipment companies), pharmaceutical companies, government agencies, and academic training centers.

The four major activities of the MBC are: (1) providing networking opportunities for various constituents of the cluster (e.g. organizing large conferences), (2) negotiating purchasing agreements with scientific suppliers for MBC members, (3) educating the public and encouraging workforce training programs, and (4) lobbying government. The MBC's board consists of representatives from both biotechnology industries such as Genzyme, Biogen, and Millennium, as well as others such as the MIT Office of Technology Transfer and Massachusetts General Hospital. This mix of representation ensures that cluster, not just industry, issues are addressed.

#### Exhibit 48: Representative Quotes from Interviews, Cluster-Specific Institutions for Collaboration

REPRESENTATIVE QUOTES	REPRESENTATIVE QUOTES
<p>Not aware of any group which is effective. The Tech Council does have some value, with service consolidation. We can get better benefits, which is tangible cost savings. But there really is no linking mechanism which provides support.</p> <p style="text-align: right;">- Pittsburgh Information Technology Executive</p> <p>We develop our own technology. The Center for Wireless Technology at UCSD does promote innovation and can spur new commercializable technology, but only the biggest companies can afford to join.</p> <p style="text-align: right;">- San Diego Communications Executive</p> <p>The reward system is based on being published and being recognized by their peers. There has been only one commercialization spin-off at NIAR (National Institute for Aviation Research). A key factor in why it didn't work was that neither NIAR nor the university was invested in the idea. Until the university changes its reward system, nothing will happen.</p> <p style="text-align: right;">- Wichita Community Leader</p>	<p>There isn't much networking or sharing of ideas in the cluster. It would be helpful to have some formal organization to allow suppliers and manufacturers to share information.</p> <p style="text-align: right;">- Wichita Plastics Executive</p> <p>Innovation arises more commonly through webs of creativity than flashes of brilliance. UC CONNECT and other regional organizations helps these webs form and stick together.</p> <p style="text-align: right;">- San Diego University Leader</p> <p>The Advanced Technology Development Center (ATDC) was beyond a traditional incubator. It provided great contacts both with fellow incubator companies and the outside business community. It's a hub for entrepreneurship in Atlanta.</p> <p style="text-align: right;">- Atlanta Information Technology Executive</p>

Source: Clusters of Innovation Initiative Interviews

## IMPLICATIONS

- **Harnessing proximity:** Zoning and industrial parks, and other tools can consciously encourage proximity of firms in clusters. The city of San Diego zoned the Torrey Pines Mesa for research, and donated land to the Salk Institute, and these efforts contributed materially to the development of the medical devices and biotech/pharmaceuticals clusters.
- **Building on subcluster strengths:** In existing and emerging clusters there are often strong sub-clusters. Identifying them, and focusing development strategies on them enable regions to build-off their strength.
- **Cluster overlap:** Some industries are in more than one cluster. These overlaps provide opportunities to use strength in one cluster to build new (overlapping) clusters. In Wichita, for example, there is an opportunity to combine assets across several clusters to build Wichita's position as a center of advanced manufacturing.

# 7 THE DEVELOPMENT OF CLUSTERS

The development of a cluster is inevitably a long process stretching over a decade or more. A good number of existing clusters trace their roots back for a century. These roots can often be traced to strengths of the business environment that are present in a location due to historical circumstances. One prominent motivation for the formation of early companies is the availability of pools of factors, such as specialized skills, university research expertise, an efficient physical location, or particularly good or appropriate infrastructure. Many Massachusetts clusters, for example, had their beginnings in research done at MIT or Harvard.

Clusters may also arise from unusual, sophisticated, or stringent local demand. Prior existence of supplier industries, related industries, or entire related clusters provides another seed for new clusters. The golf equipment cluster near San Diego, California, for example, has its roots in the southern California aerospace cluster. This cluster created a pool of available suppliers for castings and advanced materials, and engineers with experience in these technologies.

New clusters may also arise out of the formation of one or two innovative companies that stimulate the formation and growth of many others. Medtronic played this role in helping to create the Minneapolis medical device cluster. Similarly, MCI and AOL have triggered the growth of the telecommunications cluster in the Washington, D.C., metropolitan area.

Chance events are often important to the birth of a cluster. The early formation of companies in a location often reflects acts of entrepreneurship not completely explainable by preexisting local circumstances. Such companies, in other words, could have sprouted at any one of a number of comparable locations. The role of chance, however, is often less than it seems. What looks like chance may be as much the result of preexisting local circumstances. Moreover, even when chance provides a central explanation for a development, it is almost never the sole explanation. Location not only raises the odds that chance events will occur, but also the odds that chance events will lead to competitive firms and industries. Chance alone rarely explains why a cluster takes root or its subsequent growth and development.

## CLUSTER GROWTH

While the birth of clusters has many causes, the development or lack of development of clusters is more predictable. Though there is no guarantee that a cluster will develop, once the process gets started it is like a chain reaction in which the lines of causality quickly become blurred. The process depends heavily on the efficacy of the diamond's arrows or feedback loops, on how well, for example, local educational, regulatory, and other institutions respond to the cluster's needs or how rapidly capable suppliers respond to

the cluster opportunity. Three particular areas deserve special attention: intensity of local competition, the location's overall environment for new business formation, and the efficacy of formal and informal mechanisms for bringing cluster participants together. Healthy rivalry is an essential driver of rapid improvement and entrepreneurship. The entrepreneurial climate is important because the creation of new firms and institutions is so integral to cluster development. Finally, organizational and relationship building mechanisms are necessary because cluster advantages rely heavily on linkages and connections among individuals and groups.

In a healthy cluster, the initial critical mass of firms triggers a self-reinforcing process in which specialized suppliers emerge; information accumulates; local institutions develop specialized training, research, infrastructure and appropriate regulations; and cluster visibility and prestige grows. Perceiving a market opportunity and facing falling entry barriers, entrepreneurs create new companies. Spin-offs from existing companies develop, and new suppliers emerge. Recognition of the cluster's existence constitutes a milestone. As more institutions and firms recognize the cluster's importance, a growing number of specialized products and services become available and specialized expertise responsive to the cluster arises among local financial services providers, construction firms, and the like. Informal and formal organizations and modes of communication involving cluster participants develop. As the cluster grows, it develops greater influence not only over what other firms do but also over public and private institutions and government policies. Policies that have deferred cluster upgrading are often modified.

Cluster development often becomes particularly vibrant at the intersection of clusters. Here, insights, skills, and technologies from different fields merge, sparking new businesses. The presence of multiple intersecting clusters further lowers barriers to entry, because potential entrants and spin-offs come from several directions. Diversity of learning stimulates innovation.

## CLUSTER DECLINE

Clusters can maintain vibrancy as competitive locations for centuries, and most successful clusters prosper at least for decades. Just as the development of a cluster is not assured, however, neither is its continued ability to compete.

The causes of cluster atrophy and decline can also usually be found in the business environment. They can be grouped into two broad categories: Those deriving from the location itself, and those arising from developments and discontinuities in the external environment. Internal sources of decline stem from internal rigidities that diminish productivity and innovation. The onset of restrictive union rules or regulatory inflexibility can slow down productivity improvement. Overconsolidation, mutual understandings, cartels, or other barriers to competition can undermine local rivalry. Institutions such as schools and universities can suffer from their own rigidities and fail to upgrade and change. Such rigidities in clusters tend to arise in locations in which government is prone to suspend or intervene in competition. When internal rigidities arise, the rate of improvement and innovation in a cluster falters. Increases in the cost of doing business begin to outrun the ability to upgrade.

External threats to cluster success arise in several areas. Technological discontinuities are perhaps the most significant, because they can neutralize many cluster advantages simultaneously. Market information, employee skills, scientific and technical expertise, and supplier bases may be rendered inappropriate. Unless the requisite new technologies and skills are available from other local institutions or can be rapidly

developed, competitive advantage will shift to another location. The shift of golf equipment manufacturing from New England to California provides a good example. The New England cluster was based on steel shafts, steel headed irons, and drivers with heads made of woods. When the notion of making golf clubs with advanced materials was pioneered, east coast producers had difficulty competing. Some east coast firms joined the California cluster; others died or declined.

A shift in buyer needs, creating a divergence between local needs and needs elsewhere, constitutes another external threat to cluster productivity and innovation. Firms in a variety of U.S. clusters, for example, suffered when energy efficiency grew in importance in most parts of the world while the United States maintained low energy prices, retarding innovation. As this example illustrates, however, the threat posed by external developments often relates to local choices and policies.

## CLUSTER UPGRADING

In some clusters, the process of cluster upgrading leads to reductions in employment or revenue. This should not be confused with cluster decline. Economic success in a region usually leads to rising local wages and can also increase the costs of doing business. A natural part of successful economic development is the migration of less skilled and less productive activities to other locations. Over time, some clusters in a region will become more specialized, and shift to more advanced segments. The textile cluster in Massachusetts, for example, has evolved towards segments requiring advanced technology such as specialized fabrics and fibers. Such a process of cluster upgrading should lead to higher wages even if total employment declines. There is no reason for any region to abandon any traditional cluster.

Cluster development can be enhanced by conscious private and public action. Efforts to upgrade the overall regional business environment must occur in parallel. Without a competitive general business environment, regional clusters are disadvantaged.

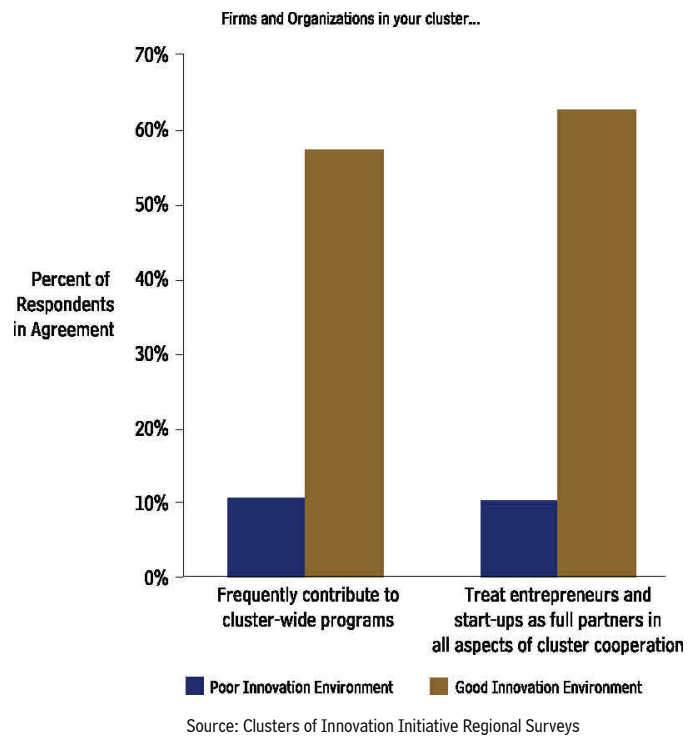
Initiatives to develop an existing or nascent cluster must begin with *cluster awareness*. Companies and local institutions must recognize that a cluster exists, and see themselves as part of it. Second, the need for and benefits of cluster upgrading must be communicated. This often requires a *preliminary study* to identify common problems and opportunities and highlight areas for joint efforts. Third, a cluster action agenda needs to be developed by a working group consisting of cluster companies, suppliers, financial institutions, government, and educational and research institutions. Fourth, a more *permanent institutional structure* needs to be created to carry over the agenda and monitor progress.

## FINDINGS

Clusters can be strengthened by increasing awareness of the cluster among local firms and organizations

Though clusters take decades to develop, this process can be facilitated provided firms and organizations in the cluster are aware of, and contribute to, the cluster. Not only must firms be aware of the presence of a local cluster, they must also get together and coordinate activities to improve the cluster's business environment. Acceptance of new companies is important if the cluster is to grow quickly and reach a critical mass (see Exhibit 49 on following page).

Exhibit 49: Cluster Awareness, Select Survey Results



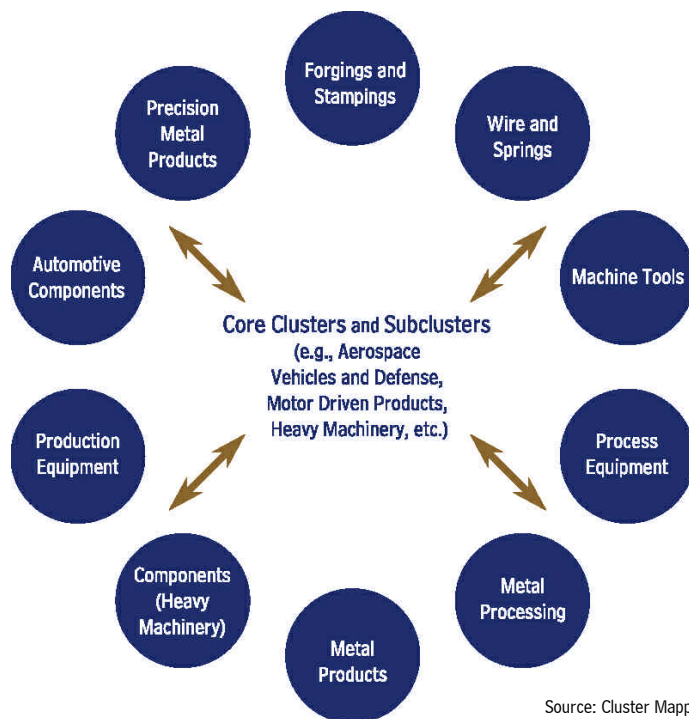
### New firm and cluster opportunities arise at the intersection of existing clusters

In thinking about how to diversify a regional economy, it is important to recognize that new clusters often grow out of the intersection of existing clusters. In San Diego, for example, one of the fastest growing clusters in the 1990s was sporting and leather goods, in large part due to the success of local golf club manufacturers (e.g., Callaway). This cluster grew out of the preexisting hospitality and tourism cluster and the aerospace vehicles and defense cluster. These golf club manufacturers pioneered the use of lightweight materials originally used in defense applications.

**Wichita** In Wichita, there are numerous heavy manufacturing subclusters with relatively high rankings in share of national employment: aerospace vehicles and defense (aircraft and parts industries), heavy machinery (construction machinery and farm machinery industries), motor driven products (refrigeration and heating in Wichita industries), power generation, and chemical products clusters. Moreover, metal manufacturing (broadly distributed over the clusters) and production tech (broadly distributed across the cluster) are also growing fairly well. There is an opportunity to leverage assets across clusters to build Wichita into a center of advanced manufacturing (see Exhibit 50 on following page).

These clusters all deal in complex equipment and complex assembly, and as a consequence, they have similar needs. These include skills of workers, process technology, information needed, materials expertise, and service providers. Companies engaged in heavy manufacturing need to recognize that they are not only part of a cluster, but also part of a larger heavy manufacturing base. In concert with government, universities, and institutions for collaboration, these companies need to identify common needs and work together to strengthen them.

Exhibit 50: Opportunities at the Intersection of Wichita's Manufacturing Clusters and Subclusters



Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

**Research Triangle** In Research Triangle as well, there appears to be a number of under-exploited, crosscutting cluster opportunities. Examples include biotechnology and information technology, telecommunications and medicine, or biotechnology and agribusiness. Substantial efforts at developing more collaborative relationships between clusters should also be explored. In the pharmaceutical / biotechnology cluster, more emphasis should be placed in a couple of areas in particular: bioinformatics, medical software, universities, analytical instruments, chemicals, and plastics.

#### Anchor companies play a disproportionate role in seeding cluster development

Anchor companies are firms (e.g., QUALCOMM in San Diego, Boeing in Wichita, and IBM in Raleigh-Durham) that play a large role in building clusters by performing several functions. First, they act as magnets for other major companies—both rival and allied companies—that will move to a region simply to be near the anchor company. Second, anchor companies tend to organize other companies in a cluster for collective action, such as lobbying government for infrastructure improvements, or collaborating with universities to build specialized research and training facilities. Third, anchor companies, and in particular major companies with headquarters in a region, tend to be more involved in supporting community projects that improve the local quality of life (see Exhibit 51 on following page).

Finally, a particularly important function of anchor companies is that they produce numerous spin-out companies, which strengthen key elements of the cluster. The anchor firm is generally the buyer of the

goods and services of its spin-outs, and local demand in the cluster is improved. By producing numerous spin-outs, the anchor increases the presence of local related and supporting industries. In some cases, spin-outs directly compete with the parent anchor company, and this results in a more vibrant context for firm strategy and rivalry. Finally, due to the personal “alumni” relationships among individuals in the anchor and the spin-outs, a strong web of informal networks tends to form, and cluster collaboration improves.

### Exhibit 51: Representative Quotes from Interviews, Anchor Firms

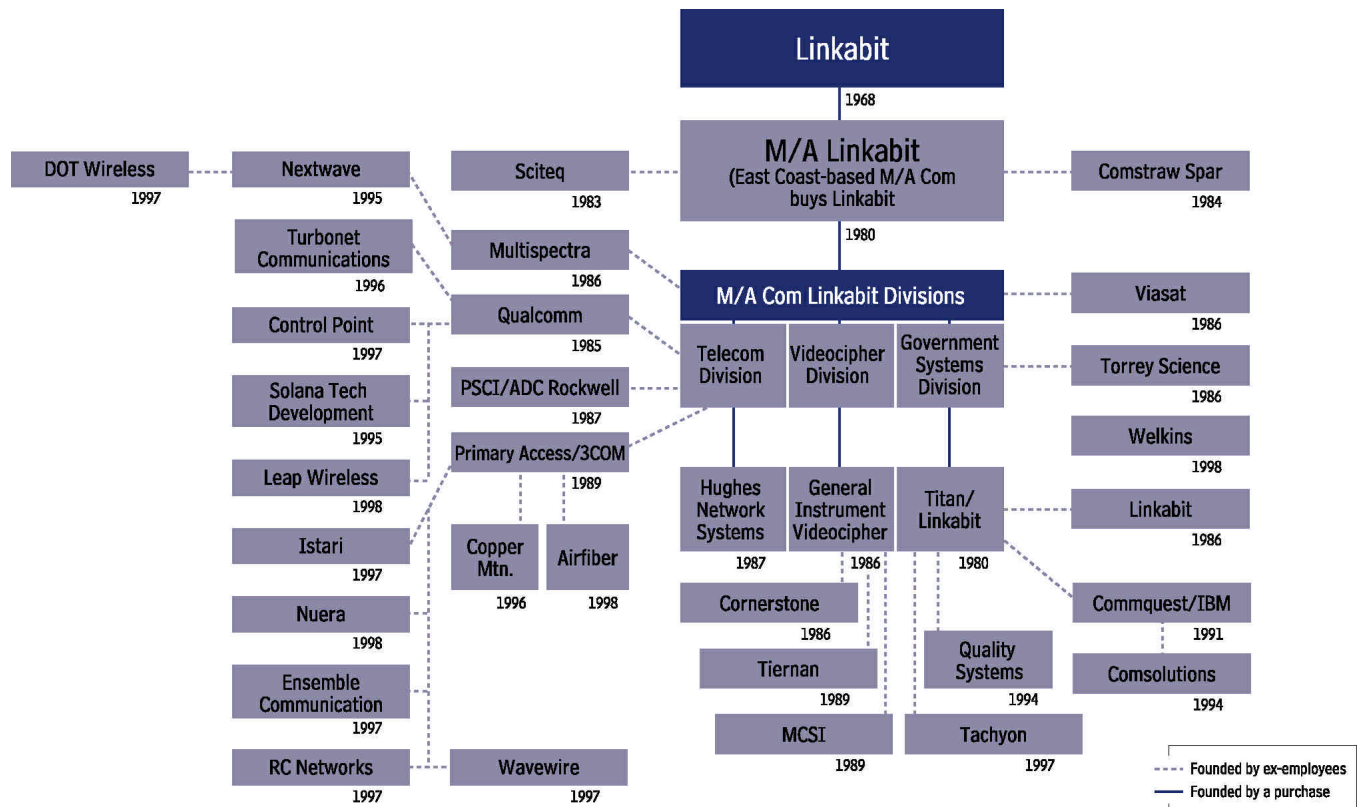
REPRESENTATIVE QUOTES	REPRESENTATIVE QUOTES
<p>FORE Systems and Free Markets have acted as anchor firms, spinning out such firms as Co-Manager, Laurel, AxelLife, and Yourfit. But it was the university professors that spun-out those firms and others, such as LYCOS and IGATE Technologies. The universities have been critical to the development of the IT sector and continue to create new firms.</p> <p style="text-align: right;">- Pittsburgh Professor</p> <p>Linkabit is this region's Fairchild. (Fairchild was the "mother firm" of semiconductor industry in Silicon Valley.) Many future start-up CEOs got their start at Linkabit and were trained under Irwin Jacob's tutelage.</p> <p style="text-align: right;">- San Diego Communications Executive</p> <p>The successes of Hybritech and Linkabit inspired an entire generation of defense engineers to hope that they could succeed. They also showed capital providers that regional entrepreneurs could be successful.</p> <p style="text-align: right;">- San Diego Venture Capitalist</p>	<p>The partner in our firm thought the region was promising and established an office in the Research Triangle in the early 1980s. He left by the late 1980s and things drifted because there weren't enough Fortune 1000 companies in the region to make it work.</p> <p style="text-align: right;">- Research Triangle Business Services Executive</p> <p>We came to Wichita because Bombardier but we also recognized the value of being near the other important OEMs such as Boeing, Cessna and Raytheon. Wichita is the air capital of the world – if you're a supplier, you need to be here.</p> <p style="text-align: right;">- Wichita Executive Aerospace Supplier</p>

Source: Clusters of Innovation Initiative Regional Interviews

**San Diego** Anchored by QUALCOMM, San Diego has become a world leading center in wireless telephony. In 1989, QUALCOMM, a Linkabit spin-off led by Irvin Jacobs and Viterbi, developed an important new technology for cellular communications—code division multiple access (CDMA). The new technology led to a highly successful IPO. Qualcomm put San Diego on the international communications map, motivating other regional entrepreneurs and attracting capital from outside the region. In recent years, major international companies such as Ericsson and Motorola have set up research and development operations in the region, and scores of start-up firms have emerged to exploit new developments in wireless technology (see Exhibit 52 on following page).

San Diego is now the national center for wireless communications. Nokia has made San Diego its center for CDMA research and plans to double its size to 1200 in the county by 2002. Ericsson and Motorola both recently entered San Diego, and both have plans to hire more engineers and focus research on wireless technology. The region is now well established as having a major national communications cluster with a particularly strong presence in wireless and internet communications technology.

Exhibit 52: Spin-outs in the San Diego Communications Cluster



Source: CONNECT, University of California—San Diego (originally created by Martha Dennis, Linkabit).

**Wichita** Wichita’s key clusters are composed of a few large and powerful anchor firms. In the aerospace vehicles and defense cluster, for example, world-class companies such as Boeing, Cessna, Bombardier, and Raytheon Aircraft have been the cluster’s engines and employ the vast majority of aerospace-related workers in the region. Today, Boeing Wichita specializes in subassemblies, producing 75% of the 737 and major components for the 747, 757, 767, and 777 jet aircraft and a number of significant military aircraft. Boeing Wichita’s impact on the Wichita economy is dramatic. Boeing Wichita accounted for 20% of earnings generated in the Wichita MSA and 21% of employment in the Wichita MSA in 1998. Boeing Wichita employs approximately 16,800 workers.

The presence of Boeing and other major aerospace manufacturers in the region has led to an increase of parts suppliers and sophisticated regional demand for the cluster. Wichita’s suppliers have expertise in machining, tooling, and metal work. Out of the 120 firms listed under the aircraft parts and equipment industry category in the Wichita Area Chamber of Commerce’s Directory of Major Employers, 1999/2000, 71% were machining/metal work/tool shops. Similarly, anchor companies spin off other companies that tend to feed the parent. For example, former workers from the aerospace vehicles and defense manufacturers have started machine shops that now supply these firms. The skills sets dominant within the anchor firms largely determine the character of the spin-off and greatly influence the make-up of the cluster.

**Research Triangle** Anchored by IBM, Nortel Networks, and Cisco Systems, the Research Triangle has become a world-leading center in telecommunications. In recent years, major international companies such as Cisco have set up research and development operations in the region, and scores of start-up firms have emerged to exploit new developments in wireless technology. Electronics and communication expertise grew up in the region as major multinationals like IBM began to establish manufacturing operations in the Research Triangle focusing on information technology. IBM has 37 different IBM organizations working at Research Triangle Park (RTP). Full-time employment here ranged from 10,000 to 11,000 during IBM's dark days of 1991 to 1994, but spiked to 13,000 in 1995 as operations shifted from Boca Raton, Fla. Production employees now account for only 7% of IBM's full-time staff. But 45% of those workers are software or hardware engineers. Sixty-two percent of IBM's local employees were not working for the company here three years ago. IBM's RTP facility is now one of its biggest in the world.

### Institutions for collaboration can significantly increase the success rate of start-up companies

There are different types of institutions for collaboration that provide start-up support. Some are formal and informal organizations and groups that facilitate the exchange of information and technology and foster various kinds of coordination and collaboration that can improve the business environment in a cluster or in the overall economy.

The institutions for collaboration that provide start-up support for a specific cluster can prove to be highly effective mechanisms that create and amplify the arrows and feedback loops in the diamond. The quality of these institutions has a significant influence on competitiveness. Examples of these types of organizations include Digital Greenhouse in Pittsburgh and UCSD CONNECT in San Diego.

A second type of start-up-centric institution for collaboration involves one that is geared to all types of clusters. These types of institutions for collaboration do not distinguish among different types of clusters, but rather attempt to provide generalized start-up support applicable to many divergent types of industries. Examples of this type of start-up support include the Council for Entrepreneurial Development (CED) in the Research Triangle.

**San Diego** In response to private sector efforts to better integrate with the University of California at San Diego, University President Richard Atkinson asked Mary Walshok, Dean of Extended Studies and Public Programs, to develop a program that would facilitate university-business interaction. After coordinating with both university researchers and private sector managers, UCSD CONNECT was established in 1985. Initial programs included Meet the Entrepreneur and Meet the Researcher Events, which helped entrepreneurs and scientific researchers gain a better understanding of the issues that each faced. This type of university-industry institution for collaboration helped connect the two groups and generated substantial interest by hosting several events that attracted hundreds of participants from start-ups, established companies, and academia.

**Research Triangle** The Council for Entrepreneurial Development (CED) was founded in 1984 to stimulate the creation and growth of high impact companies in the greater Research Triangle area. CED achieves its mission by providing programs and services in four major areas: education, capital formation, mentoring, and communications. CED is a private, non-profit organization with more than 4000 active members representing 1180 companies and is the largest entrepreneurial support organization in the US. CED is an example of an organization that is instrumental in helping local entrepreneurs, investors, service professionals, academics, researchers and public policy makers combine their efforts.

## IMPLICATIONS

- **An explicit cluster development program:** Although chance events play a role in the formation and development of clusters, conscious efforts to raise cluster competitiveness and innovative capacity can meaningfully influence the trajectory of cluster development. Useful activities include forming and supporting cluster-specific institutions for collaboration, creating effective links with cluster relevant centers of excellence in regional universities, recruiting companies to fill out missing niches in the cluster, and the like.
- **Recruiting for clusters:** Recruitment strategies at the regional level should target clusters in which the region has strength, or clusters which overlap with other clusters. This allows the region to market its unique assets rather than compete on subsidies. In recruiting efforts, regions should also identify gaps within clusters, and seek to attract companies to fill them.
- **Opportunities at the intersection of clusters:** Opportunities for growth often arise at the intersection of clusters where a region has strengths. In San Diego, for example, one of the fastest growing clusters in the 1990s was sporting and leather goods, in large part due to the success of local golf club manufacturers (e.g., Callaway). This cluster grew out of the preexisting hospitality and tourism cluster and the aerospace vehicles and defense cluster. These golf club manufacturers pioneered the use of lightweight materials originally used in defense applications.



The development of regional economies can and is affected by purposeful action. Economic development is a process which can proceed in different directions and can achieve different degrees of success depending on decisions by many different actors. Government at all levels, the private sector, and many other institutions have a role in economic development. If their efforts can be encouraged and aligned, regional development is more rapid.

**Regions must develop a shared understanding of the sources of competitiveness and the role of clusters.** Productivity and innovation—not low wages, low taxes, or a devalued currency—are the definition of competitiveness. Participants need to understand the influences on productivity and the role and importance of clusters in productivity enhancement. Early and ongoing communication and discussion educate participants about competitiveness and help to shift mindsets.

**An overall strategy for regional development is needed.** The regional economic strategy will include both efforts that improve that general business environment in the region, and an agenda around specific clusters. The strategy also needs to embrace all clusters in a region. Setting priorities is not only bad economics; it disenfranchises large parts of the private sector. Successful regional economic strategies include traditional clusters, such as agriculture and tourism, and even declining clusters. They include emerging clusters as well as established ones. To avoid misguided attempts at creating clusters that have no assets on which to build, emerging clusters should have a demonstrable local foundation and a base of firms that have met a market test.

**The private sector must take a leading role in regional economic development, not leave it to government.** Private-sector leadership is often critical for success. Active government participation in a privately led effort, rather than an initiative controlled by government, will have a better chance of success. Companies can usually better identify the obstacles and constraints in their path (as well as the opportunities) than can government. Letting the private sector lead also reduces the initiative's political content, while taking advantage of the private sector's often superior implementation ability.

**Regions need an institutional structure for economic development that encompasses all the constituencies.** The institutional structure needs to address both cross-cutting and cluster specific issues. Keeping them separate elements within an integrated structure improves the specificity of the proposals developed. Regional economic strategy efforts should be as nonpartisan as possible and remain independent of any party or administration's political agenda. Legislators and the executive branch, the opposition parties, and those in power must all be involved. Ideally, the cluster initiative will take place through an entity independent of government; otherwise, promising efforts may be dropped when a new government takes office.

With these elements in place, regions can set out to create a regional strategy, build consensus around out, and finally implement its action agenda to achieve better economic performance.

## FINDINGS

### Regions often encounter a common set of pitfalls

Because regions are so unique in their composition, and varied in their performance, no single nation-wide policy will be entirely appropriate for every region. The decisions that really affect economic and innovation performance are made in regions, not Washington D.C. Many regions have formulated and executed very good development strategies, and we have been fortunate enough to study and learn from some of them. But, in more than ten years of work in this field, we have also seen numerous poor strategies. What is more, all participants in a regional economic development strategy contribute to this list of common pitfalls.

Firms are often not proactive enough in communicating their needs to other organizations that could be of help. They also often weaken their business environment by pursuing strategies that drive clusters members out of business and discourage rivals from locating nearby.

In addition to traditional issues of excessive red-tape and taxation, governments hurt economic development by implementing regulations that discourage investments in local companies, and by neglecting to invest in research and training institutions.

Economic development organizations frequently focus on an overly narrow geographic area, place too much emphasis on building “high-tech” clusters, ignore traditional strengths of the “old-economy,” and target big companies for recruitment. Finally, common pitfalls for research and training centers are an under emphasis on the commercialization of knowledge, and too little cross-disciplinary collaboration (see Exhibit 53 below).

#### Exhibit 53: Common Pitfalls

Companies	<ul style="list-style-type: none"> <li>■ Failure to communicate needs to government, universities, training centers, and economic development organizations</li> <li>■ Cluster-killing competitive strategies of firms</li> <li>■ Discouraging the entrance of local rivals</li> </ul>
Government	<ul style="list-style-type: none"> <li>■ Neglecting investment in the engines of innovation: universities &amp; research centers</li> <li>■ Neglecting infrastructure investment</li> <li>■ Government regulations discouraging investment and innovation</li> </ul>
Economic Development Organizations	<ul style="list-style-type: none"> <li>■ Focusing on narrow geographic areas</li> <li>■ Biases toward "high tech" clusters (e.g., IT and biotech)</li> <li>■ Ignoring traditional strengths</li> </ul>
Research & Training Centers	<ul style="list-style-type: none"> <li>■ Recruiting big companies, not building competitive clusters</li> <li>■ Inattention to commercialization issues</li> <li>■ Insufficient cross-disciplinary collaboration</li> </ul>

Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School

## Regions need to overcome transition points in the development of their economies

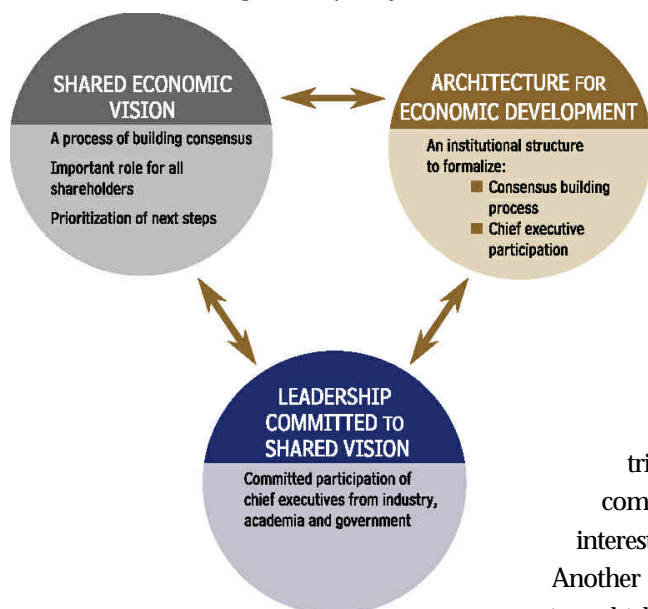
Regional leaders tend to encounter several sets of challenges as they develop their economies: understanding the new paradigm, creating needed assets, creating the capacity for action, overcoming bottlenecks and seizing opportunities, and revising the shared vision. These challenges become the targets of regional economic development strategies. The first challenge is informing leaders in business, government, university, and economic development organizations of the new understandings of economic development. Competitiveness is not preordained by a region's static assets. Rather, regions can choose to compete by leveraging differentiating assets, investing in specialized training and research, and fostering a business environment that supports innovation. This understanding of competitiveness will enable leaders to identify new assets that will be needed to develop the regional economy and build strong clusters. The third step is then creating leadership and institutional capabilities to fully leverage existing assets and create new assets as needed.

Once regional leaders understand the new model of regional development, have developed appropriate assets, and create the capacity to use their assets, the economy will grow. At this point, the main barrier to prosperity will be the bottlenecks that develop as a consequence for growth. Finally, the original vision will run its course, and leaders will need to develop a new vision in order to mobilize companies, government agencies, universities and research centers, and institutions for collaboration behind a common strategic agenda.

The regions we studied faced a range of different transitions. Leaders in Wichita were absorbing new understandings and communicating it to others in the region. In the process, they were identifying various assets that would have to be created (e.g., specialized training programs), strengthened (e.g., local research centers), and leveraged (e.g., diversity of heavy manufacturing clusters).

Pittsburgh had many important assets already in place, and the leaders and community understood regional economic development. The challenge was clearly to create the capacity for firms, universities, institutions for collaboration, and government to utilize these assets to the fullest extent possible. The San Diego economy was performing well, and using its assets, but rapid growth created bottlenecks (e.g., overuse of physical infrastructure, rising cost of living), and valuable opportunities were not being seized. New strategies were needed to reach full potential. The Research Triangle's original strategy of focusing on assets in and around the Park has been very successful, but is also reaching its limits. In addition to dealing with bottlenecks around commercialization, leaders need to rally a wider community around a new vision, and create institutions for maintaining collaboration. The growth of Atlanta has been remarkable over the last decade, but this is creating challenges that their leader-centric model of the past cannot meet. Many groups will have to work together to build regularized institutions capable of solving ongoing problems of traffic, education, and public-private collaboration. A revised vision emphasizing prosperity, not growth, will be helpful in accomplishing this task.

Exhibit 54: Creating the Capacity to Act



Broad-based collaboration is needed for development strategies to succeed

Successful regional economies benefit from the contributions of many organizations: companies generate innovations, jobs and wages; universities produce research and trained graduates; governments provide basic education, support workforce training, and build and maintain the physical infrastructure; institutions for collaboration provide information, lobby on behalf of business, help achieve consensus firms, and create networking opportunities. These contributions, however, are not automatic. One reason is that companies and organizations pursuing their own parochial interests may act contrary to the needs of a regional economy. Another is that no one individual or organization necessarily exists which has a mandate to lead a regional economic development agenda. Finally, the multitude of organizations that need to contribute to regional development may not collaborate well. Organizing for action entails overcoming these three obstacles and creating the capacity for regions to implement development strategies (see Exhibit 54).

**San Diego** Collaboration among diverse groups has been critical to San Diego’s economic development. In 1908, business and government leaders lobbied President Theodore Roosevelt to build a naval headquarters in San Diego, the city dredged the bay for military ships, and Roosevelt complied. Later U.S. Representatives from the region lobbied for military installations and succeeded in bringing a Navy Training Center, Camp Pendleton (U.S. Marine Corps), and ultimately the Naval Air Station on North Island, which was attracted to the area by the near ideal conditions for year-round flying. Once again, the city “accommodated” by making the land for the airfield available. Richard Atkinson, the current president of the University of California, stated that “one of the most important events” in the economic history of San Diego was the “campaign of Science Applications International Corporation (SAIC) and General Atomics to attract a University of California campus” to the area. Defense and research companies also sponsored the extension of the university, once established. For example, General Atomics “sold” the university on the International Thermonuclear Experimental Reactor (ITER) and “the university, in turn, sold the mayor and the governor.” In another example, General Atomics catalyzed the creation of the Super Computer Center at UCSD. On the other hand, when groups failed to cooperate they lost national competitions to host computer and superconductor research centers.

**Wichita** Wichita's mature aerospace vehicles and defense cluster is the result of 80 years of purposeful planning, investing, and coordination from the large manufacturers and the local, state, and federal government. Flat land, good winds, and excellent year-round flying weather were initially important for the cluster, but did little to distinguish Wichita from many Midwestern cities. The presence of oil was also helpful because local oil magnates provided the local capital used to finance the initial aircraft entrepreneurs. City leaders took advantage of these circumstances by building an airfield well before anyone realized how important commercial air travel would become and, later, by attracting Cessna and Lear. More recently, local leaders have orchestrated a well-coordinated push for an expensive K-12 bond vote. Recognizing that the labor pool was one of the region's most important but undeveloped assets, the private sector worked closely with the city of Wichita and the Chamber of Commerce to convince citizens that new investment was needed for the schools. Likewise, the region's economic development leaders are stepping up to create a new workforce development program in concert with the aircraft manufacturers although this might not yield results for years to come.

### A shared economic vision helps elicit broad support and coordinate activities

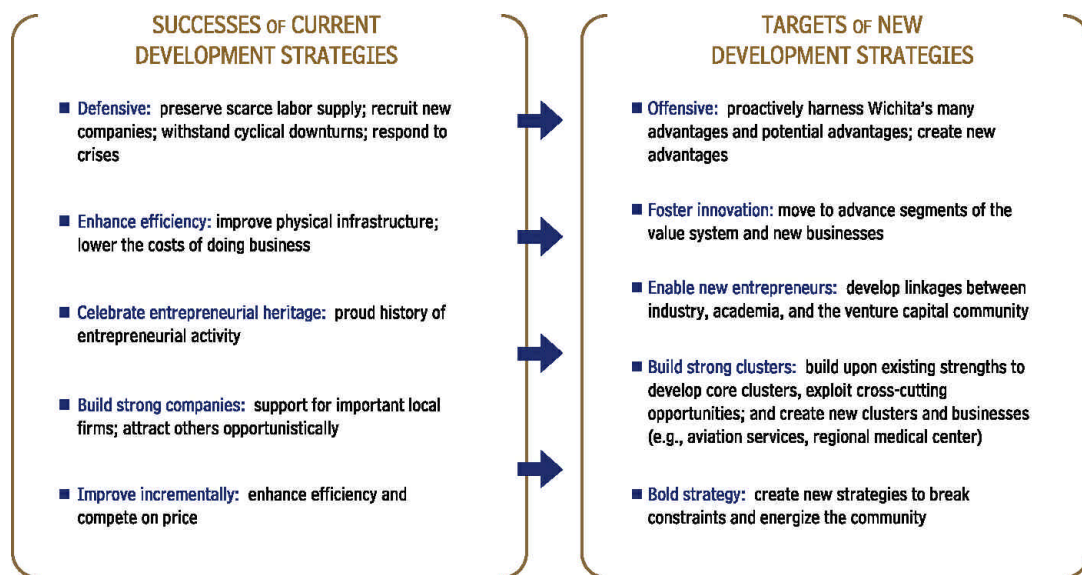
Numerous companies, government agencies, knowledge centers, and collaborative institutions must coordinate with each other in order to fully contribute to economic development. They must communicate their respective needs to each other, prioritize collectively, commit resources to solving these needs, and work together to streamline the delivery of resources. Yet, these organizations do not recognize one master; there is no CEO of regional economic development.

In order to achieve good coordination among many diverse groups, a shared vision of common objectives and methods is vital. This does not mean all participants agree on a detailed master plan. It does mean that influential individuals and groups broadly agree on a basic issue such as:

- The main challenges and opportunities facing a region;
- That a broad array of groups (e.g., companies, clusters, knowledge centers, government agencies, and institutions for collaborative) be included in solving these issues;
- That new and valuable ideas come from interaction with different sectors of an economy;
- That an organization's (e.g., companies, universities, etc.) long-term interests are tied to the health of the local economy; and
- That collaboration among diverse groups will be needed to compete in today's economy.

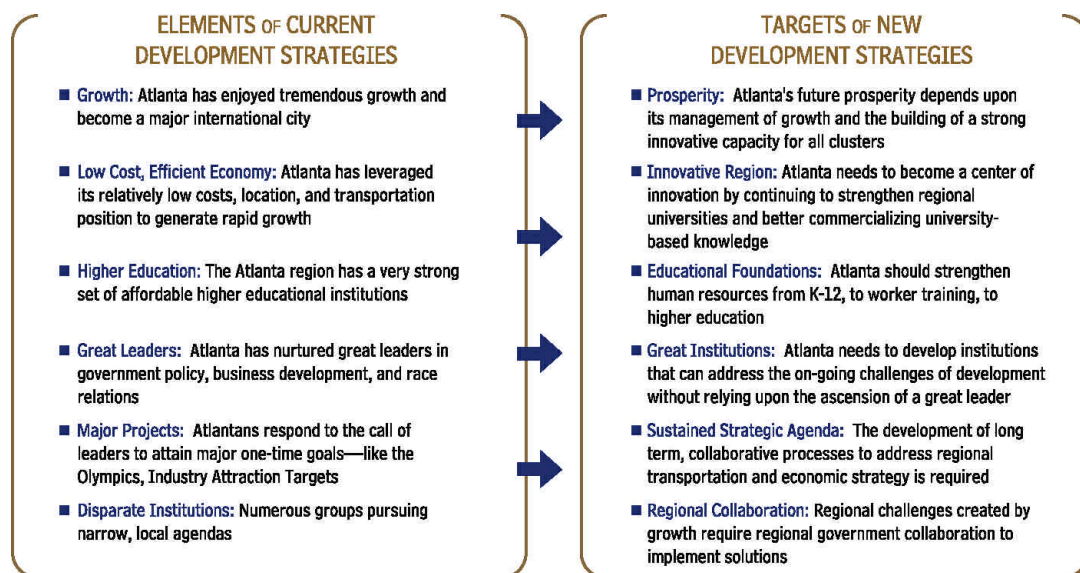
**Wichita** Our suggested New Directions for Wichita offer the outlines of a potential shared vision. The main challenges for Wichita include energizing the region behind a more offensive outlook that recognizes its differential advantages, and shifting focus to increasing innovation output. To do this, a broader array of groups in the community must participate in economic development. In particular, university-based research centers need to be strengthened, and firms in a variety of clusters must increase their level of interaction. Finally, to gain collaboration among these diverse, sometimes contentious groups, everyone must take a long-term perspective, and recognize that working with rivals and contributing to regional and cluster initiatives will build a better business environment, and in turn benefit the individual contributors (see Exhibit 55 on following page).

Exhibit 55: Wichita's New Directions



**Atlanta** The combination of a laissez faire business environment, economic and policy entrepreneurship, personalized leadership, and state-supported economic development are critical facets of the success Atlanta has enjoyed. These traits have seeded incredible economic growth. However, these same conditions also make solving the challenges of regional growth very difficult. The Atlanta region is not well configured to solve its present problems. Neither the Atlanta regional culture nor its institutions support the complex, interrelated efforts necessary to combat its educational, environmental, and transit issues. The region does not have effective regional government structures to deal with cross-jurisdiction problems. Nor does it seem to generate leaders who have the mindset to address the particulars of the solutions. To solve these issues will require a thousand little things, not one or two big things. Atlanta is a Project Town seriously in need of Process (see Exhibit 56 below).

Exhibit 56: Atlanta's New Directions



## Strong leadership is a necessary part of any successful economic development strategy

Strong leadership committed to regional economic development is needed to ensure that companies, knowledge centers, governments, and collaborative institutions contribute to their full potential (see Exhibit 57 below). The reason is that the primary mission of each of these organizations is not to promote the economic health of the region. Companies are primarily concerned about their own survival and success. Universities focus on basic research and educating their students. Governments are interested in a range of issues (e.g., crime, education, health care, and the economy), and political jurisdictions rarely coincide with the boundaries of a regional economy. Institutions for collaboration often have a narrow mandate such as promoting the region, licensing technology developed in a university, or working on behalf of a single cluster.

### Exhibit 57: Leadership from Government and Institutions for Collaboration

GOVERNMENT IN RESEARCH TRIANGLE	INSTITUTIONS FOR COLLABORATION IN SAN DIEGO
<p>The state wooed IBM with cheap labor, land and proximity to universities. Governor Sanford's involvement was crucial." - University Leader</p> <p>Governor Hunt made it easy for us (a major communications firm) to move here. - Communications Executive</p> <p>Technical institutes and community colleges were key in turning around the workforce. Governor Hodges started the community college system, and Governor Sanford really made it what it is. - Research Triangle Park Leader</p> <p>Political leaders nurtured business. Governors Hodges, Sanford, Hunt being the most notable. - Community Leader</p>	<p>CONNECT is the most primary institution that brought together the disparate pieces - people, ideas, and money. It was a critical "social innovation" led by a charismatic leader, Bill Otterson, that empowered people to take risks and succeed." - Venture Capitalist</p> <p>UC CONNECT, particularly, Bill Otterson, had a "great ability to bring together people." - Biotech Executive</p> <p>Bill Otterson's networking built the San Diego high technology community as we know it today. - Communications Executive</p>

To be sure, all of these organizations inevitably contribute to a regional economy in the course of their normal operations. But that contribution may not be all it could be. Local companies often weaken their own cluster by driving out competition, and trying to monopolize information and resource flows among input providers, suppliers, and customers. Universities may disdain commercialization of basic research, or make the process too cumbersome to be worthwhile. Governments can overtax and poorly regulate industry. Institutions for collaboration may fail to perform key functions like building cross-cluster networks and facilitating the flow of ideas and innovations from knowledge centers to industry.

In the successful regions we studied, strong leaders from the private sector, universities, government, and institutions for collaboration made sure their organizations contributed to the regional economy (see Exhibit 58 on the following page). They embraced the notion that "what is good for the community is good for my organization." These leaders made development a priority: they identified weaknesses, leverageable assets, and models of success from other regions; they appointed individuals and created and supported organizations to carry out desired initiatives; they benchmarked progress; they clearly communicated to other members in their organization that regional economic development was important and that contributions to it would be rewarded.

## Exhibit 58: Leadership from the Private Sector and Research Centers in Atlanta

### PRIVATE SECTOR

Regions can thrive only after they find a personality or driving force. Usually this is a business leader who has had success and then can motivate others. Regional groups should make this person the 'cause celebre' and publicize the success story in order to stimulate new business.

- Local CEO

People and companies like Charles Brewer (Mindspring), Bert Ellis (DXL), John Yates all launched their way to success in (the mid-1990s). These young guys represented the spawning of a new generation that inspired a lot of people.

- Venture Capitalist

Ben Dyer (Peachtree Software), Jeff Levy (Relevant Knowledge), and Leland Strange were early entrepreneurs who started numerous companies, assisted many more and now, in fact, have started their own incubators.

- Local CEO

### RESEARCH CENTERS

Georgia Tech, began to see a different culture thanks to the leadership of Joe Petit, who came to GT from the Stanford Engineering School in 1973. Petit began to instill the appreciation for entrepreneurship that he had seen at Stanford in the late 70's/early 80s.

- University Leader

A key to the region's growth has been initiative by university presidents, starting with Joe Petit at GT; he supported the increased commercialization of university innovation and the support of start-ups. Wayne Clough also deserves credit for pushing GT to become much more aggressive in licensing and technology transfer.

- Local CEO

President Clough at GT has been a champion for commercialization of GT technologies. Has led to an increasingly supportive environment for business-university ties.

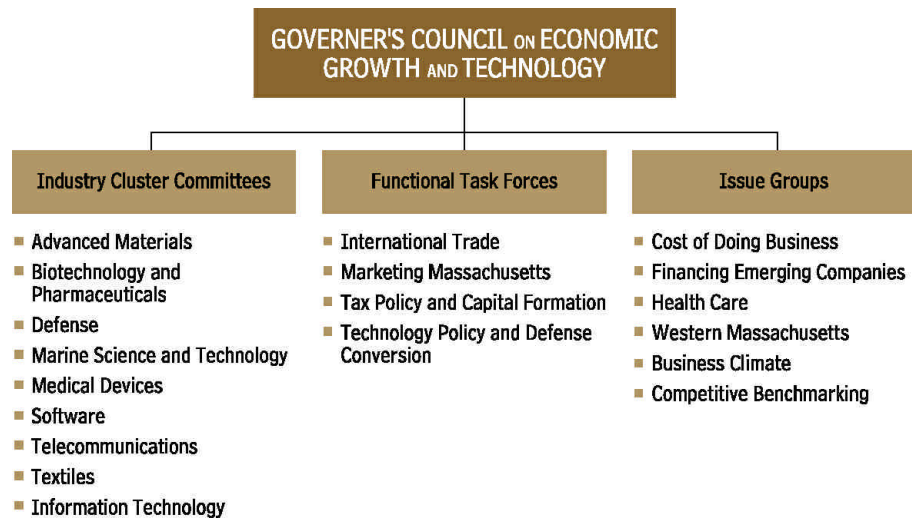
- Economic Development Official

An overarching organization for economic development helps coordinate and routinize the process

Building a consensus behind a basic agenda and a true commitment to the above attitudes is a difficult and ongoing process. It must be sustained throughout changes in political leadership, and during difficult economic times. Many regions achieve a shared vision primarily due to a crisis that galvanizes the community and spurs action. Another way to achieve it is to formalize a process for working on these issues.

**Massachusetts** An example from our research is the Massachusetts’s Governor’s Council on Economic Growth and Technology. The Governor’s Council was founded in early 1991 to provide expert, objective input on issues and policies relevant to the Massachusetts economy, to report periodically on the status of industry in the Commonwealth and to make recommendations for policy action and assist in implementation. Composed of the state’s leading business executives, academics and government representatives, the Council exemplifies the philosophy of chief executive involvement and broad-based collaboration in support of private sector-led development. The Council was organized into task forces on tax policy and capital formation, technology policy, and marketing, as well as other committees around important core, and emerging, industry clusters (see Exhibit 59 below).

Exhibit 59: Massachusetts Governor’s Council on Economic Growth & Technology



Source: Commonwealth of Massachusetts Governor’s Council on Economic Growth and Technology; Monitor Group

# 9 ACTION AGENDAS FOR THE PUBLIC AND PRIVATE SECTORS

Although many groups and individuals affect regional economies, the most influential organizations are government (federal, state, and local), universities and research institutes, institutions for collaboration, and firms. Each type of organization has an important and distinct role to play in developing regional economies and clusters. This chapter draws on the material presented in earlier chapters to identify appropriate action agendas for each organization. We have distilled the core action implications for each group and present them here in brief, rather than reiterate earlier concepts, findings, and implications.

## FEDERAL GOVERNMENT

- Invest in the foundations of science and technology. (see pp. 43-46)
  - Increase federal funding of research at universities and other research centers.
  - Establish federal overhead recovery rules, and other policies, to encourage investment in universities' science and technology infrastructure.
  - Provide federal support for specialized training programs in science and engineering.
- Improve the innovation policy context. (see pp. 46-48)
  - Fortify intellectual property law protection
  - Strengthen and enforce anti-trust laws with a greater weight on innovation.
  - Reinforce federal tax incentives that encourage business investment in R&D and university-industry collaboration.
- Allocate federal resources to reinforce cluster development. (see pp. 46-48)
  - Distribute federal research funding through a system of peer-reviewed competitive grants in a way that fosters cluster development.
  - Encourage locally-based federal agencies to communicate and coordinate with local business, institutions for collaboration, and educational and research centers based around clusters.
- Provide better data for measuring regional economic composition and performance. (see pp. A1-A9)
  - Collect more up-to-date data down to the county level.
  - Collect measures of both economic performance and innovation.
- Encourage the development of regional economic development strategies that stress innovation.
- Provide federal matching funds for innovation-focused state and regional economic development strategies.

## STATE GOVERNMENT

- Invest in the foundations of science and technology. (see pp. 43-46)
  - Recognize the state government's important role in supporting R&D funding at state universities.
  - Establish and maintain high levels of state support for community colleges and specialized training centers.
  - Create a strong university or college presence in all major regions of the state.
- Sponsor state programs that encourage cluster development. (see pp. 55-56)
  - Build cluster thinking into research parks and incubators.
  - Organize state systems of higher education around local clusters.
- Focus business recruitment around strong clusters. (see pp. 46-49)
  - Coordinate activities with firms, universities, and training centers to recruit anchor companies to their region.
- Create regional dimension to state economic development strategy. (see pp. 46-48, 77-79)
  - Encourage and assist regions to develop economic strategies.
  - Cultivate attitudes toward collaboration and sharing of information among firms, universities, training centers, labor, institutions for collaboration, and government.
- Improve information systems to regularly collect data and measure progress. (see pp. A1-A9)

## REGIONAL AND LOCAL GOVERNMENT

- Strongly support K-12 education, and create strong standards and accountability. (see p. 42)
- Upgrade core business infrastructure. (see pp. 39-42)
  - Transportation infrastructure
  - Communications infrastructure.
  - Ensure specialized training programs are a high priority in any economic development strategy.
- Develop a regional strategy that involves all shareholders. (see pp. 77-79)
  - Support regional benchmarking initiatives.
  - Encourage a common vision and collaboration among firms, universities, and training centers.
  - Work with firms, universities, institutions for collaboration, and state government to create an organizational structure to help implement a regional strategy.
- Encourage cluster development. (see pp. 55-56)
  - Establish research and industrial parks that encourage innovation-based competition.
  - Implement cluster-focused recruitment efforts.

## UNIVERSITIES AND RESEARCH INSTITUTES

- Recognize the important role of universities in regional economic development. (see pp. 43-46)
  - Take the lead on, and participate in, regional and cluster development efforts.
- Create and support technology transfer offices (see pp. 15-16)
  - Work with firms and venture capital to streamline the technology transfer process
  - Benchmark the commercialization of university-created intellectual property using measures that promote efficient dissemination of knowledge.

- Actively participate in cluster development efforts. (see p. 29)
- Align university curricula and research to meet the needs of local clusters. (see p. 33)
  - Create cluster-specific institutions to support collaboration between academia and industry clusters.
  - Work with local industry to create areas of excellence within universities that differentiate the university and complement local industry strengths.
  - Integrate research and training efforts with the needs of local industry.
  - Participate in the recruitment of companies
- Support company start-up efforts by professors and students through mentorship, entrepreneurial education, and financing. (see pp. 69-70)

## CLUSTER-SPECIFIC INSTITUTIONS FOR COLLABORATION

- Promote cluster awareness. (see p. 64)
- Engage in ongoing diagnosis of cluster's competitive position. (see pp. 57-59)
  - Compare position relative to other regional clusters.
  - Identify constraints, obstacles, and advantages
- Develop training and management programs. (see pp. 60-61)
  - Provide programs through the Institutions for Collaboration.
  - Coordinate with local institutions to provide programs.
- Actively participate with government in recruitment efforts. (see pp. 46-49)
  - Communicate with firms in clusters to identify gaps in the cluster and recruit accordingly.
- Widen institutional membership to include all cluster constituents. (see pp. 69-70)

## FIRMS

- Recognize importance of location to comparative advantage.
- Take active role in improving competitive environment.
  - Consistently communicate your needs and desires (e.g., for talent, ideas, patents) to local universities, research institutes, and training centers.
- See their cluster as a competitive asset.
- Contribute actively to cluster development activities. (see p. 64)
  - Actively participate in cluster activities to identify issues of common concern and opportunities for mutual gain (e.g., regulatory matters, new buyer needs, innovative supplier capabilities).
  - Support recruitment activities of local chambers and other regional economic development officials to bring in companies that will fill missing niches in the firm's cluster (e.g., suppliers, services providers, competitors).
  - Contribute to programs that support new ventures (e.g., improving access to risk capital, mentoring programs, and specialized services) in order to build-out cluster.

# appendix 1

## ASSESSING REGIONAL ECONOMIC COMPETITIVENESS AND INNOVATIVE CAPACITY: A HOW TO GUIDE

Competition is a game of relative gains. Some regions outperform others because they have a superior mix of assets and liabilities. Improving regional and cluster competitiveness entails identifying areas of relative strength and weakness, and building strategies that play to strengths and improve weaknesses. This guide explains how to identify strengths and weaknesses, and how to develop strategies to exploit them.

The underlying challenge in assessing a region's competitiveness is accurate benchmarking. How do you compare diverse regions around the country in order to measure their relative position in terms of economic performance, innovation output, and the capacity to innovate? Different organizations will assess different geographical areas, define clusters differently, measure different performance criteria, draw on different data sources, and use different base years to calculate growth rates. The result is an “apples to oranges” comparison and an inaccurate assessment of the relative strengths and weaknesses of the regions. We use a single analytical framework, apply a common methodology, and draw on a number of data sources in order to make “apples to apples” comparisons of regions.

### ASSESSING THE COMPETITIVENESS OF REGIONAL ECONOMIES

#### Economic Performance and Innovation Output

The first step in assessing a regional economy is to benchmark its economic performance and innovation output. Good economic performance is the ultimate objective, and innovation output is an indicator of future performance. It is important to benchmark these areas in order to determine basic development objectives (e.g., raise wages, increase innovation, maintain current performance, etc).

The study examined regional economic performance on two levels. At the broadest level, we compared the region to other regions on various indicators of economic vitality and standard of living such as employment growth, unemployment, wages, wage growth, cost of living, and exports. To assess potential future competitiveness, we examined measures of innovative output and entrepreneurship including patents, establishment formation, venture capital investments, the prevalence of fast growing companies, and initial public offerings. Wherever possible, we tracked both the level and the growth rate of each performance indicator (see exhibit on next page).

We compared the performance of regional economies to the national economy as a whole, as well as to other technologically intensive regions.

## Economic Performance Indicators

Overall Economy	Innovation Output
<ul style="list-style-type: none"><li>■ <b>Employment</b> Number of persons employed</li><li>■ <b>Unemployment</b> Number of persons unemployed</li><li>■ <b>Average Wages</b> Payroll per person employed</li><li>■ <b>Wage Growth</b> Growth rate for payroll per person employed</li><li>■ <b>Cost of Living</b> Cost of living index</li><li>■ <b>Exports</b> Value of manufacturing and non-manufacturing exports as a percentage of sales</li></ul>	<ul style="list-style-type: none"><li>■ <b>Patents</b> Number of patents and patents per capita and per worker</li><li>■ <b>Establishment Formation</b> Growth rate for establishment formation</li><li>■ <b>Venture Capital Investments</b> Value of venture capital investment</li><li>■ <b>Initial Public Offerings</b> Number of initial public offerings</li><li>■ <b>Fast Growth Firms</b> Number of companies on the Inc. 500 Magazine list</li></ul>

Source: Bureau of Labor Statistics; Bureau of Economic Analysis; International Trade Administration; U.S. Patent and Trademark Office; Price Waterhouse Cooper Money Tree; Hoover's IPO Central; Inc. Magazine, American Chamber of Commerce Researchers Association

### Composition of the Regional Economy

The next step is to benchmark a regional economy's composition, because differences in composition lead to differences in performance and innovation. More specifically, regions with a higher percentage of workers in traded industries, and with a larger portfolio of relatively strong and growing clusters, tend to be more prosperous. Our analysis of composition also enables us to identify those regional clusters that create the most jobs and contribute most to the regional payroll.

Especially in advanced nations such as the United States, regional economies are specialized, with each region strong in a different mix of industry clusters. Comparing regional economies has been difficult because clusters have not been systematically identified or mapped across all U.S. regions. To address this challenge, Professor Porter and his team at Harvard Business School have defined clusters statistically and assembled detailed data by industry and cluster on employment, wages, establishments, and patenting over time for every region in the United States. (See the boxed insert for a summary of the Cluster Mapping Project)<sup>A1</sup>

The Cluster Mapping Project provides an objective, quantitative way to profile regional economies, compare them over time, and measure the strength, evolution, and performance of the region's clusters. The cluster mapping data is used to identify the most important clusters in the region's economy, understand the drivers of the region's relative wages, employment growth, and formation of new establishments, assess the region's patenting performance, and examine the region's relative position versus other regions overall as well as in its leading clusters.

<sup>A1</sup> By traded, we mean that the location of the firms in these clusters is not driven by the need to be near a specific natural resource, or by population concentration. Instead, these industries are located in a specific area for some reason related to the region's innovative capacity.

## CLUSTER MAPPING PROJECT METHODOLOGY

- The purpose of the Cluster Mapping Project is to assemble a detailed picture of the location and performance of industries in the United States, with a special focus on the linkages or externalities across industries that give rise to clusters.
- The raw data for the project are County Business Patterns data (excluding agriculture and government) on employment, establishments, and wages by four-digit Standard Industrial Classification (SIC) Code by U.S. county. In addition, U.S. patent data by location of inventor are allocated to industries and clusters using a concordance of technology classifications with SIC Codes.
  - Confidentiality limitations mean that actual data are not disclosed for every county and economic area in every industry. Various techniques are used to compensate for missing data.
- Economies are analyzed at various geographic levels, including states, Economic Areas, Metropolitan Statistical Areas (MSAs), and counties.
- All the industries in the economy are separated into “traded” and “local” based on the degree of industry locational dispersion across geographic areas. Local industries are those present in most if not all geographic areas, are evenly distributed, and hence primarily sell locally. Traded industries are those that are concentrated in a subset of geographic areas and sell to other regions and nations.
- Among traded industries, clusters are identified using the correlation of industry employment across geographic areas. The principle is that industries normally located together are those that are linked by some external economies. These industries, then, constitute a cluster.
- Clusters are defined initially using state-level data (n= 50). The robustness of cluster composition is verified using Economic Areas as the geographical unit.
- Clusters are constructed using two approaches, which are then reconciled:
  - Select a prominent “core” industry in a field or part of the economy. Calculate the locational correlations of all other industries with the core. Those industries with statistically significant correlations with the core define the extent of the cluster.
  - Calculate locational correlations between all pairs of industries in a general field and potentially related fields. Those sets of industries with statistically significant and substantial intercorrelations among each other define the cluster.
- In both cases some industries may have spurious correlations to a cluster because of the co-location of several strong clusters in the same geographical area. Spurious correlation is eliminated using Input-Output tables, industry definitions, and industry knowledge.<sup>A2</sup>
- Note that a given industry can be *part of more than one cluster*. This sometimes reflects overly broad industry definitions. However, it is also the case that there are multiple forms of externalities, and some industries are suppliers or customers of many other industries. Thus, overlapping clusters are expected and their overlaps are important economically (see Exhibit 39, Cluster Overlap in the U.S. Economy; Number of Clusters with Common Industries, Section 6, page 66).

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<sup>A2</sup> The 1992 Input-Output Accounts measure the share of economic value traded between industries.

- The process of statistically defining cluster boundaries resulted in 41 traded clusters in the U.S. economy. These are shown in the figure below, grouped into broad categories.
- Clusters can be defined using “narrow” or “broad” definitions. We use *narrow cluster definition* to refer to the subset of the industries that are *most correlated* with a given cluster. Analysis using narrow cluster definitions eliminates cluster overlaps. An industry is a narrow industry for only *one* cluster.
- *Broad cluster definition* includes *all* industries with statistically significant locational correlations. This includes industries with stronger locational correlations with another cluster. Analysis using broadcluster definition includes the overlap among clusters. This overlap is important to understanding cluster competitiveness, but leads to double counting of employment, which leads to difficulties of interpretation for some analyses.
- Subclusters are subsets of cluster industries that are the most strongly correlated with each other relative to the rest of the cluster. There are subsets of industries where linkages are particularly strong. We define the subcluster statistically for each cluster. Separate subclusters are defined for narrow and broad cluster definitions. There are 244 subclusters in the 41 traded clusters defined using narrow cluster definition. An additional 245 subclusters arise among industries outside the narrow cluster that fall into the broad cluster definition.
- We also grouped the 241 local industries into clusters primarily using industry knowledge. There are 16 local clusters ranging from local health services and local utilities to local retail clothing and accessories. We did not analyze local clusters extensively in this project, but focused on cross-regional competition. Local clusters are crucial for examining the patterns of location with metropolitan areas.

## CLUSTERS OF TRADED INDUSTRIES



### The Assessment of the Business and Innovation Environment

The third step in a regional assessment is to analyze the business environment. A healthy business environment will lead to growth of employment in traded industries, and to strong and growing clusters, the drivers of prosperity.

The quality of the overall business and innovation environment includes both common characteristics that affect the entire economy and the particular circumstances in important regional clusters. We examine overall competitiveness, but place special emphasis on the region's innovation environment. The

## Business Environment and Cluster Indicators

	Common	Cluster-Specific
Basic and Specialized Factor Inputs	<ul style="list-style-type: none"> <li>■ Information and communication infrastructure</li> <li>■ Skilled workforce</li> <li>■ Investment in educational capacity</li> <li>■ Availability of risk capital</li> <li>■ Quality of life</li> </ul>	<ul style="list-style-type: none"> <li>■ Presence of specialized research centers</li> <li>■ Presence of specialized talent base</li> <li>■ Presence of specialized training and education institutions</li> </ul>
Context for Firm Strategy and Rivalry	<ul style="list-style-type: none"> <li>■ Tax policy (e.g., investment incentives)</li> </ul>	<ul style="list-style-type: none"> <li>■ Intensity of rivalry among firms in the cluster</li> <li>■ Degree of cooperation between firms in the cluster</li> </ul>
Related and Supporting Industries	<ul style="list-style-type: none"> <li>■ Regional position in broad based industries such as business services and energy</li> </ul>	<ul style="list-style-type: none"> <li>■ Extent of related industries inside and outside of the cluster</li> </ul>
Sophistication of Demand	<ul style="list-style-type: none"> <li>■ Overall regional education and per capita income levels</li> </ul>	<ul style="list-style-type: none"> <li>■ Sophistication of the demand in the region for the clusters' products and services</li> </ul>
Government	<ul style="list-style-type: none"> <li>■ Zoning regulations</li> <li>■ Coordination between government regional agencies</li> </ul>	<ul style="list-style-type: none"> <li>■ Cluster-specific regional policies</li> </ul>
Institutions of Collaboration	<ul style="list-style-type: none"> <li>■ Existence of regional institutions of collaboration</li> </ul>	<ul style="list-style-type: none"> <li>■ Existence of cluster-specific institutions for collaboration</li> </ul>
Attitudes toward Business	<ul style="list-style-type: none"> <li>■ Regional attitudes toward the sources of economic prosperity</li> </ul>	<ul style="list-style-type: none"> <li>■ Cluster-specific attitudes toward the sources of economic prosperity</li> </ul>

figure below illustrates some of the dimensions of the overall business environment analyzed in the research.

Data for benchmarking regional economies in terms of basic and specialized factor inputs is readily available from secondary materials available from such sources as the Department of Education, the Bureau of Labor Statistics, PriceWaterhouseCoopers, Hoover's, and others. To obtain benchmarking data on other elements of the business environment, we survey executives from business, government, academia, and economic development organizations using a common set of questions. We then follow up the survey with in-depth interviews with senior executives from a region. The combination of a survey with a large sample size and 40-60 interviews enables us to accurately benchmark the business environment of a region against rival regions.

## ASSESSING THE COMPETITIVENESS OF REGIONAL CLUSTERS

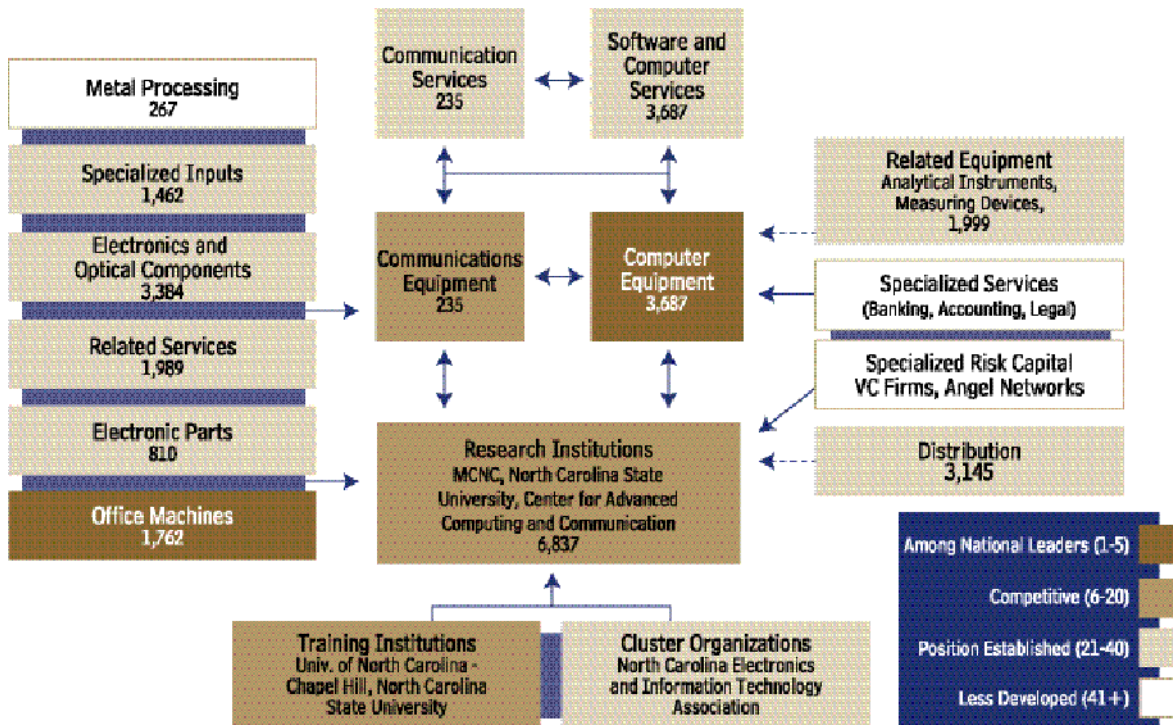
The steps for assessing regional clusters are similar to those used for assessing a regional economy. We benchmark a regional cluster to other regional clusters in the categories of economic performance and innovation output, composition, and business environment.

### Economic Performance and Innovation Output

We look at both economic performance and innovation output measures for each regional cluster, and benchmark a regional cluster against national averages and rival clusters in other regions. See the exhibit below for cluster specific measures. The Cluster Mapping Project provides data on employment growth, average wages, wage growth, patents, patents per worker, and establishment formation. Secondary sources provide data for other measures.

### The Composition of Regional Clusters

An accurate breakdown of cluster composition not only helps explain the economic performance and innovation output of the cluster, but also identifies leverageable strengths and areas of weakness. Clusters are composed of subclusters, which are composed of industries. The Cluster Mapping Project Data ranks both regional subclusters and regional industries to precisely identify areas of relative strength and weakness. Strength across a range of subclusters is desirable, as is strength in narrow industries (i.e., the *Composition and Competitive Position of the Research Triangle Communications Cluster*)



subset of the industries that are most correlated with a given cluster). See below for an example of the breakdown of a regional cluster.

### The Cluster Business and Innovation Environment

Finally, we assess a regional cluster's business and innovation environment, and benchmark it against other regions and clusters. A healthy environment stimulates cluster growth, helping to broaden and deepen cluster composition. A good business environment also fosters innovation, helping to increase the productivity and competitiveness of a regional cluster, and the firms in it. As with the regional economy, we use a combination of surveys and interviews to gather cross-cluster comparable data.

# appendix 2

## DEFINITION OF MEASUREMENTS

### OUTPUT MEASURES

Measure	Definition	Calculation	Source
Employment	Number of persons employed per MSA/cluster	Sum of employment in all counties constituting the Metropolitan Statistical Area (MSA)	County Business Pattern Data on 4-digit Standard Industrial Classification (SIC) industries per county
Wages	Payroll of region/cluster per employed in MSA/cluster	Total payroll divided by total employment per region/cluster; calculated as employment weighted average of wages per county (for region) or industry (for cluster)	County Business Pattern Data on 4-digit SIC industries per county
Productivity	Value of shipment per employee in MSA/cluster	<p>First, NAICS-based shipment data is transformed to SIC codes using the bridging methodology provided by the 1997 Economic Census. The weights of each NAICS code assigned to a SIC industry are based on the proportions of total sales/ receipts/shipments each NAICS accounts for that SIC code. However, this transformation does not generate data for all industries defined in the SIC code. Also, some data is suppressed to avoid disclosing individual company data.</p> <p>Second, the value of total industry shipments is divided by total industry employment.</p> <p>Of the 720 SIC industries listed, information is available for 110 industries.</p>	Census Bureau Shipment Data; County Business Pattern Data on 4-digit SIC industries per county

## OUTPUT MEASURES (Continued)

Measure	Definition	Calculation	Source
Exports	Value of manufacturing and non-manufacturing commodity exports per industry and MSA	Direct use of data.	U.S. Department of Commerce's International Trade Administration data on the two-digit SIC level

## INNOVATION MEASURES

Measure	Definition	Calculation	Source
Patents	Number of patents registered per MSA/cluster	Direct use of data for MSAs.  For clusters, we need to distribute the aggregate number of regional patents to individual industries.	Commerce Department data on patents per MSA
Venture Capital Investments	Value of Venture Capital Investment per MSA/cluster	Direct use of data	PriceWaterhouse-Cooper's Money Tree Database
Fast Growth Firms	Number of companies on Inc. 500 list and/or Gazelle-type company per MSA	Direct use of data  Inc. Magazine lists companies by sales growth.  "Gazelle"-firms are defined by employment growth above 100% over four years	Inc. Magazine Top 500 list of high-growth companies  Cognetics "Gazelle" companies' list
Initial Public Offerings	Number of IPOs per MSA	Direct use of data	Hoover's IPO Central.com

## COMMON BUSINESS ENVIRONMENT MEASURES

Measure	Definition	Calculation	Source
Basic research	Federal funds for research universities per MSA	Direct use of data	National Science Foundation WebCASPAR Database System
Skills of workforce	Number of employees per skill and MSA	Direct use of data: Number of scientists / engineers, technicians in scientific and engineering fields, managers and professionals, and science and technology graduates in the regional workforce	US Bureau of Labor Statistics, Occupational Employment Statistics
Education	Expenditure and performance per student and MSA	Direct use of data: High school graduation rates, student/teacher ratios, average expenditures per student, and SAT scores	California Department of Education, National Center for Education Statistics
Physical infrastructure	Transportation System, Communications System, Utilities	Direct use of data	Texas Transportation Institute Annual Mobility Report, Clusters of Innovation Initiative Regional Survey Data, Secondary Sources
Supply of Risk Capital	Size of local venture capital industry	Direct use of data: Number of local venture capital firms, and total funds management by local venture capital firms	Alternative Assets
Quality of Life		Direct use of data: Cost of housing, and level of traffic congestion	Clusters of Innovation Initiative Regional Survey Data, Secondary Sources

## CLUSTER-SPECIFIC BUSINESS ENVIRONMENT MEASURES

Measure	Calculation	Source
Specialized research centers	<p>Direct use of average questionnaire response:</p> <p>How available are local research centers to use by private firms, and how frequently do they transfer technology and knowledge to the private sector?</p>	Clusters of Innovation Initiative Regional Survey, and interviews
Specialized talent base	<p>Direct use of average questionnaire response:</p> <p>Is there a sufficient number of qualified scientists, researchers, technicians, and business managers to sustain and grow companies in the region?</p>	Clusters of Innovation Initiative Regional Survey, and interviews
Specialized training	<p>Direct use of average questionnaire response:</p> <p>Do local institutions supply a sufficient number of qualified scientists, researchers, technicians, and business managers, and will this improve or worsen in the future?</p>	Clusters of Innovation Initiative Regional Survey, and interviews
Sophistication of demand	<p>Direct use of average questionnaire response:</p> <p>Are local customers sophisticated in their demand for new and better products, and do companies receive regular feedback from these customers?</p>	Clusters of Innovation Initiative Regional Survey, and interviews
Intensity of rivalry	<p>Direct use of average questionnaire response:</p> <p>How many local rivals are there in your cluster, and would you characterize competition as more intense or more mild?</p>	Clusters of Innovation Initiative Regional Survey, and interviews
Degree of cooperation	<p>Direct use of average questionnaire response:</p> <p>Do firms share knowledge with each other, and do they consistently contribute to cluster-wide projects and initiatives?</p>	Clusters of Innovation Initiative Regional Survey, and interviews
Related and supporting	<p>Direct use of average questionnaire response:</p> <p>What is the quality of local suppliers and supporting industries, how frequently do firms source from outside the region, and how much feedback to related industries give on improving products and processes?</p>	Clusters of Innovation Initiative Regional Survey, and interviews

# appendix 3

## SAMPLE RESULTS OF CLUSTERS OF INNOVATION

### INITIATIVE REGIONAL SURVEY: ALL 5 REGIONS

**QUESTION #38a: Which five elements of the business environment currently have the greatest positive impact on your business' success?**

Positive impact #1	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	RDU
Cost of doing business (cost of real estate, wages and salary, etc.)	36.97%	7.83%	52.27%	50.71%	37.65%	27.54%
Quality of transportation	12.75%	5.22%	19.70%	10.71%	15.29%	13.04%
Specialized facilities for research	16.82%	41.74%	8.33%	7.86%	5.88%	23.19%
Qualified scientists and engineers	12.01%	25.22%	5.30%	7.14%	4.71%	21.74%
Transfer of knowledge from research institutions	4.07%	6.09%	2.27%	3.57%	5.88%	2.90%
Communications infrastructure	8.13%	9.57%	3.79%	11.43%	10.59%	4.35%
Available pool of skilled workforce	3.14%	1.74%	3.03%	0.71%	7.06%	5.80%
Quality of K-12 education	0.74%	0.00%	0.00%	2.86%	0.00%	0.00%
Sourcing of employees from advanced educational programs	0.37%	0.00%	0.76%	0.00%	1.18%	0.00%
Access to capital	1.66%	0.87%	3.03%	1.43%	1.18%	1.45%
Demanding regional customers that provide feedback	1.11%	0.87%	0.76%	0.71%	3.53%	0.00%
Specialized needs of regional customers	0.92%	0.00%	0.00%	1.43%	3.53%	0.00%
State and regional environmental safety regulations	0.18%	0.00%	0.00%	0.00%	1.18%	0.00%
State and regional tax and incentives for investment in R&D	0.18%	0.87%	0.00%	0.00%	0.00%	0.00%
Governments overall responsiveness to the needs of business	0.18%	0.00%	0.00%	0.00%	1.18%	0.00%
Level of competition in your industry	0.18%	0.00%	0.00%	0.71%	0.00%	0.00%
Quality and in-region location of your suppliers	0.18%	0.00%	0.00%	0.71%	0.00%	0.00%
Participation with regional institutions in R&D efforts	0.37%	0.00%	0.76%	0.00%	1.18%	0.00%
Weighted Total Number of Respondents	541	115	132	140	85	69
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

### QUESTION #38a: Which five elements of the business environment currently have the greatest positive impact on your business' success?

Positive impact #2	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	RDU
Cost of doing business (cost of real estate, wages and salary, etc.)	0.95%	0.00%	0.81%	2.86%	0.00%	0.00%
Quality of transportation	9.09%	2.68%	0.81%	15.00%	7.23%	4.35%
Specialized facilities for research	6.25%	2.68%	9.68%	4.29%	3.61%	13.04%
Qualified scientists and engineers	17.61%	31.25%	16.13%	9.29%	7.23%	27.54%
Transfer of knowledge from research institutions	8.90%	21.43%	8.06%	5.71%	1.20%	5.80%
Communications infrastructure	19.32%	11.61%	19.35%	27.86%	21.69%	11.59%
Available pool of skilled workforce	9.85%	8.93%	10.48%	5.71%	15.66%	11.59%
Quality of K-12 education	3.41%	2.68%	4.03%	1.43%	7.23%	2.90%
Sourcing of employees from advanced educational programs	6.25%	8.93%	4.84%	9.29%	1.20%	4.35%
Access to capital	5.11%	2.68%	4.03%	5.71%	9.64%	4.35%
Demanding regional customers that provide feedback	2.27%	0.89%	1.61%	1.43%	8.43%	0.00%
Specialized needs of regional customers	2.46%	0.89%	2.42%	2.86%	3.61%	2.90%
State local regulations for production processes and product	0.57%	0.00%	0.00%	0.00%	1.20%	2.90%
State and regional environmental safety regulations	0.38%	0.89%	0.00%	0.00%	0.00%	1.45%
State and regional tax and incentives for investment in R&D	0.95%	0.00%	0.00%	0.71%	3.61%	1.45%
Predictability of government policies	1.14%	0.00%	0.81%	1.43%	2.41%	1.45%
Governments overall responsiveness to the needs of business	0.76%	0.00%	0.81%	1.43%	0.00%	1.45%
Level of competition in your industry	2.46%	1.79%	2.42%	2.86%	3.61%	1.45%
Quality and in-region location of your suppliers	1.33%	1.79%	0.81%	1.43%	2.41%	0.00%
Assistance from regional suppliers for new product and proce	0.19%	0.00%	0.81%	0.00%	0.00%	0.00%
Relationships between firms and organizations in your cluster	0.38%	0.89%	0.00%	0.71%	0.00%	0.00%
Participation with regional institutions in R&D efforts	0.19%	0.00%	0.81%	0.00%	0.00%	0.00%
Weighted Total Number of Respondents	528	112	124	140	83	69
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

### QUESTION #38a: Which five elements of the business environment currently have the greatest positive impact on your business' success?

Positive impact #3	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	RDU
Cost of doing business (cost of real estate, wages and salary, etc.)	2.77%	0.00%	4.20%	5.22%	2.53%	0.00%
Specialized facilities for research	0.40%	0.00%	0.00%	0.75%	0.00%	1.47%
Qualified scientists and engineers	3.95%	1.89%	4.20%	3.73%	1.27%	10.29%
Transfer of knowledge from research institutions	8.30%	22.64%	3.36%	3.73%	1.27%	11.76%
Communications infrastructure	12.06%	15.09%	7.56%	19.40%	6.33%	7.35%
Available pool of skilled workforce	11.46%	13.21%	16.81%	9.70%	7.59%	7.35%
Quality of K-12 education	7.31%	3.77%	13.45%	4.48%	7.59%	7.35%
Sourcing of employees from advanced educational programs	11.66%	16.98%	6.72%	14.18%	5.06%	14.71%
Access to capital	8.30%	7.55%	8.40%	10.45%	11.39%	1.47%
Demanding regional customers that provide feedback	6.32%	7.55%	5.88%	5.97%	5.06%	7.35%
Specialized needs of regional customers	6.13%	1.89%	8.40%	5.22%	13.92%	1.47%
State local regulations for production processes and product	1.98%	2.83%	2.52%	0.75%	3.80%	0.00%
State and regional environmental safety regulations	1.98%	0.00%	3.36%	0.00%	1.27%	7.35%
State and regional tax and incentives for investment in R&D	1.78%	0.94%	0.84%	0.00%	6.33%	2.94%
Predictability of government policies	1.38%	0.00%	0.84%	1.49%	1.27%	4.41%
Governments overall responsiveness to the needs of business	2.57%	0.00%	0.84%	5.97%	2.53%	2.94%
Level of competition in your industry	3.95%	1.89%	2.52%	4.48%	10.13%	1.47%
Quality and in-region location of your suppliers	3.56%	1.89%	3.36%	1.49%	6.33%	7.35%
Assistance from regional suppliers for new product and proce	1.38%	1.89%	2.52%	0.75%	1.27%	0.00%
Relationships between firms and organizations in your cluste	1.98%	0.00%	2.52%	1.49%	5.06%	1.47%
Participation with regional institutions in R&D efforts	0.20%	0.00%	0.00%	0.00%	0.00%	1.47%
Weighted Total Number of Respondents	506	106	119	134	79	68
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

### QUESTION #38a: Which five elements of the business environment currently have the greatest positive impact on your business' success?

Positive impact #4	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
Cost of doing business (cost of real estate, wages and salary, etc.)	2.74%	0.00%	4.50%	3.31%	5.26%	0.00%
Qualified scientists and engineers	0.21%	0.00%	0.00%	0.83%	0.00%	0.00%
Transfer of knowledge from research institutions	1.26%	0.99%	1.80%	0.83%	1.32%	1.52%
Communications infrastructure	2.32%	5.94%	1.80%	2.48%	0.00%	0.00%
Available pool of skilled workforce	5.26%	12.87%	0.90%	5.79%	0.00%	6.06%
Quality of K-12 education	2.74%	2.97%	4.50%	0.83%	2.63%	3.03%
Sourcing of employees from advance educational programs	10.32%	17.82%	8.11%	6.61%	3.95%	16.67%
Access to capital	11.16%	12.87%	10.81%	16.53%	2.63%	9.09%
Demanding regional customers that provide feedback	3.16%	1.98%	2.70%	4.96%	3.95%	1.52%
Specialized needs of regional customers	5.68%	3.96%	7.21%	7.44%	5.26%	3.03%
State local regulations for production processes and product	0.63%	0.00%	0.90%	0.00%	1.32%	1.52%
State and regional environmental safety regulations	2.53%	0.99%	1.80%	2.48%	3.95%	4.55%
State and regional tax and incentives for investment in R&D	4.42%	5.94%	6.31%	1.65%	5.26%	3.03%
Predictability of government policies	2.32%	0.99%	1.80%	3.31%	2.63%	3.03%
Governments overall responsiveness to the needs of business	4.21%	1.98%	2.70%	5.79%	7.89%	3.03%
Level of competition in your industry	9.05%	7.92%	10.81%	11.57%	6.58%	6.06%
Quality and in-region location of your suppliers	8.42%	4.95%	15.32%	4.96%	14.47%	1.52%
Assistance from regional suppliers for new product and proce	4.84%	1.98%	4.50%	2.48%	10.53%	7.58%
Relationships between firms and organizations in your cluste	12.84%	14.85%	6.31%	14.88%	14.47%	15.15%
Participation with regional institutions in R&D efforts	3.79%	0.99%	5.41%	3.31%	1.32%	9.09%
Weighted Total Number of Respondents	475	101	111	121	76	66
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

**QUESTION #38a: Which five elements of the business environment currently have the greatest positive impact on your business' success?**

Positive impact #5	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
Cost of doing business (cost of real estate, wages and salary, etc.)	29.98%	0.00%	46.08%	51.33%	37.68%	0.00%
Quality of transportation	0.23%	0.00%	0.00%	0.00%	1.45%	0.00%
Specialized facilities for research	0.23%	0.00%	0.00%	0.00%	1.45%	0.00%
Communications infrastructure	0.46%	1.09%	0.00%	0.00%	1.45%	0.00%
Available pool of skilled workforce	0.92%	1.09%	1.96%	0.88%	0.00%	0.00%
Quality of K-12 education	0.23%	0.00%	0.00%	0.00%	0.00%	1.64%
Sourcing of employees from advanced educational programs	2.52%	7.61%	1.96%	0.88%	1.45%	0.00%
Access to capital	2.97%	9.78%	0.98%	0.88%	0.00%	3.28%
Demanding regional customers that provide feedback	0.46%	0.00%	0.98%	0.88%	0.00%	0.00%
Specialized needs of regional customers	0.46%	1.09%	0.00%	0.88%	0.00%	0.00%
State local regulations for production processes and product	0.23%	0.00%	0.98%	0.00%	0.00%	0.00%
State and regional environmental safety regulations	0.46%	0.00%	0.00%	0.88%	0.00%	1.64%
State and regional tax and incentives for investment in R&D	2.29%	5.43%	1.96%	1.77%	1.45%	0.00%
Predictability of government policies	0.92%	1.09%	0.00%	0.88%	2.90%	0.00%
Governments overall responsiveness to the needs of business	2.52%	3.26%	1.96%	1.77%	5.80%	0.00%
Level of competition in your industry	4.58%	6.52%	3.92%	4.42%	5.80%	1.64%
Quality and in-region location of your suppliers	3.43%	5.43%	4.90%	0.88%	2.90%	3.28%
Assistance from regional suppliers for new product and proce	2.52%	3.26%	3.92%	0.88%	2.90%	1.64%
Relationships between firms and organizations in your cluste	10.07%	22.83%	2.94%	7.96%	13.04%	3.28%
Participation with regional institutions in R&D efforts	34.32%	31.52%	27.45%	24.78%	20.29%	83.61%
Weighted Total Number of Respondents	437	92	102	113	69	61
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

### QUESTION #38b: Which factors of the business environment do you consider to be the greatest future threats to your business if not addressed?

Future Threat #1	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
Cost of doing business (cost of real estate, wages and salar	53.58%	87.18%	38.17%	38.13%	51.16%	59.72%
Quality of transportation	23.85%	6.84%	17.56%	38.85%	27.91%	29.17%
Specialized facilities for research	1.83%	0.00%	5.34%	0.72%	0.00%	2.78%
Qualified scientists and engineers	5.69%	3.42%	9.16%	6.47%	4.65%	2.78%
Transfer of knowledge from research institutions	0.55%	0.00%	1.53%	0.72%	0.00%	0.00%
Communications infrastructure	1.10%	0.00%	3.05%	0.72%	1.16%	0.00%
Available pool of skilled workforce	7.71%	0.85%	10.69%	10.07%	12.79%	2.78%
Quality of K-12 education	1.28%	0.00%	2.29%	2.16%	0.00%	1.39%
Access to capital	1.83%	0.85%	5.34%	0.00%	1.16%	1.39%
Demanding regional customers that provide feedback	0.18%	0.00%	0.00%	0.00%	1.16%	0.00%
State local regulations for production processes and product	1.10%	0.85%	3.82%	0.00%	0.00%	0.00%
State and regional environmental safety regulations	0.37%	0.00%	1.53%	0.00%	0.00%	0.00%
Predictability of government policies	0.18%	0.00%	0.76%	0.00%	0.00%	0.00%
Governments overall responsiveness to the needs of business	0.18%	0.00%	0.76%	0.00%	0.00%	0.00%
Level of competition in your industry	0.37%	0.00%	0.00%	1.44%	0.00%	0.00%
Weighted Total Number of Respondents	545	117	131	139	86	72
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

### QUESTION #38b: Which factors of the business environment do you consider to be the greatest future threats to your business if not addressed?

Future Threat #2	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
Cost of doing business (cost of real estate, wages and salar	0.93%	0.00%	0.78%	0.00%	3.53%	1.41%
Quality of transportation	25.23%	52.14%	6.20%	24.09%	11.76%	33.80%
Specialized facilities for research	1.67%	1.71%	0.78%	0.73%	1.18%	5.63%
Qualified scientists and engineers	12.43%	17.09%	14.73%	10.22%	9.41%	8.45%
Transfer of knowledge from research institutions	2.41%	2.56%	3.10%	1.46%	1.18%	4.23%
Communications infrastructure	4.08%	5.13%	4.65%	2.92%	3.53%	4.23%
Available pool of skilled workforce	24.49%	8.55%	23.26%	35.77%	35.29%	18.31%
Quality of K-12 education	10.02%	3.42%	10.08%	13.87%	11.76%	11.27%
Sourcing of employees from advanced educational programs	0.93%	1.71%	1.55%	0.00%	1.18%	0.00%
Access to capital	5.57%	3.42%	7.75%	4.38%	7.06%	5.63%
Demanding regional customers that provide feedback	1.11%	0.00%	3.10%	0.73%	1.18%	0.00%
Specialized needs of regional customers	0.74%	0.00%	0.78%	0.73%	2.35%	0.00%
State local regulations for production processes and product	4.27%	3.42%	7.75%	1.46%	4.71%	4.23%
State and regional environmental safety regulations	2.23%	0.85%	6.98%	0.00%	1.18%	1.41%
State and regional tax and incentives for investment in R&D	1.48%	0.00%	4.65%	0.00%	2.35%	0.00%
Predictability of government policies	0.93%	0.00%	1.55%	1.46%	0.00%	1.41%
Governments overall responsiveness to the needs of business	0.19%	0.00%	0.78%	0.00%	0.00%	0.00%
Level of competition in your industry	0.93%	0.00%	1.55%	0.73%	2.35%	0.00%
Relationships between firms and organizations in your cluste	0.19%	0.00%	0.00%	0.73%	0.00%	0.00%
Weighted Total Number of Respondents	539	117	129	137	85	71
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

### QUESTION #38b: Which factors of the business environment do you consider to be the greatest future threats to your business if not addressed?

Future Threat #3	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
Cost of doing business (cost of real estate, wages and salar	0.19%	0.00%	0.00%	0.78%	0.00%	0.00%
Specialized facilities for research	0.58%	0.86%	0.00%	0.00%	1.20%	1.52%
Qualified scientists and engineers	5.78%	12.93%	2.40%	3.10%	1.20%	10.61%
Transfer of knowledge from research institutions	1.54%	2.59%	2.40%	0.78%	0.00%	1.52%
Communications infrastructure	1.73%	1.72%	2.40%	2.33%	1.20%	0.00%
Available pool of skilled workforce	22.93%	31.90%	16.00%	24.81%	19.28%	21.21%
Quality of K-12 education	16.96%	12.07%	6.40%	24.81%	20.48%	25.76%
Sourcing of employees from advanced educational programs	5.97%	4.31%	9.60%	5.43%	6.02%	3.03%
Access to capital	9.83%	10.34%	15.20%	9.30%	2.41%	9.09%
Demanding regional customers that provide feedback	1.16%	2.59%	0.00%	0.78%	2.41%	0.00%
Specialized needs of regional customers	2.70%	0.86%	3.20%	4.65%	2.41%	1.52%
State local regulations for production processes and product	6.17%	8.62%	5.60%	3.88%	8.43%	4.55%
State and regional environmental safety regulations	4.55%	7.90%	5.17%	8.80%	6.98%	14.46%
State and regional tax and incentives for investment in R&D	3.85%	3.45%	7.20%	2.33%	2.41%	3.03%
Predictability of government policies	4.43%	0.86%	8.00%	2.33%	6.02%	6.06%
Governments overall responsiveness to the needs of business	3.66%	0.00%	7.20%	3.88%	4.82%	1.52%
Level of competition in your industry	2.31%	0.00%	3.20%	1.55%	3.61%	4.55%
Quality and in-region location of your suppliers	1.54%	0.86%	0.80%	2.33%	2.41%	1.52%
Assistance from regional suppliers for new product and proce	0.19%	0.00%	0.80%	0.00%	0.00%	0.00%
Relationships between firms and organizations in your cluster	0.39%	0.86%	0.80%	0.00%	0.00%	0.00%
Participation with regional institutions in R&D efforts	0.19%	0.00%	0.00%	0.00%	1.20%	0.00%
Weighted Total Number of Respondents	519	116	125	129	83	66
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

### QUESTION #38b: Which factors of the business environment do you consider to be the greatest future threats to your business if not addressed?

Future Threat #4	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
Cost of doing business (cost of real estate, wages and salar	0.82%	0.92%	0.00%	1.67%	1.25%	0.00%
Specialized facilities for research	0.21%	0.92%	0.00%	0.00%	0.00%	0.00%
Transfer of knowledge from research institutions	0.21%	0.00%	0.85%	0.00%	0.00%	0.00%
Communications infrastructure	0.41%	1.83%	0.00%	0.00%	0.00%	0.00%
Available pool of skilled workforce	6.17%	10.09%	5.98%	5.00%	2.50%	6.67%
Quality of K-12 education	7.82%	8.26%	2.56%	15.00%	5.00%	6.67%
Sourcing of employees from advanced educational programs	5.35%	8.26%	4.27%	5.83%	5.00%	1.67%
Access to capital	9.47%	13.76%	6.84%	7.50%	6.25%	15.00%
Demanding regional customers that provide feedback	1.23%	0.00%	0.85%	3.33%	1.25%	0.00%
Specialized needs of regional customers	1.65%	0.92%	0.00%	3.33%	1.25%	3.33%
State local regulations for production processes and product	5.14%	8.26%	3.42%	2.50%	5.00%	8.33%
State and regional environmental safety regulations	8.23%	11.01%	10.26%	5.83%	6.25%	6.67%
State and regional tax and incentives for investment in R&D	9.67%	8.26%	9.40%	8.33%	11.25%	13.33%
Predictability of government policies	13.17%	13.76%	14.53%	10.83%	13.75%	13.33%
Governments overall responsiveness to the needs of business	12.96%	6.42%	23.93%	10.83%	15.00%	5.00%
Level of competition in your industry	11.11%	4.59%	7.69%	14.17%	17.50%	15.00%
Quality and in-region location of your suppliers	2.26%	1.83%	3.42%	0.83%	3.75%	1.67%
Assistance from regional suppliers for new product and proce	1.65%	0.92%	2.56%	2.50%	1.25%	0.00%
Relationships between firms and organizations in your cluste	2.06%	0.00%	1.71%	2.50%	3.75%	3.33%
Participation with regional institutions in R&D efforts	0.41%	0.00%	1.71%	0.00%	0.00%	0.00%
Weighted Total Number of Respondents	486	109	117	120	80	60
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

### QUESTION #38b: Which factors of the business environment do you consider to be the greatest future threats to your business if not addressed?

Future Threat #5	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
Cost of doing business (cost of real estate, wages and salar	7.69%	0.00%	10.00%	15.32%	9.46%	0.00%
Available pool of skilled workforce	0.22%	0.97%	0.00%	0.00%	0.00%	0.00%
Quality of K-12 education	1.54%	1.94%	0.91%	1.80%	0.00%	3.51%
Sourcing of employees from advanced educational programs	1.54%	1.94%	1.82%	1.80%	1.35%	0.00%
Access to capital	3.52%	9.71%	1.82%	2.70%	0.00%	1.75%
Specialized needs of regional customers	0.22%	0.00%	0.91%	0.00%	0.00%	0.00%
State local regulations for production processes and product	0.66%	0.00%	0.91%	0.90%	0.00%	1.75%
State and regional environmental safety regulations	4.62%	6.80%	3.64%	5.41%	2.70%	3.51%
State and regional tax and incentives for investment in R&D	3.08%	4.85%	1.82%	2.70%	2.70%	3.51%
Predictability of government policies	7.47%	6.80%	4.55%	11.71%	6.76%	7.02%
Governments overall responsiveness to the needs of business	19.12%	30.10%	20.00%	15.32%	13.51%	12.28%
Level of competition in your industry	22.64%	27.18%	21.82%	16.22%	25.68%	24.56%
Quality and in-region location of your suppliers	5.71%	0.97%	7.27%	5.41%	8.11%	8.77%
Assistance from regional suppliers for new product and proce	2.42%	0.00%	3.64%	0.90%	4.05%	5.26%
Relationships between firms and organizations in your cluste	8.35%	5.83%	9.09%	6.31%	14.86%	7.02%
Participation with regional institutions in R&D efforts	4.62%	2.91%	8.18%	5.41%	2.70%	1.75%
Weighted Total Number of Respondents	455	103	110	111	74	57
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

Below is a list of actions governments at various levels can take that may help increase innovation in your region. How important is each, as a priority or continuing priority for government over the next five years?

### Promote world-class primary and secondary education

	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
1 (not at all important)	0.93%	0.60%	2.16%	1.01%	0.00%	0.88%
2	1.86%	1.81%	2.16%	0.51%	2.94%	2.63%
3	10.62%	7.83%	15.11%	5.56%	19.85%	7.02%
4	32.01%	34.34%	35.25%	27.27%	36.03%	28.07%
5 (critically important)	54.58%	55.42%	45.32%	65.66%	41.18%	61.40%
Weighted Total Number of Respondents	753	166	139	198	136	114
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### Promote specialized education and training programs to upgrade

1 (not at all important)	0.67%	1.21%	1.45%	0.51%	0.00%	0.00%
2	5.87%	8.48%	7.97%	4.59%	4.41%	3.51%
3	16.82%	24.24%	13.04%	12.76%	16.18%	18.42%
4	45.53%	42.42%	50.00%	42.86%	51.47%	42.11%
5 (critically important)	31.11%	23.64%	27.54%	39.29%	27.94%	35.96%
Weighted Total	749	165	138	196	136	114
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### Implement tax reform to encourage investment in innovation

1 (not at all important)	0.74%	0.60%	0.00%	0.51%	1.47%	1.77%
2	6.67%	5.99%	2.53%	6.63%	7.35%	14.16%
3	28.64%	27.54%	24.75%	31.63%	33.09%	26.55%
4	39.01%	41.92%	38.38%	42.35%	30.88%	39.82%
5 (critically important)	24.81%	23.95%	33.84%	18.88%	27.21%	17.70%
Weighted Total Number of Respondents	810	167	198	196	136	113
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
<b>Speed up regulatory approval processes in line with product</b>						
1 (not at all important)	5.03%	1.82%	5.73%	7.18%	6.77%	2.70%
2	15.08%	13.94%	13.54%	14.87%	18.05%	16.22%
3	32.04%	21.21%	34.90%	36.92%	35.34%	30.63%
4	32.16%	36.97%	29.69%	27.69%	30.08%	39.64%
5 (critically important)	15.58%	26.06%	16.15%	12.82%	9.77%	10.81%
Weighted Total Number of Respondents	796	165	192	195	133	111
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### **Simplify compliance procedures for government regulations**

1 (not at all important)	1.98%	0.60%	3.05%	3.05%	2.21%	0.00%
2	10.37%	5.99%	10.66%	8.63%	14.71%	14.16%
3	31.48%	27.54%	27.92%	35.03%	36.76%	30.97%
4	36.91%	43.11%	36.04%	37.06%	29.41%	38.05%
5 (critically important)	19.01%	22.75%	21.32%	16.24%	16.91%	16.81%
Weighted Total Number of Respondents	810	167	197	197	136	113
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### **Reform liability laws to stimulate and reward next generation**

1 (not at all important)	3.73%	2.44%	5.64%	4.57%	2.22%	2.65%
2	16.42%	15.85%	13.33%	16.75%	16.30%	22.12%
3	34.33%	31.10%	34.36%	32.99%	37.78%	37.17%
4	30.35%	26.83%	32.31%	34.52%	31.11%	23.89%
5 (critically important)	15.17%	23.78%	14.36%	11.17%	12.59%	14.16%
Weighted Total Number of Respondents	804	164	195	197	135	113
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
<b>Promote antitrust legislation to encourage competition</b>						
1 (not at all important)	18.20%	19.02%	20.62%	15.74%	16.91%	18.75%
2	34.04%	35.58%	35.05%	29.44%	31.62%	41.07%
3	30.67%	24.54%	27.84%	35.53%	38.24%	26.79%
4	13.59%	15.95%	13.40%	16.24%	10.29%	9.82%
5 (critically important)	3.49%	4.91%	3.09%	3.05%	2.94%	3.57%
Weighted Total Number of Respondents	802	163	194	197	136	112
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### **Support the particular needs of start-up companies**

1 (not at all important)	4.20%	4.19%	5.53%	3.59%	5.15%	1.77%
2	12.72%	12.57%	13.57%	8.72%	16.91%	13.27%
3	32.10%	29.34%	25.63%	36.92%	36.76%	33.63%
4	30.00%	35.33%	29.65%	32.82%	25.00%	23.89%
5 (critically important)	20.99%	18.56%	25.63%	17.95%	16.18%	27.43%
Weighted Total Number of Respondents	810	167	199	195	136	113
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### **Strengthen and modernize intellectual property protections**

1 (not at all important)	3.74%	3.66%	3.59%	3.57%	5.19%	2.68%
2	14.46%	7.93%	14.87%	14.80%	22.96%	12.50%
3	33.29%	25.00%	32.82%	37.24%	40.74%	30.36%
4	34.04%	45.12%	35.38%	31.12%	20.74%	36.61%
5 (critically important)	14.46%	18.29%	13.33%	13.27%	10.37%	17.86%
Weighted Total Number of Respondents	802	164	195	196	135	112
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
<b>Provide services to assist and promote regional exports</b>						
1 (not at all important)	8.31%	11.45%	7.07%	9.28%	5.19%	7.96%
2	24.19%	28.31%	22.73%	26.80%	22.22%	18.58%
3	36.72%	33.13%	33.84%	38.66%	34.81%	46.02%
4	24.94%	20.48%	27.78%	22.16%	31.11%	23.89%
5 (critically important)	5.71%	6.63%	8.59%	2.58%	6.67%	3.54%
Weighted Total Number of Respondents	806	166	198	194	135	113
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### Improve information and communications infrastructure

1 (not at all important)	3.35%	3.07%	4.06%	3.06%	4.44%	1.75%
2	12.80%	15.95%	13.20%	5.61%	14.81%	17.54%
3	32.55%	37.42%	30.96%	29.08%	37.78%	28.07%
4	34.53%	28.83%	37.06%	37.24%	31.85%	36.84%
5 (critically important)	16.77%	14.72%	14.72%	25.00%	11.11%	15.79%
Weighted Total Number of Respondents	805	163	197	196	135	114
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### Assist in attracting suppliers and service providers

1 (not at all important)	10.25%	16.67%	11.28%	10.20%	5.15%	5.41%
2	25.50%	29.01%	24.62%	21.43%	20.59%	35.14%
3	32.50%	29.63%	29.74%	35.20%	38.97%	28.83%
4	25.88%	20.99%	27.18%	27.55%	30.15%	22.52%
5 (critically important)	5.75%	3.70%	7.18%	5.61%	4.41%	8.11%
Weighted Total Number of Respondents	800	162	195	196	136	111
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
<b>Promote universal computer literacy</b>						
1 (not at all important)	3.44%	0.00%	4.62%	2.04%	3.70%	3.54%
2	13.62%	0.00%	16.92%	12.24%	14.81%	8.85%
3	32.55%	0.00%	33.85%	27.55%	36.30%	34.51%
4	33.80%	0.00%	30.26%	35.71%	31.85%	38.94%
5 (critically important)	16.59%	0.00%	14.36%	22.45%	13.33%	14.16%
Weighted Total Number of Respondents	639	0	195	196	135	113
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### Government support for funding of specialized research institutions

1 (not at all important)	7.58%	3.64%	7.69%	6.60%	13.33%	7.96%
2	24.22%	20.61%	29.23%	20.81%	28.15%	22.12%
3	33.66%	35.15%	32.31%	34.01%	35.56%	30.97%
4	23.73%	26.06%	21.03%	28.93%	17.78%	23.01%
5 (critically important)	10.68%	14.55%	9.23%	9.64%	5.19%	15.93%
Weighted Total Number of Respondents	805	165	195	197	135	113
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### Catalyze partnerships among government, industry and universities

1 (not at all important)	6.59%	6.13%	7.18%	7.11%	8.15%	3.51%
2	19.40%	20.25%	15.38%	18.27%	26.67%	18.42%
3	33.58%	38.04%	32.31%	32.49%	32.59%	32.46%
4	27.99%	24.54%	30.77%	28.93%	25.93%	28.95%
5 (critically important)	12.44%	11.04%	14.36%	13.20%	6.67%	16.67%
Weighted Total Number of Respondents	804	163	195	197	135	114
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

## RESULTS OF CLUSTERS OF INNOVATION INITIATIVE REGIONAL SURVEY

	Average of all Respondents	San Diego	Pittsburgh	Atlanta	Wichita	Research Triangle
<b>Improve transportation and other physical infrastructure</b>						
1 (not at all important)	1.37%	0.62%	2.04%	1.02%	2.96%	0.00%
2	4.60%	4.32%	8.67%	2.03%	5.19%	1.75%
3	19.40%	16.67%	22.45%	14.21%	31.11%	13.16%
4	32.96%	34.57%	36.22%	31.98%	28.89%	31.58%
5 (critically important)	41.67%	43.83%	30.61%	50.76%	31.85%	53.51%
Weighted Total Number of Respondents	804	162	196	197	135	114
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

### **Increase funding for university-based research**

1 (not at all important)	7.71%	3.64%	10.26%	8.12%	11.94%	3.54%
2	20.27%	16.97%	23.59%	14.72%	27.61%	20.35%
3	32.84%	32.73%	32.31%	33.50%	35.07%	30.09%
4	25.62%	23.03%	23.59%	29.95%	19.40%	32.74%
5 (critically important)	13.56%	23.64%	10.26%	13.71%	5.97%	13.27%
Weighted Total Number of Respondents	804	165	195	197	134	113
Row Percentage	100.00%	20.34%	24.46%	24.46%	16.71%	14.04%

# ABOUT

## THE CLUSTERS OF INNOVATION INITIATIVE PARTICIPANTS

### MICHAEL E. PORTER

Michael E. Porter is the Bishop William Lawrence University Professor at Harvard University and a leading authority on competitive strategy and international competitiveness. He co-chairs the Clusters of Innovation Initiative at the Council on Competitiveness and is a member of the Council's executive committee.

The author of 16 books and over 75 articles, Professor Porter's ideas have guided economic policy throughout the world. Professor Porter has led competitiveness initiatives in nations and states such as Canada, India, New Zealand, and Connecticut; guides regional projects in Central America and the Middle East; and is co-chairman of the Global Competitiveness Report. In 1994, Professor Porter founded the Initiative for a Competitive Inner City, a non-profit private sector initiative formed to catalyze business development in distressed inner cities across the United States. The holder of eight honorary doctorates, Professor Porter has won numerous awards for his books, articles, public service, and influence on several fields.

### COUNCIL on COMPETITIVENESS

The Council is a nonprofit, 501(c)(3) organization whose members are corporate chief executives, university presidents, and labor leaders dedicated to setting an action agenda to drive U.S. economic competitiveness and leadership in world markets. The Council helps shape the national debate on competitiveness by concentrating on a few critical issues including technological innovation, workforce development, and the benchmarking of U.S. economic performance against other countries.

The Council's work is guided by a 30 member executive committee. Chief executives of 40 of the country's most prominent nonprofit research organizations, professional societies and trade associations contribute their expertise as national affiliates of the Council.

## MONITOR GROUP

Monitor Group is a family of competitive service firms linked by shared ownership, management philosophy, and inter-related assets. Each entity in the Group is dedicated to providing products and services which fundamentally enhance the competitiveness of our clients. Our aspiration is to operate as an “intelligent switch” in a closely-linked global network of expertise and experience, not merely as a narrowly defined consulting firm, a research company or a merchant bank. We are dedicated to creating innovative, winning, action-oriented solutions by deploying our human, knowledge, and social assets in unique combinations dictated by each client’s unique circumstances—consulting interventions, capital infusions, deal structuring, management development programs, customized software, cutting-edge market research, and so on as appropriate.

Monitor Group is organized into three major operating units:

- **Monitor Action Group**, which consults to top management to help resolve their most important and intractable competitive problems;
- **The Monitor Merchant Banking Group**, which marries capital investment with advisory services to enhance company competitiveness;
- **The Intelligent Products Group**, which provides customized data and software products to support competitive decision making.



ontheFRONTIER, a Monitor Group company, has extensive experience in competitiveness assessment and cluster development projects throughout the United States and the world. Our private and public sector client base spans over twenty countries in North and South America, Europe, Asia, Africa and the Middle East. In addition, we have collaborated extensively with development agencies such as the World Bank Group and the United States Agency for International Development (USAID) on microeconomic development issues.

ontheFRONTIER’s work focuses on improving business competitiveness through building winning strategies, fostering cooperation among clusters of firms, and facilitating productive dialogue between private and public sector leaders to promote innovation. Our vast network of partners forms the basis of our collaborative effort to diffuse a new web-based set of offerings. We are working with financial institutions, industry associations, multilateral agencies, and others to diffuse web-based business strategy tools and insights to businesspeople around the world. For more information, please visit [www.ontheFRONTIER.com](http://www.ontheFRONTIER.com).