

Innovation America

Cluster-Based Strategies for Growing State Economies



Council on Competitiveness

Founded in 1908, the National Governors Association (NGA) is the collective voice of the nation's governors and one of Washington, D.C.'s most respected public policy organizations. Its members are the governors of the 50 states, three territories and two commonwealths. NGA provides governors and their senior staff members with services that range from representing states on Capitol Hill and before the Administration on key federal issues to developing and implementing innovative solutions to public policy challenges through the NGA Center for Best Practices. For more information, visit www.nga.org.

The Council on Competitiveness is a nonpartisan, nongovernmental action think tank located in Washington D.C. The mission of the Council is to set an action agenda to drive U.S. competitiveness, productivity and leadership in world markets to raise the standard of living for all Americans. The Council is the only group of corporate CEOs, university presidents and labor leaders committed to the future prosperity of all Americans and enhanced U.S. competitiveness in the global economy through the creation of high-value economic activity in the United States. For more information, visit www.compete.org.

Foreword

The National Governors Association's *Innovation America* initiative focuses on strengthening our competitive position in the global economy by improving our capacity to innovate. The goal is to give governors the tools they need to encourage entrepreneurship, improve math and science education, better align post-secondary education systems with local economic growth, and develop regional innovation strategies.

To guide the *Innovation America* initiative, we have assembled a bipartisan task force of governors and members of the academic and business communities. Working with the NGA Center for Best Practices, the task force is developing innovation-based education and economic strategies. Through a variety of forums and publications we will collect and share best practice information to ensure every state — and the nation — is equipped to excel in the global economy.

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Co-Chair, Innovation America Task Force

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Innovation America Task Force

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Preface

The Council on Competitiveness and the National Governors Association (NGA) collaborated on a cluster-based economic development initiative in 2002. Since then, the world has grown flatter, creative talent has become more mobile, and global outsourcing has become more common. As a result, firms in emerging nations today can quickly enter markets by integrating themselves in global value chains — combining investments from around the world with their own low-cost and increasingly high-skilled labor force.

The United States cannot compete with such high skill — low wage economies on the basis of costs. It must compete on the basis of innovation — the development and application of new ideas that create value. It is innovation that will enable the U.S. economy to continue growing and American families to enjoy a rising standard of living.

Recognizing the critical role innovation will play in driving America's future prosperity, Arizona Governor and NGA Chair Janet Napolitano has focused her Chair's Initiative on innovation and reached out to the Council on Competitiveness to once again work with the NGA. The Council welcomes this partnership and the vital role that governors play in addressing the country's innovation and competitiveness challenges.

The Council on Competitiveness has long championed regional and cluster strategies for economic development. Yet the nature of clusters must evolve in response to the changing and challenging global economy. This new publication offers a fresh examination of what cluster strategies work best in this new context as well as builds on the lessons of recent experience. We are pleased to join with NGA in publishing it.

Deborah Wince-Smith
President, Council on Competitiveness

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Executive Summary

Cluster strategies have the potential to accelerate regional economic growth, but only if they are properly understood and applied. This *Governor's Guide* examines the changing economic environment in which clusters function, summarizes the lessons learned from recent experience, and offers practical recommendations for cluster initiatives that governors can take to strengthen their states' economies.

A cluster is a group of firms, related economic actors, and institutions that are located near one another and that draw productive advantage from their mutual proximity and connections. They may be connected by functional relationship (e.g., suppliers and purchasers, producers and distributors) or by competition for similar markets. The most successful clusters are typically found in multi-county regions where participants can easily interact and leverage the same pool of labor and training assets. Firms that are part of robust clusters are in a stronger position to compete successfully in the global economy and thus to contribute to regional prosperity. Consequently, governors are keenly interested in strategies for promoting the emergence and growth of clusters, especially in high-wage, high-growth industries. The challenge is to develop effective strategies — ones that reflect an understanding of the complexities of cluster dynamics in a changing world.

Clusters are defined by relationships, not memberships, and spatial boundaries are variable and porous. Clusters are often interdependent and overlapping, with some companies being part of more than one. Their formation is usually serendipitous rather than engineered by government. Still, clusters are more likely to develop in regions that offer the needed human, intellectual, financial, and social capital and that nourish their growth through supportive public policies and programs.

Determining the regional location of the state's clusters is the starting point of any cluster-based strategy. Identifying clusters is still as much art as science, but a useful picture of clusters can be drawn by combining analyses of business sectors, employment, and wage data with regional observation and interviewing key business leaders. In doing so, however, it is important to avoid creating definitions and boundaries that are too narrow, that cannot adjust to constant change, or that discourage collaboration among clusters.

Once clusters are identified, there are at least five kinds of initiatives that policymakers can take to support their growth:

- **Establish a solid foundation:** Every cluster has some fundamental needs that are not cluster specific but that affect the ability of clusters to succeed. These include the region's educa-

tional assets, physical infrastructure, attractiveness to creative talent, and capacity for aligning the efforts of regional educational, workforce, and economic institutions. Governors are already doing much to promote improvements in these areas, but cluster-strategy development offers additional opportunities to focus the attention of key constituencies on the importance of these building blocks.

- **Build relationships:** Inter-firm collaboration facilitates learning and the aggregation of intangible assets, especially the tacit knowledge that resides within company employees and practices. State leaders can help by convening a cluster leadership council and supporting cluster associations.
- **Deepen skills and talent:** By nature, clusters attract and enhance talent, but government can reinforce this tendency by creating cluster hubs at community colleges, fostering cluster-focused professional science masters programs at nearby universities, encouraging cluster-training consortia, and encouraging cluster-based career advancement paths.
- **Align innovation investments:** States can realize higher returns on their investments in research and development (R&D), centers of excellence, and business innovation by focusing on clusters. In the process, they should keep in mind that innovation is about more than breakthroughs in science and technology; it also is about incremental improvements in products, services, and the processes for producing and marketing them — improvements that are often the result of new product designs and business models.
- **Accelerate entrepreneurship:** Talent and research are necessary, but it takes entrepreneurship to translate good ideas into successful products and services. Governors can promote entrepreneurship by supporting entrepreneurial networks, creating cluster-focused incubators, organizing small business centers around cluster expertise, and encouraging entrepreneurship education programs at high schools and postsecondary institutions.
- **Open global priorities:** Successful clusters extend their networks to distant competitors, vendors, and institutions. Government can help by supporting participation in international conferences, trade shows, and study tours; by providing export assistance; and by establishing cluster-based learning exchanges.

Cluster strategies are not silver bullets, but properly designed and applied, they offer a promising way to promote innovation, entrepreneurship, and economic growth.

Chapter 1 — Introduction

The concept of industry clusters has dominated economic development policy over the past two decades. Even before the term “cluster” entered the public policy vernacular, states targeted resources and investments to fortify their strongest sectors or to develop potentially competitive sectors. States directed funds to research centers, education and training programs, incubators, and industrial parks that focused on specific sets of industries.

In the late 1980s, however, states began to notice the competitive advantages and economic value added by “clustering” and “networking” among companies, and they began to support and encourage these interdependencies. A series of reports in 1989–90 for Florida by SRI International may have been the first official application of cluster analysis and use of the term “cluster” by a state.¹ The publication of Michael Porter’s path-breaking book on competitive advantage in 1990 provided a model that tied the various pieces together in a neat system. By the end of 1992, both Arizona and Oregon had formal cluster strategies in place. Before long, specialization rather than diversification became the sine qua non of regional economic prosperity, and clusters became the new organizing framework for economic development.²

This guide reviews what has been learned about clusters and cluster initiatives to date, suggests ways that governors can influence cluster growth and sustainability, highlights some of the changes associated with globalization, and describes some proven or promising cluster initiatives. It begins with a brief discussion of why firms have clusters and how changing global conditions affect the structure of and reasons for clustering. Then it turns to why clusters are important economic units for governors to target and describes the tools with which they can affect their shape and growth.

A. Clusters: A Confluence of Private Decisions and Public Policies

An industry cluster is a group of firms, related economic actors, and institutions that are located near one another and that draw productive advantage from their mutual proximity and connections. It is the key to understanding the performance of regional economies and the competitiveness of individual firms.³

One reason clusters are receiving so much attention is that they are based on observations of business behavior. Businesses have clustered for decades, indeed for centuries. Metal-working companies serving the Springfield Armory clustered along the Connecticut River valley as early as the 18th century, and by the end of the

19th century, manufacturers clustered in large cities networked and learned from one another — apparel in Philadelphia; plastics in Massachusetts; furniture in Grand Rapids, Michigan; jewelry in Providence, Rhode Island; and industrial machinery in Cincinnati, Ohio. By the first half of the 20th century, the film industry had concentrated in the Los Angeles area, finance in New York, insurance in Hartford, and automotive in Detroit. More recently, Silicon Valley has epitomized an environment that supports converging and overlapping clusters of high-technology companies.

Today, globalization is changing the geography of markets, competition, and cooperation. Yet companies continue to cluster and remain remarkably place based.

B. Clusters and Competitiveness in the Global Economy

Cluster strategies take on new significance in today’s global economy. Trade agreements and major advances in communications and transportation have reduced trade barriers and created an extremely competitive global economy. Although competition in this global economy is sometimes viewed as between nations, it really is between high-performing economic regions. Exporting firms in Phoenix are as apt to be competing with firms in Bangalore, India; Guang Zhou, China; or Dublin, Ireland as with firms around Boston, Austin, or northern Virginia. These innovation hot spots with fast-growing, high-wage companies and strong regional assets — such as quality educational institutions and a robust R&D environment — are the catalysts for growth in the world economy. The relative competitiveness of a nation’s innovative regions that trade international goods and services will determine the relative wealth of that nation over time.

Because the United States is a high-wage nation, its ability to compete through low-cost production of internationally traded merchandise is limited. Scores of regions around the world now are able to acquire and use advanced equipment and have a workforce skilled to use it. Overnight deliveries combined with the Internet have elongated and extended supply chains. Information is accessible and shared on the Web in milliseconds, and virtual Web-based social networks crisscross countries and cultures. Technology and capital are highly mobile. Even some of the research and development that the United States once thought was its core strength is being outsourced.

The result is a shift of certain traditional advantages to new clusters in emerging Asian and Eastern European economies that are capturing increasing shares of U.S. markets. In China each year, Datang produces 9 billion pairs of socks, Chaozhou makes 510

million wedding and evening gowns, and Shengzhou manufactures 300 million neckties.⁴ Even high-tech development and production, once thought to be safely ensconced in the United States, where most of the engineers and scientists were working, is being outsourced. Taiwan designs and assembles 65 percent of the world's notebook PCs.⁵ A recent survey of 186 of the world's largest corporations found that 77 percent will build new R&D centers over the next 3 years in India or China.⁶

Place still matters to companies, but the reasons have changed. Supply chains now often span the globe, particularly in situations where little face-to-face interaction with suppliers is needed and where the tasks involved can be codified and the work product digitalized.⁷ Intangible factors, such as access to tacit knowledge, experienced workers, sources of design and innovation, and opportunities to network and collaborate, have become a more important reason for clustering than the tangible factors associated with the proximity of suppliers and customers. Innovation still continues to thrive best in the hot-house environment of clusters and is more important than ever.

C. Why Clusters Are Important to Governors

Clusters are of interest to governors because they can help power a regional economy by boosting innovation, wages, employment opportunities, entrepreneurship, and business diversification.

Clusters boost innovation. The increased competition and cooperation among firms in clusters drives innovation. The presence of local competitors keeps leading firms from becoming complacent. The existence of local suppliers, research institutions, and related firms allows firms to innovate more effectively. A Council on Competitiveness survey found that three-fourths of companies collaborate with their suppliers and customers to innovate, three in eight collaborate with similar companies and industries, and almost a third collaborate with university faculty.⁸

Clusters lead to higher wages and productivity. A 1997 study conducted at the United States Department of Agriculture (USDA) Economic Research Service found that average earnings in rural counties that have high shares of particular industry classifications, defined as clusters, were higher than in rural counties without clusters.⁹ A 2006 study across Canada found that between 1998 and 2005, both employment and average income in clustered industries in “city-regions” grew more than twice as fast as in non-clustered industries.¹⁰

Clusters improve employment opportunities. Where firms are clustered, employers tend to attract and compete for similar talent. As a result, pipelines for employment often develop between local schools and businesses, and community- and school-based “grapevines” quickly circulate information about job openings, career opportunities, and workplace conditions.

Clusters stimulate regional entrepreneurship. Joe Cortright notes in a 2006 study that “more than 80 percent of the scientists in California research institutions that went on to start their own biotechnology firms did so in California.”¹¹ Pharmaceutical firms have been found to benefit twice as much from research produced locally as they do from research produced elsewhere. Opportunities are more transparent, role models more visible, and opportunities — to supply, compete, or complement — more available in clustered economies.

Clusters aid diversification and improve regional sustainability. Clusters often lead to new industry development, driven by people who shift their knowledge, skills, technologies, and/or talents to different products or services or new markets. New York City's fashion apparel cluster generated an industrial and graphic design cluster, and the polishing skills needed for central Minnesota's granite industry cluster led to the development of an emerging prescription lens cluster.

D. Policy Tools for Cluster Development

It is important to recognize that states rarely, if ever, have the ability to create clusters out of whole cloth. However, governors and state policies can play a significant role in facilitating the development of clusters and aiding their sustainability. In particular, governors can do much to aid clusters by exercising their role as convener and using the bully pulpit. Governors also can drive clusters through tax policy, education and training, research investments, regulatory streamlining, and encouraging access to seed and venture capital.

Convening. A major element of cluster growth is bringing private sector leaders together with public leaders, including elected officials, education leaders, and even nongovernmental entities. The governor's office is the most effective entity to ensure that all the key organizations are brought to the table, and it can be instrumental in brokering partnerships and networks. Governors also can appoint special liaisons to work with clusters, thus building the capacity to understand their needs and challenges.

Using the bully pulpit. By talking up clusters in public forums locally and when conducting trade and business development

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visits, governors can play a major role in convincing businesses, investors, and skilled workers that their states are serious about supporting their strategic growth industries. Governors who are knowledgeable about their clusters show investors they care about nurturing these emerging and growing sectors and can help bring capital and talent to the regions. Using the bully pulpit also means aggregating economic information in a way that captures clusters so that the state can track and report on cluster performance.

Implementing tax policy. Tax policy can be used to encourage and support cluster activities. For example, R&D tax credits can reward clusters that are R&D intensive. Likewise, tax incentives that reward businesses for providing industry-specific worker training or for creating high-wage jobs also can be effective. Designing tax policy around clusters is important because many clusters may not be able to take advantage of tax incentives that focus only on capital purchases (many clusters involve service industries, require highly skilled talent, and are not capital intensive).

Funding education and workforce training. Education and training are among the largest of state expenditures and are perhaps the most powerful tools at the disposal of a governor for shaping industrial policy. The quality of K–12 education is one of the most important factors that people and companies evaluate in their location decisions, and the type and quality of higher education is critical in producing and attracting the skilled talent that high-tech businesses need in the region. Moreover, a flexible and responsive community college system is key to providing the type of workforce training needed for fast-growing clusters.

Encouraging research investments. Governors can support clusters by investing in related research in state universities and in the private sector through direct state investments or challenge grants. Governors also can provide matching dollars to federal research grants in areas considered important to the states' clusters.

Moreover, to demonstrate a long-term commitment to cluster development, many states have created large, multiyear “innovation” funds directed at supporting research in targeted areas fundamental to a region's clusters.

Streamlining regulations. To support clusters, states can employ a streamlined regulatory policy that is tailored, flexible, and responsive. The use of technology such as on-line filing can simplify the administrative burden of regulations; such streamlining can be particularly helpful to small and start-up firms. Occasionally, regulatory choices can directly spur industry creation. In Delaware, the deregulation of interest rates charged by lenders led to the growth of the financial services (and particularly credit card) sector in Wilmington. In California, strict environmental regulations and incentives have helped catalyze a significant concentration of environmental technology firms.

Improving access to seed and venture capital. Most private seed and venture capital is concentrated in just a few areas of the country. To counter this, many states have improved access to such loans by starting their own funds or investing state dollars in a larger fund that serves the area. Although most state programs do not target clusters, venture capital funds can be specialized. For example, 40 percent of all investments in 2005 went to biotechnology or software companies, and two-thirds went to just six high-tech industries.

Purchasing local goods and services. The state can choose to support clusters in its role as purchaser. The state typically is the largest purchaser of certain goods and services, and choosing to buy from regional clusters, such as office supplies, alternative energy, and processed foods, rather than from outside the region creates a market and sends a message to others to buy locally where possible. Kentucky and Montana, for example, purchase furnishings from their wood products cluster for their state park systems.

Chapter 2 — Understanding Clusters and How They Form

Although clusters are now fully integrated into the conventional economic development vernacular, there is still no general agreement on what constitutes a cluster. Nevertheless, sufficient guidance exists to allow most states and regions to recognize and understand their clusters so that they can design strategies to nurture and sustain them.

A. Defining Clusters

A cluster can be defined as a group of interdependent companies, organizations, and institutions in a geographic region with common or complementary interests that have reached sufficient scale to develop specialized expertise, services, resources, suppliers, and labor.

Rural areas often worry that they can not support legitimate clusters because of their lack of industrial density. The scale necessary to be considered a cluster, however, depends on size of place and degree of specialization. In less populated areas, smaller numbers of similar companies constitute a significant local cluster, such as the 11 houseboat builders around Lake Cumberland, Kentucky, that dominate the high-end boat market.

Texas's Clusters

Governor Perry of Texas defined an industry cluster in SB275, Government Code, Section 481.001 (6) as “a concentration of businesses and industries in a geographic region that are interconnected by the markets they serve, the products they produce, their suppliers, the trade associations to which their employees belong, and the educational institutions from which their employees or prospective employees receive training.” The same code directs his office to cooperate on developing strategies that strengthen all clusters and to specifically target six types: semiconductors, ICT, microelectronics, energy, nanotechnology, and biotechnology.

B. Common Characteristics

Clusters also demonstrate the following characteristics:

1. ***Clusters are often connected by common resource needs, technologies, or interests as well as by products.*** Companies may cluster around many types of needs and interests. The glue could be a critical core technology or process that defines

a set of products, such as optics and imaging or composites. None is easily identified through existing industry classifications. Companies also could be connected by a common dominant production process. Many plastics clusters include large members that are primary users of plastics technologies but that also are classified under consumer electronics (e.g., BIC) or toys (e.g., Lego). Some of the biggest Web-design firms are listed as advertising companies (e.g., DoubleClick), not information technology. Clusters also form around common functions, such as logistics and warehousing, transportation, design, R&D, or administrative headquarters. In northwest Arkansas, for example, Wal-Mart, Tyson's, J.B. Hunt, and Arkansas Best anchor a prolific supply-chain logistics cluster that includes the offices of more than 1,000 suppliers.

2. ***Clusters may be interdependent and overlapping.***

Companies can be in more than one cluster, depending on whether the relationships are similarities, commonalities, or complementarities. The ongoing convergence of technologies is making it even more difficult to pigeonhole a particular company. An advertising company could be considered part of design, multimedia, and information technology (IT) clusters (only about 10 percent of the IT companies in most IT clusters have IT industry classifications). A winery could be included in food processing, tourism, or biotech clusters. Overlapping memberships add to the synergy but also the complexity of clusters.

3. ***Spatial boundaries of clusters are variable and porous.***

Cluster geography, in the loosest sense, is defined by the distance and time that people are willing to travel for employment and that employees and owners of companies consider reasonable for meeting and networking. Geography is influenced by factors such as travel conditions, cultural identity, and personal preferences. For example, officers of metals companies in western Minnesota and eastern North and South Dakota drive up to 100 miles to attend meetings of the Tri-State Manufacturing Association. In places where rugged mountains or forests divide towns, making travel times longer, as is the case in many parts of Appalachia, people may only be willing to regularly travel 15 or 20 miles. In densely populated neighborhoods with strong cultural identities and invisible boundaries, distances may be measured in city blocks. Silicon Alley is concentrated in Manhattan, mainly south of 41st Street. Whatever their boundaries, virtually all clusters include more distant companies that have special relationships with, and are treated by, members as insiders.

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4. **Clusters depend on talent.** Three-fourths of human resources managers recently surveyed said that “attracting and retaining” talent was their number one priority.¹² In today’s global economy, companies depend more than ever before on highly educated and/or creative employees who are problem solvers and idea generators, sometimes called the “creative class. Talented people, be they scientists, managers, artists, or designers, tend to choose to be near others with common interests and lifestyles and where cultural and recreational amenities are plentiful. Although researchers and the press focus on the creative classes in large cities, some small cities and towns have been able to attract talented workers, especially those starting families. Places with cultural and recreational caches without the high costs of living associated with cities, such as Kalispell, Montana; Asheville, North Carolina; Northampton, Massachusetts; and Brattleboro, Vermont, are becoming meccas for entrepreneurs and innovators.

C. Forming Clusters: Serendipity and Strategy

Clusters don’t happen overnight. It takes considerable time, usually decades, for clusters to develop and evolve. Case studies of clusters show that their origins generally have been serendipitous events rather than consciously designed policies. However, their formation often is aided by their business environment, which can include supportive public policies, attractive local resources, a talented and creative labor pool, strong educational assets, and first-class research and development institutions.

Stanford University’s research and entrepreneurial culture was important to the development of a semiconductor cluster and Silicon Valley, North Carolina’s Research Triangle Park to the development of its biotechnology cluster, Minnesota’s health care system to the development of its medical devices cluster, Santa Fe’s landscape to the development of its arts cluster, Alabama’s steel and metals industries and training programs to the development of its automotive cluster, and Chicago’s multimodal transportation system for agriculture to the development of its food-processing cluster.

The prime movers of cluster growth are entrepreneurs. As clusters form, entrepreneurial firms provide information about new opportunities, become role models for yet more start-ups, and generate spillover knowledge about technologies, markets, and customers, all of which help reduce the risks of starting a new business.¹³ Employees — often from a small number of founding firms —

may see and seize opportunities to convert the skills they’ve honed on the job into new businesses that fill gaps in the cluster’s value chain, create new and innovative applications, manufacture complementary or even competitive products, or simply find and compete in niche markets. After enough companies form, a support structure begins to take shape, and a local buzz develops that attracts companies and services from other places. The cluster embarks on a trajectory in which future growth comes from an accumulation of experiences, competencies, and innovations — a type of “path dependency.”¹⁴

Once a core cluster activity begins to generate economies of scale and demonstrate growth potential, public policies become even more important, priming the pump and easing the nascent cluster along. Rates and trajectories of growth can be influenced by public policies. In almost every cluster success story, public policy played a key role by filling gaps or overcoming weaknesses in critical factors, recruiting new members, and providing incentives for innovation.

California’s investment in biotechnology research and its community college-based training programs for biotechnology technicians have been critical to the growth of that cluster. Alabama’s customized training, technology centers, and sizable tax incentives were primary catalysts for the growth of an automotive cluster. New York’s ceramics cluster got a boost from the state’s investment in the Center for Advanced Ceramic Technology, its Ceramics Corridor Innovation Centers, and the Appalachian Regional Commission’s entrepreneurship programs. Business decisions generate clusters, but the public sector can seed, encourage, and support their growth.

Mississippi’s Furniture Cluster

The furniture cluster in northeastern Mississippi was founded in the late 1940s when Morris Futorian, an immigrant artisan in Chicago, was looking for a place where he could apply Fordist mass production principles to the manufacture of furniture. He found Mississippi more welcoming than places where furnitu remaking was still very much a craft and also found an endowment of raw materials and surplus labor. A cadre of entrepreneurial employees — who referred to themselves as graduates of “Futorian University” — did the rest. The cluster got a boost, however, from a supportive and innovative community development foundation, an advanced technology upholstery center at Itawamba Community College, and business assistance from Mississippi State University.

Chapter 3 — Identifying a State’s Clusters

The starting point in any cluster-based strategy is determining what and where a state’s clusters are. Identifying clusters is still as much art as science. It requires decisions based on imperfect data, local knowledge, informed but subjective choices, and political considerations. In Europe, no data analysis is needed to identify industrial districts; evidence of the cluster’s presence pervades the community and tourist literature. In Udine, Italy, a province that produces half the chairs sold in Europe, a giant chair graces the front of the provincial exhibition hall. The streets of Sassuolo are lined with tile designers, tile showrooms, and displays.¹⁵

In contrast, in America as well as in many other developed nations pursuing cluster strategies, clusters are more dispersed and concealed within larger, more diversified economies. Further, in America, companies and workers are more foot loose than their European counterparts, and clusters develop around less easily identifiable assets, such as core technologies, similar production processes, critical natural resources, or cultural factors.

As a result, there exist two general processes for identifying clusters. The first is the *algorithmic* approach, based on the economic data that are available by place and type of business. It uses available data to measure the scale, concentration, and changes in pre-selected combinations of sectors. The second is a *heuristic* approach, a discovery method that relies on case studies, self-identification by businesses and associations, the news media, business directories, and local knowledge to identify regional areas of economic specialization and interdependencies. The former works well for traditional, product-based clusters, but the latter is required to find most of the clusters that are beginning to develop. Comprehensive cluster identification efforts will employ both approaches.

A. Clusters by the Numbers

Most analyses of clusters begin with an analysis of the numbers and relative (to state or national) concentrations of establishments and employees for specified sets of industries within designated geographic boundaries. The primary source of this information is generally the federal employment and wage data required for unemployment compensation (ES-202), which is sorted by establishments, counties, and the North American Industrial Classification System (NAICS)

The most important, and most subjective, step in all algorithmic methods is to determine which sectors are similar or interdepend-

ent enough to collectively represent and, for policy purposes define, a “cluster.” Just how similar or interdependent sectors must be to be grouped into a cluster and the size of the geographic region are critical decisions that affect size and concentration. A recent book on the new media clusters had eight definitions for a new media cluster.¹⁶ Once those decisions are made, establishment and/or employment data are aggregated and compared with other places in terms of totals, concentrations, and growth.

Most analyses set threshold levels of size and concentration to be considered a “cluster,” and they favor “traded clusters,” which export products or services out of their region — although consumption-based clusters that divert expenditures from other places to local purchases also add value.¹⁷ Including many sectors in a cluster, which is a common tendency, increases the scale of the cluster and strengthens political support but weakens relationships among members who have less in common and reduces advantages of specialization. Companies in clusters such as business services, advanced manufacturing, or knowledge industries have less in common than companies in biotech, furniture, or multimedia clusters but exist in larger numbers. When the criteria are more restrictive, clusters become less common and more specialized.

Once standard sectors are aggregated into clusters, it opens the door to a variety of other quantitative measures of cluster strength and impact. One common extension of the core cluster firms is the number of regional companies in its value chains, the companies downstream that supply them, and the companies upstream that add further value. These numbers are generally based on the national input-output tables that estimate the value of inputs from contributing sectors to products and the contribution of the product to other sectors of the economy. The presence of companies that match the value chains in a region is a valuable approximation of the total scale of a cluster because clusters include value chains. It should be used as a wish list rather than an indication of actual supplier relationships; local firms with supply chain NAICS codes may not have the right qualifications or competencies.

Another important measure is the scale of and trends in exports. Clusters with large export markets have greater impact on the wealth of a regional economy. Other measures used to estimate the potential and value of a cluster are rates of innovation — generally by using patents as a rough proxy, wages, and productivity.

The power of the use of algorithms lies in the ease of use and replication over time and across regions. One drawback to relying on databases is that each company is assigned a single industry classification when many firms actually have more than one.

Cluster-Based Strategies for Growing State Economies

Table 1: Examples of Quantitative Sources of Information

| Source | Data |
|---------------------------------|---|
| ES 202 database | Establishments, employment, wages by county |
| County Business Patterns | Establishments by size, employment, wages by county |
| Dunn & Bradstreet | Establishments, employment |
| Bureau of Labor Statistics | Wages by occupation, location quotients for counties |
| State manufacturing directories | Products, location, number of employees, industry codes |
| Bureau of Economic Analysis | Demographics, employment by industry, incomes |

Table 2: Heuristic Methods

| |
|---|
| • Rely on local knowledge to identify economic strengths and assets |
| • Interview companies |
| • Review recent regional plans |
| • Consider secondary industry classifications |
| • Identify sources of greatest demands for workers and training |
| • Look for business networks, interest groups |

B. Clusters by Searching and Scanning

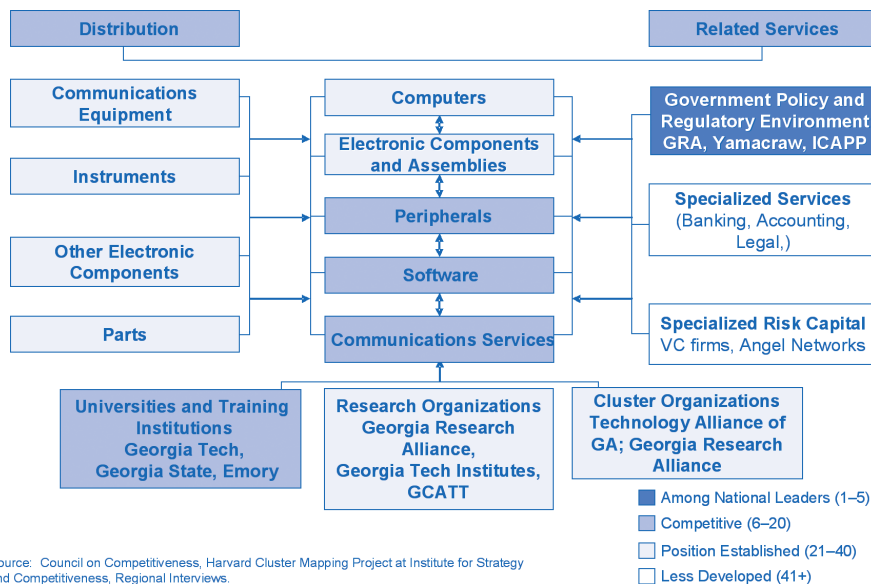
Albert Einstein had a sign hanging in his Princeton office that read, “Not everything that can be counted counts, and not everything that counts can be counted.”

An alternative — and frequent supplement — to the quantitative approach is the *heuristic* approach. It relies on observation, case studies, and local experience to identify clusters that may be too

small, may bridge political boundaries, or may be based on unrecognized businesses or unrecorded interdependencies to fit data-driven methods. It also allows groups of companies with common interests that have developed a collective identity to demonstrate that they have the attributes of a “cluster.” The technology-based optics and imaging cluster in and near Rochester, New York, for example, covers a wide range of industry codes and is held together by professional relationships, the historical presence of Kodak and Xerox, and university research.

A heuristic approach layered on data analysis can be used to make modifications — often large enough to alter the significance of a cluster. For example, many companies do not have industry classifications that match their relationships to a cluster. DoubleClick in New York City is classified as “media representative” although its specialization in digital advertising places it in the information technology cluster. In Connecticut, Lego, which produces plastics parts and has been a key member of the state’s plastics cluster, is classified as a toy manufacturer. In western Massachusetts, Yankee Candle, the largest employer in the region’s creative enterprise cluster, is classified as “all other miscellaneous manufacturing.” Leading employers in Oregon’s strong sports apparel cluster that manufacture overseas, such as Nike and Adidas, are classified under distribution, not production industry codes. (See Chart 1 for an example of a cluster map that incorporates qualitative and quantitative data.)

Chart 1: Example Cluster Chart: Atlanta Regional Information Technology Cluster



Source: Council on Competitiveness, Harvard Cluster Mapping Project at Institute for Strategy and Competitiveness, Regional Interviews.

Table 3: Examples of Emerging Clusters that Lack Descriptive NAICS Codes

| |
|--|
| • Alternative energy |
| • Composites |
| • Complementary and alternative health |
| • Motorsports |
| • Design enterprises |
| • Mining services |
| • Fine furniture |

The heuristic approach is almost essential to finding micro-clusters. Rural clusters often depend more on a sense of how local businesses relate to one another than on comparative concentrations or scale. In rural areas, clusters may need larger areas, more diverse membership, and more active cooperation to be called a cluster. Some groups of companies in more densely populated rural areas may function as satellites of stronger clusters in nearby metropolitan centers. Heavy lift helicopters in southern Oregon; wind sports in Hood River, Oregon; renewable energy in southwestern Minnesota; and houseboats on Lake Cumberland in Kentucky are distinctive and dominant micro-clusters that would not easily be found by analyzing data. Gathering this knowledge requires going directly into communities.¹⁸

C. Under the Radar

Even careful heuristic approaches miss many important but perhaps unorthodox clusters — especially if they represent newly emerging industries that lack classifications or are dominated by self-employed workers, freelancers, misclassified workers, or part-time companies. The large and growing alternative and complementary health cluster around Asheville, North Carolina; maple syrup in Vermont, and alternative energy in southwestern Minnesota are significant local clusters that lack industry classifications and defy easy measurement.

Perhaps the most common oversight in cluster analysis is the growing numbers of micro-enterprises and entrepreneurial businesses that represent large proportions of some key clusters. Some numbers are available in national self-employment databases but are either not included in cluster analysis or are not available at a sufficiently specific level of industry classification. Florida’s information technology industry cluster, for example, lists on its cluster Web

site 62,680 employees in its software and computer systems subtotal — but misses more than 18,000 who are self-employed, which would boost the number by almost 30 percent. Nationally, 53 percent of multimedia artists, 60 percent of photographers, 32 percent of designers, and 22 percent of architects are self-employed. Further, self-employment numbers may be quite conservative. A recent national survey estimated that a “business without employees actually has, on average, more than 1.7 employees (e.g., family members, helpers, apprentices).”¹⁹

The creative cluster includes companies that take their principal competitive advantage from a distinctive appearance, form, content, or sound embedded or embodied in their products or services. It includes artists and artisans; digital, media, and graphic arts; architectural, landscape, and graphic design; advertising; interior decorating; fashion apparel; and fine furniture as well as all the sectors that supply, support, reproduce, distribute, and market their products.

Montana’s creative enterprise clusters in 2004 employed about 5 percent of the work force — nearly as much as manufacturing. New York City has 11,671 businesses in the creative core, accounting for more than 8 percent of employment and 5.7 percent of all employers.²⁰ Some have called the creative cluster a “keystone species” because its impact on a region is disproportionate to its size; it influences overall quality of life, residential desirability, and creative and innovative milieu.

Table 4: Comparison of Data-Driven and Knowledge-Driven Methods

| | Algorithmic Approach | Heuristic Approach |
|------------|--|---|
| Strengths | Standardized and comparable Inexpensive Compatible with national value chains | Flexible Depth of understanding Uncovers unconventional clusters Identifies rural clusters |
| Weaknesses | Inflexible Limited to NAICS codes, political boundaries Ill-suited to creative sectors | Imprecise Difficult to aggregate Labor intensive |

Cluster-Based Strategies for Growing State Economies

Because clusters are regional systems, not aggregations of firms, they include an array of supporting institutions, associations, and organizations, and clusters can only be understood by including those members not classified by industry codes and by mapping the connections among the elements. The specialized institutions and services that support the clusters are generally found through a mapping process using focus groups of and interviews with people from leading companies and other organizations that know and understand the cluster. The inventory of members and forms of relationships are generally refined and expanded in the first stages of cluster mobilization.

The focus groups and interviews also should reveal the leading innovators and exporters in the cluster, strengths and weaknesses in the support structure, and external linkages. A short survey can provide basic information about supply chains and relationships among firms and institutions to estimate the relative mix among regional, state, national, and international linkages.

One product of such an analysis is giving a subjective value to key factors, such as the analysis used in Montana, which was created by a contracting firm but was based on regional input and subject to cluster review (Table 5).

Arkansas's Creative Northwest

The northwestern corner of Arkansas, from Fayetteville north to the Missouri state border, has been for decades a poor, isolated rural region heavily dependent on agriculture and traditional manufacturing. It also was known for its rich endowment of arts and culture, but this was not viewed as an amenity and was not an economic driver. Eureka Springs in Carroll County has been its hidden gem, a draw for artists, writers, and artisans and an attraction for tourists; it was recognized as one of the “100 Best Arts Towns in North America.” Today, the rapid growth of the region energized by the logistics needs of Wal-Mart, Tyson, J.B. Hunt, and Arkansas Best is creating a concomitant growth of the creative economy to support the cultural base that attracts talent. The region has about 5,500 employed or self-employed full time in its creative sectors. The growth centers of the region's economy in addition to Eureka Springs are Fayetteville, through the efforts of the Fayetteville Downtown Partners to transform the downtown into a cultural arts district, and of the Walton family to build the world-class Crystal Bridges Museum of American Art, which, when it opens in 2009, will herald a new arts era in the region.

Table 5: Montana Wood Products Competitiveness Factors

| Factor | Rating | Comments |
|----------------------------------|--------|---|
| Skills and labor | 7 | Labor in short supply, few educational programs target sector. Most learning informal or through private trainers. |
| Relationships and social capital | 5 | Strong associations and some informal networking, but companies still view each other mainly as competitors. |
| Suppliers and services | 7 | Even though reductions in lumber supply and mills cause consolidation, cluster has strong supply chains. |
| Marketing and transportation | 2 | Very high cost, difficult to transport logs out of forests and to customers. |
| Technology and innovation | 8 | Adoption of new technologies by firms, strong support from Montana manufacturing extension and cooperative extension. |
| Entrepreneurship | 4 | Becoming more costly with mechanization, and support from banking industry more common at high value-added end of market. |
| Equity and opportunities | 7 | Lack of formal education not a limitation and good paying jobs available to anyone willing to do the work. |

Chapter 4 — Initiatives to Grow and Sustain Clusters

Once clusters have been identified, mapped, and named, the real challenge begins. What can governors do with this knowledge that advances the growth, competitiveness, and sustainability of their states' clusters? How can deeper understanding be converted into effective actions and successful outcomes? The rubber meets the road in formulating and launching “cluster initiatives,” the name given to projects, resources, and investments that benefit a specific set of industries and region.

The sections that follow explain a variety of promising cluster initiatives that have been used in various forms. Each is either a current or recent cluster initiative in some region, an initiative not intended as cluster-specific but typically implemented by clusters, or a general initiative that could be more effective if targeted to clusters.

A. Establish a Solid Foundation

Every cluster has some fundamental needs that are not cluster specific but affect its ability to compete with other regions and other nations. The nation's earliest cluster strategies, which were designed by SRI International in the late 1980s, listed seven economic foundations: a competitive tax and regulatory environment, skilled human resources, accessible technology, capital availability, physical infrastructure, quality of life, and economic development programs. As the understanding of clusters has improved, it has become clear that some of those foundations are of more value when they are more specialized. Some aspects of skills, technologies, tax and regulatory environments, and economic development programs, for example, are specific to certain clusters. Three areas that continue to undergird — and undermine, where deficient — most if not all clusters are the creative milieu, which is an element of quality of life; basic education; and physical infrastructure. For more on these, especially education, see the companion documents being simultaneously published under the NGA *Innovation America* initiative: *The 2007 State New Economy Index* and *Building a Science, Technology, Engineering, and Math Agenda*.

B. Build Relationships

The real strength of clusters lies in their intangible assets, particularly the tacit knowledge that resides within the employees and routines of companies in the cluster and the mechanisms for sharing it across companies and institutions. A century ago, Alfred Marshall described clusters as places where “ideas moved easily

from firm to firm as if knowledge was ‘in the air.’”²² Even in the 21st century, wired America, with clusters and people more dispersed within regions, local buzz keeps ideas flowing and companies innovating. In more diversified modern economies, the knowledge that was once simply something in the air still is more likely to be confined to cafes, coffee shops, and conference hallways. Thus, clusters depend much more on formal organizational frameworks to facilitate the sharing of knowledge as well as for working together toward common goals and solidifying their collective presence.

Therefore, almost every cluster program begins with a mobilization strategy. Clusters have become virtually synonymous with membership organizations designated to represent them, variously called councils, associations, partnerships, or networks. These organizations have become powerful voices for their members, mechanisms for engaging industry and aggregating needs and demands, pipelines for getting information to members and to government, platforms for networking and learning, and, in some cases, pathways of obtaining public monies into the cluster. As such, they have become important to the success of some clusters.

Florida's Technology Coast Manufacturing and Engineering

In 1991, a group of defense contractors in Florida's panhandle was invited to a conference about Italy's industrial districts and the value of collaboration held at Okaloosa-Walton Community College. Based on what they learned about networks in Italy's industrial districts, about 30 companies formed the Technology Coast Manufacturing and Engineering Network (TeCMEN). With initial support from the state and foundations, members of the network hired a director, solidified their relationships with regular meetings and events, collaborated on training, jointly bid on contracts, and visited federal labs together to find research that could be commercialized. Networks formed, and members made deals following meetings or over coffee. Now managed by the Economic Development Council of Okaloosa at the college, TeCMEN's current official mission statement is “to promote the economic and technological growth within Okaloosa's defense community through the association, collaboration, and contract-teaming of its manufacturing and engineering-based companies.”

Cluster-Based Strategies for Growing State Economies

Although Arizona and Oregon were the first states to support cluster associations, in other regions, associations were forming spontaneously. In some places, the catalyst was isolation from sources of innovation and markets; in others, it was real or perceived external threats to an industry. A small group of metalworking companies in western Minnesota formed the Tri-State Manufacturers Association to discuss common concerns and soon attracted more than 100 member companies, reaching into eastern North and South Dakota to companies that had similar needs. The Technology Coast Manufacturing and Engineering Network formed in 1991 with support from the Florida legislature, partly in anticipation of reductions in defense spending, after learning about the Italian artisan associations and networks at a local conference.

In recent years, a new generation of cluster associations is emerging that focuses more on industry leadership than on extensive broad-based membership. These leadership or innovation councils, which are limited in size, are charged with setting priorities and generating resources for the cluster and often are held accountable for a cluster's activities. Cluster leadership councils have roles to play but are not the same as the more inclusive associations that create the conditions necessary for networking, learning, and innovation throughout the cluster.

Cluster associations, in contrast to leadership groups, are intended to build trust among members to work collectively toward common goals, share nonproprietary knowledge, and network. A membership roster, however, does not define a cluster. Nonmembers miss out on the access to services provided by and relationships developed within the associations, but they can still benefit as “free riders” from specialized public and private services, labor pools, and local knowledge. In some places, the strength of social foundations precludes the need for an organization. Northeast Mississippi's furniture cluster is a case in point; its high concentration and strong community connections obviate the need for an industry organization.

The experiences of cluster organizations over almost two decades have produced useful lessons for what to do and not to do in building cluster organizations (Table 6). Many cluster organizations face the same obstacles that networks did a decade earlier: inability to show early returns to time invested; lack of company leadership; and formation in response to incentives or exhortation rather than need. The early stages of organizational development often get press coverage and bring a sense of excitement. But after meetings become routine, only the associations that meet immediate needs or provide real services survive. Having a designated facilitator or cluster manager often helps provide continuity and supports sustainability.

INITIATIVE: CONVENE A CLUSTER LEADERSHIP COUNCIL

States should look first to the business leaders from within the cluster to help better understand the cluster's assets, needs, and challenges and to lend their support, often the first step in a mobilization process. Governors can play a critical role in getting the right leaders to the table. Leadership councils generally represent the sub-sectors in the cluster: executives of leading large and small companies; associations and nonprofits serving the cluster; major providers of services, capital, education, and training; and, in the case of interdependent clusters that have already formed, other cluster leadership groups. The councils, staffed by people intimately familiar with the industry, can either have an indefinite life span or be organized with a finite life span, turning over responsibilities to whichever organization steps up to represent the cluster.

The leadership council typically begins with some sort of diagnostics, such as identifying the most pressing needs — including social issues that affect the cluster's region, work force, and quality of life — and recommending strategies and setting priorities. It helps to involve public sector officials at levels roughly equivalent with the business executives and to maintain a high level of visibility within the business community. The kinds of activities of cluster-oriented leadership organizations, such as those formed for San Diego and Silicon Valley in California, in Connecticut, and in South Carolina have been neatly defined by the California Regional Economies Project down to levels of detail as minute as how to arrange meeting rooms.²³

INITIATIVE: SUPPORT CLUSTER ORGANIZATIONS

A cluster organization, unlike a leadership council, is not appointed. It is membership driven, service oriented, and open. The most successful organizations are associations that provide a menu of key services, useful information, and frequent networking venues. Cluster organizations are easy to start, generate considerable excitement in their early stages, and brand the cluster. Cluster organizations have proven difficult to sustain, especially if they are the result of external stimuli and have short-term funding support. Failure rates of cluster organizations may be as high as success rates. Causes include organizations that do not represent the cluster, overreliance on dues without commensurate services and value, lack of leadership, and competition with existing trade associations.

Table 6: Examples of Effective Cluster Organization

| Name | State | Reason for forming | Web Site |
|--|-------|-------------------------|-----------------------------|
| Arizona Optics Industry Association | AZ | Leadership, recognition | http://www.aoia.org |
| Life Sciences Alley | MN | Common needs | http://www.medicalalley.org |
| Tri-State Manufacturers Associations | MN | Overcome isolation | http://tsma.com |
| Oregon Association of Nurseries | OR | Collective services | http://oan.org |
| CIT.ms (Communications & Info Tech) | MS | Recognition, support | http://www.CIT.ms |
| New York Software Industry Association | NY | Networking | http://nysia.com |

Cluster organizations are most successful in emerging sectors that depend heavily on new contacts, networking, and knowledge and in mature sectors that are under threat or seeking solutions to common problems. The most successful cluster associations have been those that build on existing relationships, extend the services and competencies of existing business associations, or offer immediate cost savings. If organizations form that speak for a group of companies, the needs expressed have to be taken seriously, which means there must be resources available to meet the most compelling and well-documented needs.

Table 7: Do's and Don'ts of Successful Cluster Organizations

| Elements of successful organizations | Elements of unsuccessful organizations |
|---|---|
| Strong industry leadership | Club-like exclusivity |
| Staff to organize and manage activities | Compete with existing industry associations |
| Provide needed services | Measure success in terms of funding |
| Support for collective projects | Dominance by public sector |
| Facilitate networking | Too broad a set of industries |

Minneapolis's Device Cluster

Minnesota's Twin Cities are known as the leader of the medical device industry. Initially labeled "Medical Alley," the area has all the elements of a successful cluster — industry leaders, young growing companies and entrepreneurs, education and training at the university and community college, established medical centers that are early adopters, venture capitalists that know the industry, and a strong association. The cluster employs only about 1 percent of Minnesota's work force, but its jobs are high wage and market growing. The association has played a key role in providing services such as education and training, networking, and early stage capital as well as in building the image of the cluster. In 2006, the association merged with the bio-sciences cluster, which has similar markets, and changed its name from Medical Alley to Life Sciences Alley. The advantage is more members (about 500), giving it more clout and resources.

Cluster-Based Strategies for Growing State Economies

INITIATIVE: PROVIDE OPPORTUNITIES FOR COLLABORATION

Government initiatives in the early 1990s to encourage interfirm collaboration were ostensibly replaced by cluster initiatives. But what goes around comes around, and networks are now seen as an essential outcome of clusters and source of synergy. The social structure of clusters enables small companies to more easily find the partners they need to expand their capabilities into more complex products, reach new markets, share expensive equipment, or find solutions to problems. The process happens where social capital is strong, levels of trust are high, and opportunities are transparent.

The ability of firms to form networks is hampered by time and resource constraints on small firms and lack of a coordinator or broker. The lessons from the government network programs that took place in the 1990s have shown what works and why. Past efforts highlighted the importance of a cluster infrastructure, the intangible outcomes that companies valued, and sufficient duration of support. Networks remain the heart and soul of clusters. They also have been shown to be particularly effective in less populated and poor areas, allowing microenterprises to achieve scale economies and reach new markets.

Table 8: Policies to Catalyze Networks Used by States*

| |
|---|
| • Legal advice |
| • Consultants |
| • Network facilitation training |
| • Incentives to plan networks |
| • Matching funds to implement |
| • Matching funds for multifirm activity |

* For example, Arkansas, Connecticut, Kentucky, Oregon, Massachusetts, Washington

C. Deepen Skills and Talent

Of all the factors that motivate and grow clusters, none is more universally important than human resources. In almost any cluster's plan, the availability of pools of experienced and skilled labor and the customized and specialized education and training that produce, upgrade, and deepen the skills and knowledge are two of its highest priorities. Companies need talented managers and

researchers; mid-level technical, clerical, and support staff; and entry-level workers. The most highly educated and specialized are recruited globally as well as drawn from local universities.

The biggest bang for the human resource buck of a regional cluster comes from access to the pool of employees who comprise the middle of the work force. These workers tend to be regionally bound and less importable or exportable than almost any other production factor. There is no easy substitute for a skilled local labor force and the know-how it possesses.

Companies depend on an uninterrupted flow of workers with the necessary skills and knowledge of the industry and the ability to apply them to both routine and unanticipated situations. Emerging clusters need a pipeline of employees to support anticipated growth; mature clusters need replacements for retirees and new skills as technologies change; and transforming clusters need retraining for transferability. All clusters require continual upgrading of skills as technologies and processes change — an area in which U.S. companies have lagged behind their international competitors. U.S. employers invest less per employee in training than any of the six other major industrialized countries and less than two-fifths of what China invests.

The community colleges have assumed the primary responsibilities for preparing and retraining the mid-level workforce. Over the past 20 years, they have done an impressive job of responding quickly to the needs of new and expanding companies with customized and contract training, of small and mid-sized enterprises (SMEs) with their advanced technology centers and occupational programs; and of entrepreneurs with business centers and incubators. At the same time, they serve their communities by providing access to higher education for all, including new immigrants, students with families and/or with full-time jobs, and those with little preparation or few resources. Community colleges have demonstrated they can successfully juggle a variety of missions, serve all populations, and meet their goals.

Many four-year colleges and second-tier universities also serve local labor markets and add value as a source of interns and summer employees, as a means for students and companies to explore future employment, and as a career path for the advancement of incumbent workers and baccalaureate education of community college students. Most clusters appreciate both the individual and complementary strengths of the two-year and four-year institutions.

Until recently, states did little to align education with their clusters. They paid scant attention to the value of developing special expertise — and even less to international experiences. Special cluster centers and programs were developed sporadically as a

result of scale of demand, influential employers, entrepreneurial college presidents or deans, or funding opportunities. To address the unmet needs, the National Science Foundation through its Advanced Technological Education Centers, for example, has invested in 32 industry- and technology-dedicated centers as of 2006. Many are multi-institutional centers with locations in the hearts of closely related industry clusters. The new Workforce Innovation in Regional Economic Development (WIRED) program launched by the U.S. Department of Labor is also targeting improved integration of education and workforce programs with regional clusters.

One positive development has been the establishment of professional science master's (PSM) degree programs to meet growing industry needs for applied scientists and mathematicians. Created in 1997 with the support of the Alfred P. Sloan Foundation, the PSM degree is designed to be a better, faster, and cheaper alternative to traditional graduate degrees in science. PSM programs typically require two years of study and feature cross-training in more than one academic discipline. Many of the programs include internships and training in business, technology transfer, regulatory affairs, information technology, and communications. Today there are more than 100 PSM programs at 51 universities in 20 states, but there could be many more and they could be more cluster-focused. Although governors do not institute degree programs in higher education, there are several ways that they can encourage the formation of PSM degree programs. For details, see the NGA Center issue brief on this subject.²⁴

As more is learned about clusters, clustering, and globalization, more states are planning and developing specialized programs, expertise, and services that align their college systems with cluster-based economic development strategies, as in Alabama, Connecticut, North Carolina, South Carolina, Washington, and Wisconsin. Only by making hard choices and practicing institutional and system-wide cooperation can colleges develop specific expertise while at the same time addressing the breadth of regional needs and individual interests.

INITIATIVE: ESTABLISH A CLUSTER-BASED WORKPLACE LEARNING SYSTEM

The contributions of work experience to learning are well documented; in many European nations, apprenticeships are the core of their educational programs and are supplemented by classroom instruction — both supported by public dollars. The United States, however, has had only limited success in creating widespread work-

based programs in institutions of secondary or higher education. Few U.S. employers are willing to devote the time and resources to mentoring students or have shown much interest in creating systems that could provide real learning opportunities for students, whether as part of a semester course offered at an educational institution, as after-school jobs, or as summer programs.

Cluster associations represent a structure for collectively creating a comprehensive workplace learning system, reducing individual costs, and improving the pipeline of qualified students into the cluster, particularly if the costs are shared between the private and public sector. Employers gain from contributions made by student employees and have the opportunity to evaluate future employees. Employees gain by receiving real life work experience and by making valuable career connections, both to employers and to future employees.

Faculty also gain from workplace learning programs by upgrading their own skills as they teach the programs needed by employers and by making their instruction more current and relevant. For example, Mission College, a community college in a Silicon Valley area, had summer internships with National Semiconductor and Intel for all faculty members, even those not teaching in technical programs.

Table 9: Establishing Workplace Learning Models

| |
|--|
| • Develop framework for program with schools through the cluster association |
| • Design course requirements, wage rates, and business obligations |
| • Identify company sponsors/student employers |
| • Conduct training workshop for participating businesses and mentors |
| • Select students and prepare them for cluster workplace |
| • Establish cluster-based learning network for students to share experiences |
| • Find resources for incentives to share costs with participating businesses, as reimbursements or tax credits |
| • Monitor and assess outcomes |

Cluster-Based Strategies for Growing State Economies

INITIATIVE: CREATE CLUSTER HUBS AT COMMUNITY COLLEGES

The cluster hub is a new breed of industry-driven technology center that concentrates on the distinctive nature of work in a set of related industries (Table 10).²⁵ It is a resource that industry can rely upon to understand its particular needs and interests, solve problems, assure a continuing flow of qualified entrants, and serve as a source of skill upgrading for the incumbent work force.

Specialization allows community colleges to achieve true excellence, be relevant to their regional economy, and use their resources more cost efficiently. It allows students access to better and deeper programs (“know what”), better employment information and more rungs on career ladders (“know who”), deeper understanding of industry context (know why), and more informal learning opportunities (“know how”). Cluster hubs give businesses access to a more specialized labor pool, a greater array of programs and courses, and more opportunities for training networks.

The following characteristics distinguish effective state-wide cluster hub programs.

1. Recognize the importance of context in education and training and the value of skills and knowledge that can be directly applied to a particular business environment. Industrial maintenance, for instance, has generic skill requirements, but different knowledge is necessary to maintain equipment in a biotech company, a defense contractor, an auto supplier, and a food processor.
2. Depend on broad collaboration within a state community college system. The college within a state given the responsibility and resources to develop cluster expertise must ensure that its expertise and resources are accessible and available to companies across the state through other educational institutions as well.
3. Establish partnerships and articulation agreements with secondary systems to encourage new enrollments and with universities to design career pathways and collaborate on research and development.
4. Seek ideas from other institutions specializing in the same cluster to enhance its programs and expertise. Some cluster hubs have formed international learning networks to broaden their exposure, such as CraftNet, Automobile Manufacturing Technical Education Collaborative, EntreNet, Media Arts Alliance, and the Medical Device Industry Education Consortium.

Table 10: Examples of Community College Cluster Hubs

| Community College | Cluster | Location | Focus |
|--|----------------------------|-----------------|---|
| Catawba Valley Community College | Hosiery | Hickory, NC | Technology, testing, and design |
| College of Redwoods | Fine Furniture | Eureka, CA | Design, quality, business skills |
| Guilford Technical and Community College | Entertainment technologies | Greensboro, NC | Recoding, staging, sound, business skills |
| Indian Hills Community College | Bioagriculture | Ottumba, IA | Fermentation, pilot facility |
| Walla Walla Community College | Wine | Walla Walla, WA | Enology, viticulture, culinary arts, entrepreneurship |
| Lamar Institute of Technology | Chemical | Beaumont, TX | Process technologies |

Source: *Industry Cluster Hubs at Community Colleges*, Data base developed by RTS with support from the Alfred P. Sloan Foundation, <http://www.rtsinc.org/clusterhubs/>.

North Carolina’s BioNetwork

North Carolina uses a cluster hub model to support its large and growing biotechnology cluster. Started in 2003 with a grant of \$7.1 million from the GoldenLeaf Foundation, BioNetwork funds link its colleges together and with North Carolina State and North Carolina Central Universities through a central office headquartered at the state’s community college system office. Most BioNetwork activity occurs at centers at five community colleges specializing in different aspects of biotech: bio-processing, pharma, bio-ag, noncredit programs, and business support services. BioNetwork staff at colleges do not teach classes on their own campus, freeing their time to develop curricula and services and train instructors at their own colleges and elsewhere. BioNetwork also operates a mobile lab to take training to companies and colleges, to create new curricula, and to sponsor seminars and job fairs. All colleges are eligible for grants from an innovation fund and an equipment and facilities fund.²⁶

INITIATIVE: ENCOURAGE TRAINING CONSORTIA

Training networks are one of the most widely used cluster-specific resources. Offering company training through consortia (also called skills alliances) rather than to one company at a time makes programs more affordable to smaller firms and encourages them to invest in training. For training that is both expensive and essential, companies have been quick to network, especially to provide training in lean manufacturing, ISO 900, CAD, and English as a second language. Training consortia follow three basic formats: training networks, skills alliances, and sector strategies.

Training networks were initiated in earnest under the many state programs to encourage business networking during the 1990s. States offered grants to networks of three or more companies. In 1998, Pennsylvania’s department of community and economic development enacted industry consortia training for networks, naming five clusters as the targets of the training. Connecticut introduced a full-blown business training program in 1999 that by 2002 had funded 11 cluster-based networks, including a metal-working training network in Bridgeport that became the core of the state’s metals cluster. Oregon is currently using its governor’s Workforce Investment Act set-aside funds for training consortia and is training its economic and workforce developers in networking techniques linked to its clusters. For more information on regional skills alliances and sector strategies, see the NGA Center Issue Brief: [State Sector Strategies: Regional Solutions to Worker and Employer Needs](#), 2006.

Table 11: Examples of Connecticut’s Training Networks

| |
|--|
| • Metal Manufacturers Training and Education Alliance (META) |
| • Housatonic Education for Advanced Technology (HEAT) |
| • Automotive Training Collaborative |
| • Fairfield County Information Technology Consortium |
| • Connecticut Association of Metal Finishers |

Oregon’s Wind Energy Training Consortium

A partnership of wind energy businesses, the Workforce Response Team, Columbia Gorge Community College, and Mid-Columbia Council of Governments, is working with a consortium of wind energy companies to train technicians. No training program for wind turbine maintenance technicians currently exists on the west coast. Focusing first on the wind industry, the consortia also will identify skill sets common to technicians in other renewable fields such as hydro, biofuel, and solar. Columbia Gorge Community College will develop curricula; identify alternative training delivery systems including on-line offerings, evening classes, shortened schedules, and sequential modules versus academic schedules; and create strategic partnerships with other community colleges, universities, and other training entities. Region 9 Workforce Investment Board, with input from business and economic development, will serve as advisor for the project.

INITIATIVE: ENGAGE WITH COMMUNITY-BASED ORGANIZATIONS

Clusters depend on a supply of educated, reliable, entry-level employees but face shortages of these types of workers. In some places, those shortages are caused by large numbers of unemployed and underemployed people who are disconnected from conventional hiring processes. One effective way to reach those populations is to work through intermediary community-based organizations. Some of the most effective cluster programs operate under the rubric of “sectoral skills strategies,” many of which operate similarly to cluster strategies.

Cluster-Based Strategies for Growing State Economies

Most foundation-supported community-based intermediaries that work with underemployed, unemployed, hard-to-employ, and immigrant populations lack meaningful employer engagement. The intermediaries have stronger ties to the people who need help or to the educational institutions than to businesses. Assessments of successful intermediaries have shown that typical factors include acting like a business, employing staff with sufficient industry experience to speak the language of the cluster, and developing real relationships with the cluster's leaders. Adding employees with cluster experience to intermediaries and bringing the intermediaries to the table with cluster members to discuss needs and to design strategies would benefit both employers and potential employees. The Jane Addams Resource Corporation in Chicago, staffed by former metal workers, has been effectively working with companies to identify and train low-income Chicagoans for the industry since 1985.

INITIATIVE: FIND AND RECRUIT TALENT

If clusters want to attract talent — especially young talent — they have to understand what influences young people's decisions. Because creative young people seem to avoid suburbs and prefer central cities, clusters need city neighborhoods where they can afford to live. Therefore, the quality and real estate costs of downtown neighborhoods are important considerations. Some — in fact many — cities and towns are looking to their creative sectors to be the magnets for young talent and are establishing cultural quarters, an idea originating in Europe, and arts districts to ensure their growth. These are urban neighborhoods with low rent living and working space for artists and designers along with galleries, music and theatre venues, coffee shops, and boutiques. Carytown in Richmond, Virginia; Culver City in Los Angeles; and the Pearl District in Portland, Oregon, are examples of arts districts. Small and mid-sized cities also are competing for young talent by recreating themselves as creative and entrepreneurial places.²⁷

Talent also is recruited from other states and from sources outside the United States. Today, three of every eight residents of Silicon Valley are foreign born,²⁸ and in 2000, half the engineers and scientists in Silicon Valley clusters were foreign born. Without this population, Silicon Valley would not be as competitive. Clusters need to be proactive in making sure their environments are welcoming and supportive of immigrant talent, for example, by providing educational and cultural programs for employees and their families and offering social networks. Some states are offering special incentives for engineers, teachers and medical professionals to take jobs in their states.

It is important to recognize that educational credentials are not the only measure of creativity — and in some cases, it is not the best. Many regions are home to people whose talents are not identified by either degrees or test scores. These talents, if nurtured, could fit many of the emerging clusters that thrive on unconventional ideas, such as media arts, design, and entertainment.

INITIATIVE: PROMOTE CLUSTER CAREER ADVANCEMENT PATHS

Career pathways are a way to connect education and training programs with support services to help people — especially those who are most disconnected and disadvantaged — gain employment and/or advance within an occupational or industry sector.²⁹ Cluster-based career paths pay more attention to industry know-how acquired along the way and to informal grapevines among students to identify opportunities. Paths move vertically within clusters and horizontally across clusters with similar work environments and contextual requirements. Career paths depend upon information about the cluster, connections between education and training programs and employers, curricula that are defined by job competencies, and articulation of community colleges' programs with higher education requirements to ensure continuity along the paths.

D. Align Innovation Investments

Behind every strong cluster is a set of innovative companies that are never satisfied with the status quo, companies that are continually looking for improved products or practices or searching for the next new big breakthrough.³⁰ The importance of innovation cannot be overstressed. It is how new value in a business and economy is created, regardless of source. In a 2005 survey by the Council on Competitiveness, executives attributed 42 percent of their productivity gains to innovation, three times more than any other single factor.³¹ Clusters need creative and innovative people as well as implementers and users to create commercial value, and they need imitators to keep innovations flowing.³²

There are three major sources of innovation: research and development that is commercialized; functional improvements in products, services, and production processes that come from inside or outside a firm; and design improvements that enhance a product's aesthetic appeal and make it distinctive.

Universities are vital sources of R&D-based innovation and assets to research-intensive clusters. The importance of MIT's research to Boston's high-tech clusters, Stanford's research to Silicon Valley's,

or the Research Triangle’s three flagship universities to the biotech cluster is undeniable. The patents they produce are only the tip of the iceberg in terms of value to their related clusters. Research that is not commercialized can influence corporate research and practice, and faculty consultants and graduate students can affect corporate strategy. Federal research dollars also are important catalysts for cluster development — in the case of Silicon Valley and Boston, one of the two most important factors in both the development and growth of their technology clusters.³³

Innovation, however, is difficult to quantify. Common measures such as investments in R&D, concentrations of high-tech companies, IPOs, and numbers of patents per capita, however, miss most of what occurs in companies without internal R&D departments or dedicated expenditures — a group of companies that are almost all SMEs. Further, few patents are actually commercialized; for example, a study of the biotech industry in 2002 found that of an average of 5,500 biotechnology patents that had been filed each year, about 400 were in development and only 100 had reached the market in the past 30 years.³⁴

Other innovations are unpublicized improvements or inventions that occur on the job when, for instance, an employee creatively retrofits a machine to a new use, finds a way to reduce waste, or suggests a better office management system. Innovations also frequently come from outside of the conventional innovation infrastructure. As the Alliance for Regional Stewardship stated last year, “In the old economy, hierarchy ruled and R&D departments were responsible for generating a predictable flow of new improvements. In today’s innovation economy, anyone with a good idea can potentially become innovation leaders.”³⁵ In a survey of executives in 2005 conducted by the Council on Competitiveness, the highest response for frequency of collaboration in the innovation process was suppliers/customers, followed by innovations flowing from internal experts, external experts, other companies, university faculty, and, at the very bottom, labs and research institutions.

The most overlooked source of effective innovation involves product design changes that influence consumption choices — the creative content or appeal of goods and services that distinguishes them from competitors and causes customers to pay a premium. According to *Business Week* magazine, “when people talked about innovation in the ‘90s they invariably meant technology. When people speak about innovation today, it is more likely they mean design. Consumers, who are choking on choice, look at design as the new differentiator.”³⁶ A survey of chief executive officers conducted in 2006 found that 72.7 percent believed that “design is a key competitive weapon against low-cost imports” and 86.6 percent thought it could provide a lasting advantage.³⁷ This type of

innovation requires the right brain thinking associated with the arts as much or more than the left brain thinking associated with science and technology.

Arizona Biosciences

Arizona, after carefully assessing its assets, saw niche opportunities to convert its institutional and industry strengths in health care and medical research into a biotechnology cluster. In 1997, the Arizona bioindustry cluster was formed. Three years later, voters approved a sales tax increase, part of which was used to build the bioindustry research centers at Arizona State University, Northern Arizona University, and the University of Arizona, followed a year later by a large investment in the biosciences by the Flinn Foundation to create and implement the Arizona’s Biosciences Roadmap. The governor appointed the Arizona BioInitiative Task Force to attract additional key bio organizations, and a few months later, the BioIndustry Organization of Southern Arizona was formed. After a series of key investments in biosciences research, education, institutes, and companies under the leadership of Governors Hull and Napolitano — including attracting the International Genomics Consortium and founding the Translational Genomics Research Institute — a 35-percent tax credit for investors in bioscience companies, a collaborative evaluation agreement among eight pharmaceutical firms, the emerging cluster is well positioned for further growth.

Table 12: Innovation Sources

| Form of Innovation | Examples of Institutional Sources |
|----------------------------------|---|
| Research and development | University research Private and federal research labs |
| Product and process improvements | Community colleges University extension services Small business centers |
| Design and differentiation | Colleges of arts and design Private design companies |

Cluster-Based Strategies for Growing State Economies

INITIATIVE: INVEST IN CLUSTER-BASED INNOVATION CENTERS

States and federal agencies have been investing in science and technology innovation centers since the early 1980s. Oklahoma's Center for Science and Technology, Texas's Regional Centers for Innovation and Commercialization, Ohio's Edison Centers, and New York's Centers for Advanced Technology are but a few examples. Most have been established to do applied scientific research and development with an emphasis on technology transfer, commercialization, and regional economic impact but also to attract funding from federal agencies and corporate partners or customers.

A cluster-based innovation center, in contrast, is a bottom-up institution driven more by members' interests, including assistance in applying for small business innovation research (SBIR) grants, finding research partners or capital, and dealing with intellectual property issues. The North Carolina Biotechnology Center is a preeminent model, bringing together researchers, businesses, seed capital, and entrepreneurial support in one place. Research and development centers at the University of Alabama, University of Michigan, and Clemson University are all linked to their respective regional automotive clusters. The Center for Electronic Imaging Systems at the University of Rochester supports the area's optics and imaging cluster. Each center has close ties to the industry, sending a stream of students to intern and graduates to work. Although the final producers tend to keep their research in-house, centers conduct research and development for suppliers and customers.

South Carolina's International Center for Automotive Research (ICAR)

Clemson University established ICAR in 2002 for its automotive cluster, hoping to make it the world's premier automotive and motorsports research and educational facility. It is anchored by BMW but includes about 120 suppliers in the Greenville-Spartanburg area as well as a growing number of jobs associated with motorsports. ICAR was based on market research revealing a need for research on system integration, testing, assembly, and supplier management and on BMW's commitment to invest in its first R&D center outside of Munich. BMW, Michelin, and Timkin have endowed faculty chairs, and the state committed \$209 million over three years. Still a work in process, one goal is to create an interactive environment, with a mix of uses and activities that fosters collaborative partnerships that appeal to the creative class of technology researchers.

INITIATIVE: DIRECT R&D FUNDS TO CLUSTERS

The tendency at universities is to conduct basic research that reflects the interests and expertise of faculty members and/or agencies providing funds. If that research happens to match local needs, then so much the better. But local demand is not typically the driving force; universities serve larger regions and global customers. There are, of course, many exceptions, and a certain proportion of the research has local relevance because farsighted leaders have invested wisely. Much of the research focuses on the best-known high-tech regions in the United States — Boston, Research Triangle Park, and Silicon Valley — but many smaller clusters have made effective use of R&D. Many states have strengthened their clusters considerably by investing in research, even if the clusters never reach the scale of the global leaders. Oregon State University, Penn State University, and Mississippi State University all conduct research on wood products, and all three states have high concentrations of wood products companies. The Ceramics Corridor Innovation Centers in Alfred, New York, combine research and development for the ceramics, glass, and materials science technologies as well as provide incubator space and technical assistance.

Table 13: Suggestions for Allocating R&D Funds

| |
|---|
| <ul style="list-style-type: none">• Use cluster information as a criterion in awarding R&D grants |
| <ul style="list-style-type: none">• Require applicants to project expected benefits to cluster and regional economy |
| <ul style="list-style-type: none">• Assist cluster members in identifying and applying for federal grants |
| <ul style="list-style-type: none">• Set aside funds for applications involving three or more partners |
| <ul style="list-style-type: none">• Create a simplified format for mini-grants to small businesses |

INITIATIVE: ENCOURAGE COLLABORATIVE AND MULTIDISCIPLINARY R&D

It is now generally accepted that innovation is a consequence of iterative and interactive processes across disciplines and is rarely the fruit of a solitary inventor in the proverbial garage. The need for cooperation, of course, must be balanced by the need for confidentiality, because partners may be competing for financial rewards. If the research is to develop a new product, there may be only one winner; if the research is a process or core technologies that many can use, there can be multiple winners.

About 20 hosiery companies in North Carolina invested in developing an automated boarding machine that would make the entire cluster more competitive against low-cost competitors. Large corporations are able to build research networks within their organizational structure, and they have the international connections to readily find partners to complement their in-house competencies. Small and mid-sized firms are more isolated and need assistance in finding partner companies, nearby and abroad. One strategy would be to promote collaborative proposals to SBIR grants.

INITIATIVE: SUPPORT INCREMENTAL INNOVATIONS

Although many programs support university and corporate R&D, there are few programs for incremental innovations and little support for small firms or groups of small firms to solve problems and improve processes. The continuous improvement user groups funded by the state of Michigan in the 1990s proved to be an effective way for networks of small companies to collectively learn from each other and innovate. Most SBIR grants support R&D that is expected to be commercialized, and most of the grantees are high-tech companies. Fewer grants are made to small firms in traditional sectors for ideas to increase their competitiveness. Very small grants might be enough to set free creative instincts and leverage significant improvements.

INITIATIVE: SEGMENT EXPERTISE IN MANUFACTURING EXTENSION SERVICES

The design of the U.S. national program to accelerate technology transfer and diffusion to small and mid-sized businesses initially assumed a cluster focus. A study for the Cleveland Advanced Manufacturing Program in 1991 recommended targeting 12 regional clusters.³⁸ When the centers and parallel state programs merged into the current Manufacturing Extension Partnership (MEP), specialized support was replaced by generic services. In many states, there is an informal compartmentalization of expertise depending on the industry experience of the extension engineers and the locations to which they are assigned that may address cluster needs. The extension engineer assigned to the Hickory, North Carolina, area has special knowledge of the hosiery cluster. Cluster-based staffing is not systematic, however. Where it happens, it is a response to well-organized and persistent demand or internal expertise selected for a particular assignment. Clusters could be better served by access to specific people who are familiar with their operations. As major co-investors in the country's 59 MEP centers, state governments are in a strong position to influence MEP practices in their states.

INITIATIVE: INCREASE ATTENTION TO DESIGN AS AN INNOVATION STRATEGY

A lead article in *Business Week* in March 2005 called "Design thinking . . . the key to earnings growth and an edge that outsourcing can't beat." Neither state nor federal economic development or innovation programs have paid sufficient attention to the aspect of design that adds new value to products and induces customers to pay for appearance or style, the kind more likely to come from artists than engineers. In departments of commerce, design is defined in terms of functionality and manufacturability. Yet markets for specialty goods are growing, and states have an opportunity to strengthen design capabilities in their educational systems, design sectors, and companies. Designers themselves cluster and represent a growth industry, but most are in large cities — New York, Boston, Seattle, and Portland in the United States; Milan, London, and Copenhagen, and Singapore abroad. Four examples of initiatives states can take to support design are listed in Table 14.

Table 14: Actions for Improving Design and Creativity

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| <ul style="list-style-type: none"> • Form a state-wide design extension service: Small firms that produce for end markets would benefit from assistance in using art and design more effectively to differentiate and add value to their products, packaging, and company brand. |
| <ul style="list-style-type: none"> • Support design networks: The smallest companies can't afford to employ full-time designers but might be able to share ideas and design artistry if networked. The network also would give small firms opportunities to explore new ways of adding value through design. |
| <ul style="list-style-type: none"> • Establish a design internship or artists' residency program: Some of the most successful corporations rely on art to stimulate creative thinking and new products. Kohler Corporation has had a successful artists' residency program for years. Artists working inside companies and with cluster organizations could result in better solutions to problems, new products, and new markets. Some leading business schools are using integrative thinking to spark creativity by getting managers and researchers to use "abductive" reasoning as well as inductive and deductive reasoning, asking "what could be." |
| <ul style="list-style-type: none"> • Support interdisciplinary research: In the United States, some of the top business schools are beginning to promote integrative thinking, taught by teams of business people, scientists, and artists. The European Union is in the forefront of public support, funding programs at universities and research centers across Europe that require teams of artists, scientists, and engineers. The United Kingdom has made 700 awards from national lottery funds for such research |

INITIATIVE: MOBILIZE INVESTMENT CAPITAL FOR HIGH-TECH STARTUPS

Venture capital in the United States has not recovered to its highs of the late 1990s, and what does exist is highly concentrated in a few places. In Silicon Valley, venture capitalists are very aware of a potential investment's physical distance from them. Venture capitalists prefer their investment companies to be close so that they can better support and monitor their investment's operations. The high concentration and tough requirements leave many strong candidates in less populated or less wealthy areas unable to get good ideas off the ground.

The inaccessibility of venture capital to so many businesses has led some states to use tax revenues or pension funds to fill gaps and other states to act as brokers, attracting capital, making loans, and providing information about capital sources to applicants. The New Mexico Investment Council, Michigan Strategic Fund, Mississippi's Magnolia Fund, and Finance Authority of Maine are just a few state initiatives. Although few of these programs have been cluster-based, a cluster focus would increase effectiveness and lower risks because program managers would be more knowledgeable and experienced in a particular industry, it could attract venture capital companies that specialized in certain industries, and it would produce greater synergy among the startups. States also could do more to target the growing number of angel investment programs and tax credits to specific clusters.

Table 15: State Support that Could Be Targeted

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| <ul style="list-style-type: none"> • Pre-seed or seed capital |
| <ul style="list-style-type: none"> • Investments in privately managed funds |
| <ul style="list-style-type: none"> • Tax credit incentives |
| <ul style="list-style-type: none"> • Bridge funding for SBIR grants |
| <ul style="list-style-type: none"> • Matchmaking services |

E. Accelerate Entrepreneurship

Clusters are carefully woven into a complex tapestry by cadres of enterprising entrepreneurs and innovators who see and seize opportunities to add value to an existing set of regional competencies. The addition might be a new element of an existing value chain, a way to be more competitive in existing markets or supply chains, a new compatible niche product, or a new application of some cluster technology. Many of the entrepreneurs are already employed within clusters, fewer come directly through the educational system, and some are attracted from other places.

States and federal agencies have been supporting entrepreneurship at least since 1979 when the publication of David Birch's book *The Job Generation Process* surprised the nation by showing the extent to which small businesses accounted for economic growth.³⁹ Many regions have pinned their hopes for growth and targeted their venture capital on the "gazelles," the high-tech companies considered capable of rapid growth. But focusing only on gazelles misses many emerging creative clusters dominated by the self-employed and microenterprises. Between 1997 and 2004, U.S.

employment grew about 7 percent while self-employment numbers grew 26 percent.

How do clusters influence entrepreneurship? Most entrepreneurial skills programs focus on such aspects of the entrepreneurial process as doing market research, writing a business plan, raising capital, and creating an organization. They assume these are generic processes, but the truth is that the cluster into which they fit shapes the skills that are needed. Although many skills apply to any types of business, there are skills that are specific to a certain kind of industry. Starting a new bed and breakfast, a metal-forming business, or a parts distributor require knowledge of different kinds of businesses. Knowledge of cluster-specific skills, relationships, and language can make the difference between success and failure. State policies that adapt initiatives to specific clusters have the potential to be more effective.⁴⁰

INITIATIVE: SUPPORT ENTREPRENEURIAL NETWORKS

Entrepreneurs thrive on networking. They may have a great idea but have only some of the knowledge necessary to convert it into a business. Networks give entrepreneurs opportunities to meet other entrepreneurs with complementary knowledge, different connections, and common concerns. If the entrepreneurs are in somewhat similar or complementary businesses, the knowledge and contacts that develop are bound to be more relevant. The National Commission on Entrepreneurship mapped out a process for building networks that highlighted the importance of ensuring leadership, allowing for failure, networking the networks into strategic alliances, and letting go after they achieve their purposes.⁴¹ Of special interest to innovative entrepreneurs are networks that link them to leading researchers at universities. One model for doing this electronically is the *iBridge Network*, a program of the Kauffman Innovation Network, Inc., and its Web site: <http://www.iBridgeNetwork.org>.

INITIATIVE: CREATE SPECIALIZED INCUBATOR SPACE

Business incubators, according to the National Business Incubator Association, are “a business support process that accelerates the successful development of start-up and fledgling companies by providing entrepreneurs with an array of targeted resources and services . . . usually developed or orchestrated by incubator management.” The public sector has invested heavily in incubators over the past two decades to spur R&D commercialization at universities and to create opportunity in poor rural communities.

Many incubators have a particular focus, generally on areas such as high tech or manufacturing, and most look for businesses that bring new wealth into the community. According to the National Business Incubation Association, about 47 percent of all incubators are for mixed use, and 37 percent limit tenants to technology companies. Incubators that target companies in specific clusters, however, have the added advantage of being able to offer even more highly specialized services and expertise and create more opportunities for networking and learning. Some of the most successful cluster-based incubators target biotechnology or food processing, which require special equipment that can be shared, and software or the arts, both of which thrive on creative environments. A few are described below.

- The New York Software Association manages an incubator in New York City with support from the Empire State Development Corporation.
- The North Carolina Central Carolina Community College’s Small Business Center created an arts incubator in 11 historic buildings in Siler City, revitalizing a depressed downtown.
- Appalachian Center for Economic Networks in Appalachian Ohio created a kitchen incubator for the local high-end food processing cluster that assists clients with label design, marketing, distribution, processing, and capital.
- The Environmental Business Cluster in San Jose, California, is a 12-year old clean energy and environmental technology commercialization center that provides business assistance programs to resident and nonresident companies and helps form technology partnerships and networks.

Ohio’s ACEnet

Appalachian Ohio has been a persistently depressed rural area that successfully used a food cluster-based entrepreneurial strategy combined with creative marketing and branding to add wealth and create jobs. The Appalachian Center for Economic Networks (ACEnet) worked with farmers selling commodities to move up the value chain. With foundation and Appalachian Regional Commission (ARC) support, ACEnet established the food ventures center, a shared-use fully equipped food manufacturing facility with a retail store; taught entrepreneurial skills; and found artists to write stories about the products and create innovative labels and packaging. ACEnet networks producers and assists with marketing, distribution, processing, and capital. “Networking occurs in the quick deals, crucial tips, market information and resource-sharing moments that happen hundreds of times a day across ‘the network.’”⁴²

Cluster-Based Strategies for Growing State Economies

INITIATIVE: ORGANIZE CLUSTER EXPERTISE ACROSS SMALL BUSINESS CENTERS

Small business centers are available in most regions of states to assist small enterprises in getting started, raising capital, expanding, marketing, or improving specific business competencies. Each office is expected to have a broad set of business skills to serve a wide variety of customers but not necessarily any deep understanding of a particular type of business, and they provide generic types of support. Most customers are in or are looking to start local service or retail operations. Small businesses and entrepreneurs could be better served by centers that have deeper knowledge of their customers. Because most centers have tight budgets, in-house expertise is only possible in a few areas. If a state system is organized so that each cluster has an advisor or set of advisors somewhere in the state, people could receive more useful advice and more directly applicable answers to questions.

INITIATIVE: EDUCATE FOR ENTREPRENEURSHIP

Entrepreneurial education has been an educational goal for decades that, with recent support from various foundations and the ARC, is becoming a reality. Much of the nation's entrepreneurial education has been designed with two assumptions: (1) that entrepreneurship is an alternative career track and curriculum for those seeking employment, and (2) that entrepreneurial skills are generic and one can major or graduate in "entrepreneurship." In reality, most entrepreneurs learn their skills on the job, and different types of business require different sets of skills. Starting a technology-based company with products and a clearly defined market is different from starting a film company that is project-oriented and dependent on networks and personal reputation.

Linking entrepreneurial education to clusters suggests the following three possible cluster-specific approaches:

- Recognize enterprise distinctiveness and include skills that are specific to the particular cluster
- Integrate entrepreneurial competencies into existing workforce curricula by, for example, posing problems that require an understanding of the cluster and by framing discussions in business cluster contexts
- Establish real or fictitious cluster enterprises operated by student teams as a context for learning technical and business skills.

Some of the cluster hubs have been successful in producing entrepreneurs. Graduates of the relatively new Center for Enology and

Viticulture at Walla Walla Community College in Washington have established four new wineries.

State governments could do more to support entrepreneurship education in general as well as in cluster-specific forms. At present, most universities, if they offer entrepreneurship courses at all, offer them only to students in the business or engineering school. They could follow the example of the Ewing Marion Kauffman Foundation, the National Science Foundation, and other such organizations in assisting universities, community colleges and even high schools to teach entrepreneurship skills to students in all disciplines and facilitating student experience through such programs as L-SITES, Learning through Simulated Information Technology Enterprises. States can also support such non-school entrepreneurship training programs as *FastTrac*.

F. Open Global Priorities

Isolation is the biggest barrier to cluster growth. To be competitive and innovative, clusters have to be globally aware and globally engaged. Despite globalization, many parts of America are still geographically and linguistically challenged. Globalization too often means immigrants, imports, exchange students, and exotic foods in grocery chains, not economic opportunities that lie outside U.S. borders.

Clusters need global pipelines to knowledge and innovation as much as they need local buzz,⁴³ and they need access to global markets for goods and labor as much as to local markets. Intellectual property contributions of immigrant non-citizens, for example, reached almost 25 percent in 2006, up from only 7 percent in 1998.⁴⁴

Exposure to different operating environments and different cultures is a powerful stimulant for innovation. After a dozen owners of North Carolina hosiery companies traveled with public sector officials from the nearby state and community college to comparable hosiery and knitwear clusters in Italy, the experience led to the revamping of services and organization of the community college-technology center, refocusing on marketing networks, dyeing, design, and cluster-quality standards. Even the increased outsourcing of R&D has a silver lining for those willing and able to think and act globally — access to talent and innovation from other places.

Successful clusters establish linkages to suppliers and customers. They closely monitor trends in other parts of the world to gain different perspectives. They extend their networks to distant competitors, vendors, and institutions through international profes-

sional associations, trade shows, and research partnerships. Clusters that are cut off from external sources of knowledge eventually risk losing their competitive position, creating the kind of intellectual lock-in that kept Detroit producing large cars and the Northeast producing frame computers for too long.⁴⁵

Dynamic clusters export. Economic growth in underdeveloped nations is creating new markets for U.S. products and, increasingly, cultural goods and services. For example, there is a growing market among youth outside the United States for American culture expressed in music, movies, clothing, and accessories. The international market for the entertainment and media industries where information technology and entertainment clusters are quickly converging, that is, on-line rentals and digital streaming, licensed digital downloads, on-line video games, electronic books and news, and on-line casino gaming, is experiencing rapid growth — 6.6 percent per year — and is expected to reach \$1.8 trillion in 2010.

INITIATIVE: SUPPORT INTERNATIONAL PARTICIPATION IN EVENTS AND STUDY TOURS

Participation in international conferences, trade shows, and study tours is a vital source of innovation and inspiration for U.S. clusters. Despite the accumulated evidence of the added value of exposure to new people and places, programs that support travel for the express purposes of marketing, observing, learning, and networking are few and far between. Maintaining connections with counterpart clusters in other parts of the world, including networks, and exchanges of faculty or employees can prevent clusters from being too locked in to their internal strengths. It also can generate innovations and lead to new market opportunities. A state travel fund, with a required match and restricted to groups of three or more firms in clusters, that supports participation in trade shows, professional events, or study tours would help overcome cluster isolation.

Montana in Ireland

The Montana World Trade Center organized a visit to Ireland in 2003 for a group of artists and businesses from Montana's creative enterprise cluster that included an exhibit of the state's art at the Bank of Ireland. In addition to generating ideas, learning what sells in European markets, and building relationships, the trip resulted in \$500,000 in initial sales across the Atlantic — including hot tubs and fishing gear as well as art.

INITIATIVE: SUPPORT AND ASSIST EXPORT AND EXPORT NETWORKS

A study of the role of exports among firms in seven industry clusters in Appalachia found that more than half rated it as very important to their business, yet they listed many barriers that inhibited exporting, including costs, information, working capital, trade barriers, foreign regulations, and just getting paid. Many of the approaches to simplifying exporting for small and mid-sized firms have been developed by network initiatives, and some of the most successful networks were groups of similar companies targeting export markets. When the North Carolina Department of Commerce awarded grants to clusters in the late 1990s to develop strategic plans, the hosiery cluster's plan included two export networks, which eventually formed following a benchmarking trip to northern Italy. A rapidly expanding middle class with new purchasing power in China, India, and other developing nations and a taste for American culture creates new markets for U.S. niche goods, whether they are designer jeans, designer genes, or disco music. Reinforcing the argument for support for exporting, surveys reported in the 2003 Cluster Initiative Greenbook found exports to be the most common form of commercial cooperation. Public export support has proven to be effective when targeted to consortia of small companies that are interested in similar global markets.

INITIATIVE: ESTABLISH CLUSTER-BASED INTERNATIONAL LEARNING EXCHANGES FOR STUDENTS

U.S. students and workers are poorly prepared for the global economy. School semesters spent abroad and international exchanges for students are rare. Most employees have little opportunity to learn from those working in different cultures and work environments. The Trans-Atlantic Technology and Training Alliance, an international alliance of community colleges, facilitates cluster-based exchanges of faculty and students, such as the EUC-Syd in Sønderborg and Bellingham Technical College in Washington for culinary arts; Siemens Professional School in Berlin and Kentucky Community and College System for automotive industries; and Howard Community College in Maryland and Niels Brock College in Copenhagen for information technologies. Because the majority of community college students and many higher education students are already in the work force, a cluster association could become the focal point for exchanges or students in their work force. Short-term exchanges of students for credit, or of employees with branch plants, suppliers, or customers overseas could spur the transfer of ideas and increase the value to each.

The Media Arts Alliance

The Media Arts Alliance (MAA) is an international network of community and technical colleges working to improve education, training, and economic opportunities in regional digital media and entertainment clusters. Member colleges in places such as Seattle, Houston, the Silicon Valley, Maryland, Berlin, and Durbin (South Africa) may specialize in music and event production, film production, and digital arts but with considerable convergence. In one project, students from different cultures shared music tracks and altered the mixes to reflect their local talent and culture. The final mix was ultimately returned to the original creator after its “round the world” trip. The goal is to expand awareness of global music trends and improve professional collaborative skills. MAA also is exploring international quality standards for entertainment production programs.⁴⁶

Chapter 5—Value Found and Lessons Learned

Clusters are, a priori, effective settlement patterns for companies. The proof is their persistent prevalence. Companies would not choose to locate so close to their competitors without realizing advantages. Public agencies need to know the measurable results of cluster-based interventions in terms of such things as jobs, wealth, and equal opportunity, and whether they are allocating public money as efficiently and equitably as they might. State leaders should ask this question: Have public interventions been able to improve upon natural clustering tendencies by adding additional advantages or by accelerating their growth?

Evaluating the outcomes of an initiative is easier than measuring the impacts on the larger entity that the initiative is intended to affect. Both require enough time for an intervention to have the intended effects, and both are subject to uncontrollable external forces that can alter any expectations. Therefore, assessments are approximations of impacts at best.

Given those caveats, what has been learned from past cluster initiatives? Most of the evidence of outcomes is anecdotal, for three reasons: (1) there are multiple variables that must be controlled to isolate the effects of specific interventions; (2) outcomes are long term, and most cluster initiatives are relatively recent and short term; and (3) outcomes require baseline data that may not exist.

A. Case Studies Continue to Suggest Advantages of Clusters

Much of the evidence of the impacts of clusters or cluster initiatives comes from case studies of clusters or network strategies. The most extensive survey was performed on behalf of the Competitiveness Institute and published in 2003.⁴⁷ In that survey, about 85 percent of respondents agreed that their respective cluster initiatives improved the competitiveness of their cluster, and 89 percent said that their respective cluster initiatives helped the clusters grow. Four in five responded that their cluster initiative met its goals, and 77 percent said “it lived up to its expectations,” but 14 percent replied “it’s been mostly talk, not much action.”

A larger set of assessments, both international and in the United States, exists for network initiatives that began before most cluster programs, but in many instances, these could be considered cluster initiatives, and there is other research that measured whether regions with clustered sets of industries outperform those with less clustered industries.

- A study conducted at the USDA Economic Research Service found that average earnings in rural counties with high shares of particular industry classifications, defined as clusters, were higher than rural counties without “clusters.”⁴⁸
- A more recent study across Canada found that between 1998 and 2005, both employment and average income in clustered industries in “city-regions” grew more than twice as fast as in non-clustered industries.⁴⁹
- The International Institute for Labour Studies assessed the impact of Valencia, Spain’s, efforts to imitate the cluster technology centers in Emilia Romagna’s industrial districts and found limited successes: expanded services to small firms and increased demand for services. Among the lessons learned were that the centers required continuing public subsidies to remain in an industry leadership position, they should be located within the cluster, and they worked best in collaboration with other similar institutes.⁵⁰
- A variety of evaluations of networks and cluster organizations across the United States, the United Kingdom, and Australia all found that firms networked primarily to increase employee professional learning and knowledge.⁵¹ An assessment of five cluster strategies supported by the Northwest Area Foundation, for example, surveyed companies and found that in each case, learning was the number one reason the companies cooperated and was the number one value gained, which affirms the importance of tacit knowledge.⁵²

B. Final Thoughts

Cluster-based strategies have proven effective in improving clusters’ ability to compete and, in many instances, have influenced regional and local growth patterns.⁵³ In the new global economy, clusters continue to confer advantages to their member firms and institutions, and promoting them is still good public policy. To maximize their impact on regional prosperity, however, practitioners and policymakers need to continually assess how the dynamics of clusters are changing and tailor policies to support today’s opportunities, not yesterday’s challenges.

Glossary of Terms

Cluster: A geographically limited critical mass (i.e., sufficient to attract specialized services, resources, and suppliers) of companies that have some type of relationship to one another — generally a complementarity or similarity in product, process, or resource.

Clustering: The act of companies with similar interests or needs in a geographic region establishing new or closer relationships and linkages.

Cluster Initiative: An activity that addresses the specialized needs of a set of companies or the entire cluster designed to enhance the competitiveness of the cluster.

Cluster Association: A membership-based organization that collectively represents the needs and interests of members, provides services, and/or serves as a vehicle for members to associate and network.

Cluster Breadth: The range of industries related by common products, technologies, distribution channels, and/or end users.

Cluster Depth: The range of vertically integrated industries such as components, parts, materials, equipment manufacturers, and support services.

Creative Economy: Companies that take their principal competitive advantage from a distinctive appearance, form, content, or sound that they embed or embody in their products or services and employees that work in some aspect of culture, arts, or design.

Externalities or Economies of Scale: Reductions in costs that result from increases in the scale of demand for valued services or resources. These economies are often discussed as “localization economies,” which are the benefits that accrue to firms as a result of the clustering of similar firms, and “urbanization economies,” which are benefits that are associated with population density.

Innovation: The transformation of knowledge into new products, processes, and services; the act of using something new. The innovation process consists of the steps through which something that is used moves from conceptualization to utilization.

Knowledge Clusters: Specialized networks of innovative interrelated firms that derive competitive advantages through accumulated, embedded, and imported knowledge among local actors about highly specific technologies, processes, and/or markets.

Location Quotient: The ratio of the relative concentration of establishments or employees in a cluster to total establishments or employees in the economy divided by the same relative concentration in the larger economy (state or nation). A location quotient of 1.0 represents average concentration, a quotient of greater than 1.0

represents a higher concentration, and a quotient of less than 1.0 represents a smaller concentration.

Network (formal): A contractual alliance or membership organization in which some number of firms agree to share resources, costs, or information. Some form of cooperation and some level of trust are required. Networks are often, but not necessarily, embedded in clusters.

Networking (informal): Informal interactions and relationships among firms and support organizations that are not contractual or membership based. They imply something more than simple proximity to like or related firms and deliver more than external economies.

Network Broker: A person or organization that facilitates joint initiatives among groups of companies.

Region: A geographically bounded territory that has a common hub, labor market, or source of economic growth.

Regional Innovation System: Elements (businesses, agencies, associations, etc.) and the relationships between the elements that interact with production, diffusion, and use of new and economically useful knowledge that is encompassed within specified geographic boundaries.

Sectoral Programs: Workforce development programs, usually run by nonprofits, that address the needs of workers and employers in specific groups of industry sectors.

Social Capital: Stocks of social trust, norms, and networks that people can draw upon to solve common problems. Networks of civic engagement, such as business and neighborhood associations and cooperatives, are an essential form of social capital, and the denser these networks, the more likely it is that members of a cluster will cooperate for mutual benefit.

Soft Network: A group of companies that has some core competency, resource, or need in common that choose to form a local or regional association that enables them to share costs of services and information, interact, and/or influence policy.

Supply or Value Chains: All of the companies in the production stream that make the individual systems, parts, and services that eventually are incorporated into a final product purchased by an end customer or user.

Temporal Clusters: Spatial clusters that are based on seasonal activities.

Temporary Cluster: International gatherings characterized by knowledge exchange similar to those found in a permanent cluster, although short-lived and intensified.

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