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REGIONAL CLUSTER STRATEGY AND SUCCESSFUL SCIENCE AND TECHNOLOGY PARKS

By James O. Gollub

Science and Technology Parks as Economic Laboratories

Science and technology parks are now deliberately Grafting themselves as economic ecologies—dynamic environments for innovation—that can be accelerators of regional economic development. This trend is reflected in S&T parks embracing four new rules for economic competitiveness that place them squarely at the core of their region's economic strategy, often as partners and increasingly as the leader of change if not a template for how the overall region could evolve. What these new rules are for economic competitiveness and how they are being applied by S&T parks is the focus of a series of two articles and extensive previous work by the author.

Science and technology parks are a popular focus for economic development initiatives because they are viewed by developers, institutional and community leaders as a source of new, technology-driven, growth for the surrounding region. Part of the attraction of S&T parks is that they are usually "greenfield" projects-a clean slate for which new economic policies and practices can be crafted and implemented. As such, S& T parks can often be treated as economic islands unencumbered by the problems of the region that surrounds them, unlike a typical redevelopment area which comes with the natural economic legacy of its past, good or bad. However, there are, of course, successful urban S&T parks that effectively harness regional assets under appropriate conditions. While the earlier generation of S&T parks emphasized providing attractive "campus" real estate settings close to desirable facilities, such as universities or airports, the next generation of S&T parks is increasingly embracing the idea of creating a specialized micro-economy, suited to the special needs of different industries. Making sense of how S&T parks can best serve as catalysts and anchors for next generation economic development works better when placed in a current economic development framework. That framework encompasses four basic rules for competitive economies:

1. Focus on the S&T park as a tool for regional development.
2. Emphasize industry cluster formation, expansion and attraction as the goal.
3. Create advantages in economic inputs to enable clusters growth.
4. Use collaborative solutions to create new economic input advantages.

This article focuses on the first of these two rules. The second article in this series focuses on the application of the second two rules.

Using New Rules to Achieve Successful S & T Parks

Around the world regional leaders and institutions are seeking to enhance the formation, expansion and attraction of technology-driven enterprise through the development of industrial clusters, Science and technology parks are an important tool for enabling cluster-based development. This importance stems from the fact that a science and technology park provides a controlled environment within which companies within specific clusters can be provided with sources of advantage in technological resources, human resources, financing, physical and information infrastructure as well as quality of life features. Today's successful science and technology park is, essentially, a next generation community. By understanding the dynamics of regional economies, the clusters that drive their development and by systematically mobilizing sources of advantage that respond to cluster requirements these next generation technology communities enable growth and serve as an synergistic anchor for broader regional development. This article is the first of two articles on regional cluster-based science and technology parks.

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New Rule 1: Think Regionally

Understanding the value that a science and technology park can bring to an economy begins by shifting the traditional focus of economic development from the locality to the economic region. Despite our being in the center of a technology era (running on "Internet time"), today's economy still has much in common with the renaissance when centers with unique products—natural resource or manufacturing capability—were 'networked' by traders to trading centers in what were to become great merchant cities. Today a regional economy is still a geographic area in which there is a specialized knowledge and capacity that is of a scale and form that distinguishes the region from other geographic areas.

Region and Locality— Economic vs. Political

The same physical definition of a region applies today as in the past: the distance that any resident can travel across and back to perform a job. Today, we call this a "commutershed" and its scale depends on highways, public transit and air connections. More pragmatically—for measurement purposes—a region can be defined as a metropolitan statistical area, an MSA. After decades of regions tending to increasingly resemble one another in nations such as the US, we are now finding ourselves in an era in which, not unlike the renaissance, we have great metropolitan regions—our analog to city-states—taking shape with their own economic identities that attract and produce talent and wealth.

What is important about thinking regionally, particularly for an S&T park, is that industries do not really care about political boundaries—except when they are a barrier or have dramatically different economic cost factors. What industries do care about is obtaining sources of advantage for their enterprise. For this reason, a political boundary between a city and its neighbor, or one county and another, is not a useful economic distinction. If anything, localities and their surrounding jurisdictions are often pitted against each other in a manner that forces them to outbid each other on short-term issues, rather than compete on the basis of their building their strategic sources of advantage for industry. This fragmentation binders building regional-scaled initiatives that concentrate resources and produce mutually beneficial economic benefits that will sustain regional economic performance. More common is cross-jurisdictional bickering and inability to rapidly undertake decisions important to shaping the economic future. For the developers of an S&T park the region is the platform on which their venture must build and grow, no matter what jurisdictions may say.

Regional Agglomerations

Today, there are many more geographic centers that can produce portions of the "value-chain" for a given industry and coordinate their production, assembly, distribution and service. Despite this, agglomeration—the tendency of industrial activities to concentrate in certain geographic locations where there is a common advantage—has not diminished. What is happening is that regions are becoming increasingly specialized in the advantages they offer a given industry and in doing so induce their formation, expansion and attraction. For this reason, despite the Internet, software companies have tended to agglomerate in locations where they share in common specific inputs to their businesses and lives-whether a labor force of software application writers familiar with C++ or Java, knowledge of the needs and idiosyncrasies of a specific end-market customer, or a specific style of life. When a region succeeds in creating inputs that foster the formation or attraction of outputs, the feedback loop that takes shape creates regional wealth and dynamism—the ability to adapt to economic cycles over time.

Decentralization and Disintermediation of Industry

There is no doubt that the world will continue to decentralize and disintermediate its economic activities so that design, engineering, manufacturing of components, integration, testing, assembly, distribution and service are more widely dispersed. This will occur so that these economic activities are closer to either key inputs or end-markets (hence decentralization). Activities will also be more likely to be assigned or "outsourced" to the most cost effective supplier or strategic partner (hence disintermediation).There is no doubt that regional economic "chemistry" grows and attracts enterprise and that each region has its own identity which creates jobs and quality of life. S&T parks are clearly vehicles for reinforcing or redefining that

economic identity. But this does not happen automatically. The starting point for achieving a successful S&T Park development is to understand where and how it fits into the broader economic region. One can think of an S&T park as an economic node or island within the broader organism of the region. Anyone developing a science and technology park should, therefore, have a good answer to the following question: Do you know your region's identity and how it is performing?

S&T Parks and Regional Economic Performance

Thinking regionally is important for political as well as operational reasons for S&T parks. After all, the S&T park will help to shape the region's next generation economy, both as a model of what is to come and as a catalyst. For this reason those developing S&T parks need to understand where the regional economy is and what overall economic performance challenges it faces as the park develops. A park's challenges and opportunities will often be set by the initial conditions of the surrounding region. For this reason both the region's stakeholders and the S&T park developer need to understand how the region has been performing. This knowledge will help politicians and community stakeholders recognize and buy into the value of park development. As mentioned earlier, an S&T park can be a catalyst and anchor for regional growth.

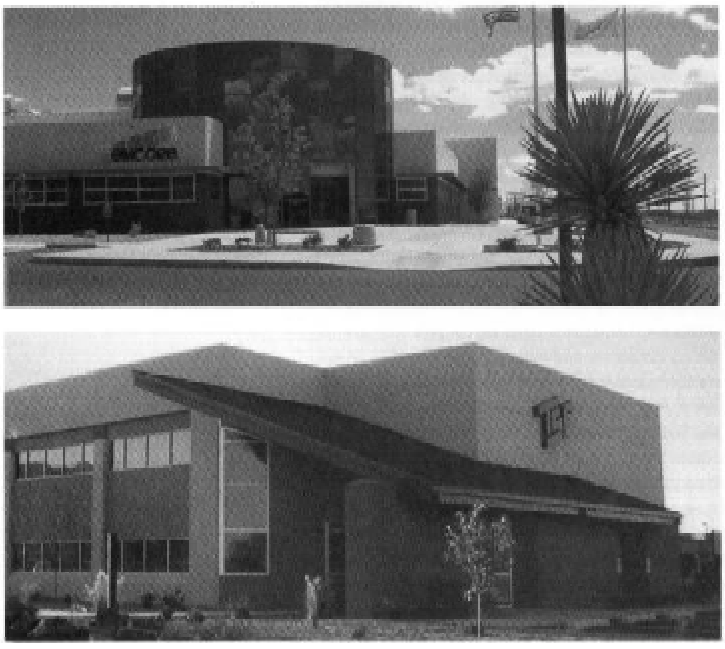
Regional economic performance is often simply defined in terms of job growth. This is not adequate to tell the story of the regional "holding company." As our team has defined it, regional performance can be viewed in terms of three basic measures: prosperity, disparity and sustainability. Each of these measures tells a story of where the region has been and is going as an economic entity. A region's confidence in itself and its leaders and its concern with its economy can be tracked by showing how the region has performed over time, and by how it ranks next to its top competitors. Prosperity can be measured through composite in dices of employment growth, wage growth and income growth. Disparity can be measured through composite indices of overall percent in poverty, the standard deviation of income difference, black-white in come difference, and urban-suburban poverty ratios. Sustainability can be estimated by producing a ratio of employment growth in key industries against change in selected environmental measures, such as air

Sandia Science & Technology Park: Thinking Regionally

Sandia National Laboratories has played a leadership role in organizing stakeholders to develop a 200-acre site, consisting of four separately owned parcels of land, into a science and technology part that will help build the next generation regional economy of Central New Mexico. The managers of the Sandia Science & Technology Park recognized early on that the success of the park would be enhanced by linking its vision and form to that of the surrounding region. The Sandia National Laboratories team began to build momentum for their park through a series of activities that would accomplish this goal.

In 1999, the team organized and held a conference in conjunction with the Council on Competitiveness and the city of Albuquerque. "The Southwest as a Region of Innovation: brought together the delegations form major technology clusters of the region as well as from the region's national laboratories and universities. As part of this conference, an initial cluster analysis of the major metropolitan areas of the Southwest was carried out (by Information Design Associates and ICF Consulting) that indicated the location and competitive position of major clusters. In additions, the conference convened initial working groups of representatives from high-tech clusters to learn about competitive challenges and potential for collaborative actions. This event helped prepare Sandia National Laboratories in its efforts to collaborate with the city of Albuquerque on a Department of Energy (DOE) funded project to shape the "Next Generation Economy Initiative" for the Central New Mexico region, of which the science and technology park ins an integral component. Regional performance analysis, cluster competitiveness analysis, regional competency assessment, and collaborative strategy development were completed, focusing on accelerating regional cluster development, and supporting the market strategy and development objectives for the science and technology work.

Sandia has since not only held a second Southwest as Region of Innovation (SWRI II) Conference, but has undertaken its own innovative collaboration with land owners of the land associated with the Sandia Science & Technology Park to ensure coordinated development. Sandia is also a major partner in the Community Reuse Organization (CRO) that has been formed to implement the collaborative strategies arising from the Next generation Economy Initiative—particularly initiatives that will enhance the supportiveness of the S&T park to emerging regional clusters. For proceedings of the Southwest as a Region of Innovation conferences and cluster report, see http//www.Sandia.gov/SWRI.



EMCORE Phot Voltais (top) and Team Specialty Products (above), tenants in the Sandia Science and Technology Park.

Figure 1

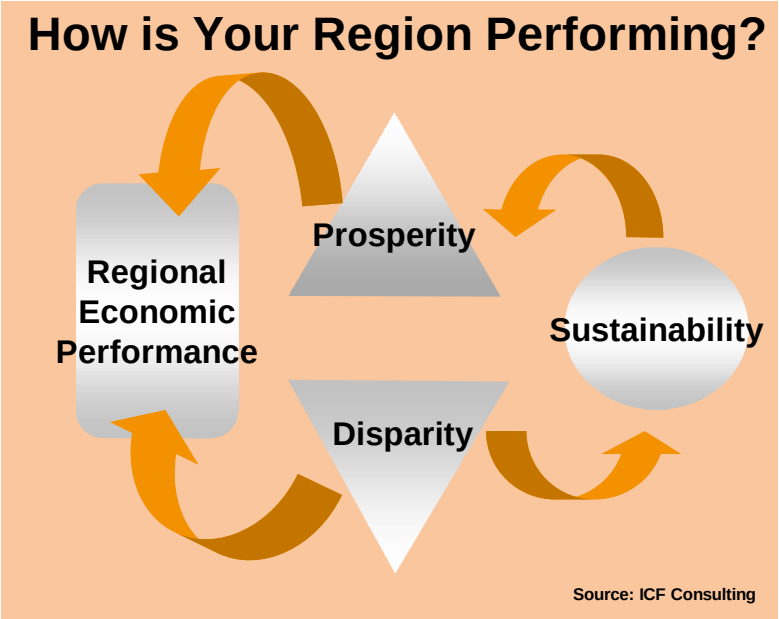
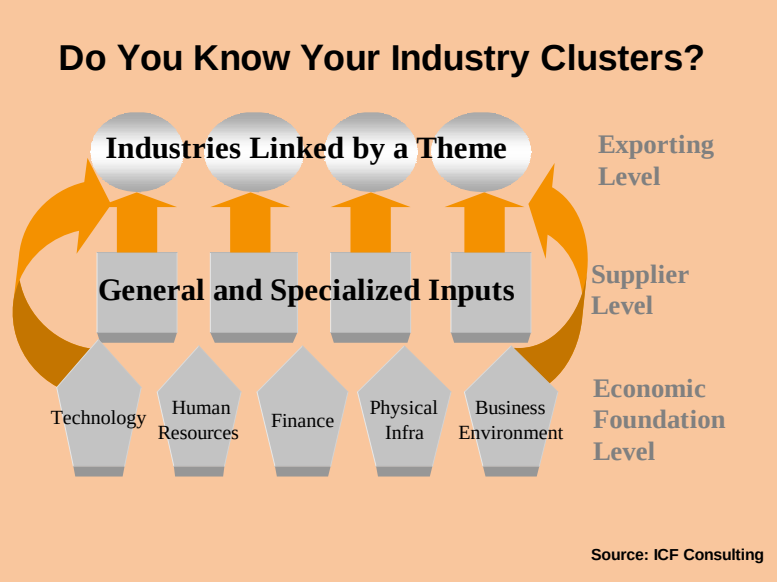


Figure 2



quality and hazardous waste sites per 1000 employees, among other measures.

If public commitment to an S&T park is to be made, whether in the form of off site improvements or in vestments, loans to companies, or location and operation of specialized institutions on site, then there needs to be a shared understanding of how the S&T park will contribute to regional performance over time. Starting with regional economic performance provides a key point of departure for defining needs and goals for a science and technology park. (See Figure 1)

New Rule 2: Clusters Drive Regional Performance

Defining Targets for S&T Parks

The concept of a science and technology park en compasses a spectrum of co located business activities from research and development to engineering and light manufacturing, all presumably with ostensibly environmentally clean and offering diversity of high skilled employment. This concept stands out in contrast to what might be construed to be the less clean and less skill-intensive industrial park with its emphasis on manufacturing and distribution or the strictly administrative focus of a traditional office park. At the time when developments, such as the Stanford Research Park, were established, the distinction between high technology and traditional industry was clear. Today, there are no industries that are not technologically driven and the primary distinction among parks is between centers that emphasize technology development vs. technology-based production. The evidence suggests that there is no longer any absolute definition of what a science and technology park or research park must be—hence the trend towards creating "next generation technology communities." What ever a park's composition, the core objective is to create a "platform" for economic activities that appeals to tenants over time and generates the quality of jobs that a region desires.

But how do developers of S&T parks decide what their park should focus on? Is it simply a matter of turning the sale and lease of sites over to a master developer who will work with commercial real estate agents to secure tenants based on current market demand? Is filling up an S&T park simply a matter of being patient and letting the early tenants set the pattern for future tenants in conjunction with real estate market demand? While most S&T parks have defined the parameters that their tenants should meet if they were to locate there, in many cases, these were aspirations that were hard to achieve—such as specific industry sector targets or types of technology development activity. As a result a large number of S&T park managers have had to accept, and were grateful for, tenants that were even marginally close to the tenant criteria.

Getting Beyond High Tech Companies as a Target

In the past decade, however, new perspectives on what drives a regional economy have made it possible for developers to not only develop a more focused approach to park development, but actually able to define which industries and which companies in those industries would best be served by the park. Conventional high technology targets are simply not sufficient to guide park development.

The Power of Clusters

The understanding that regional economies are driven by what are called "industrial clusters" has given this desire a very tangible and actionable focus. Industrial clusters are agglomerations of industries, suppliers and supporting institutions within a region that export to national and global markets. They are a set of industries that share in common technological, skill, finance and logistical inputs and because of this tend to agglomerate near one another and both purposefully and inadvertently share innovative practices and scales of economy. Clusters are important because while they typically account for approximately 25 percent of employment, their economic multipliers tend to explain the balance of the region's non-exporting employment. (See Figure 2)

Identifying Your Cluster Portfolio

A cluster can be identified by first identifying exporting industries that exist in a region, then identifying the employment concentration ratios of individual industries relative to the US, and then determining which set of industries meet the criteria of sharing critical inputs. These groupings become the basic "cluster portfolio" of a region.

Measuring Cluster Depth and Breadth

Beyond initial identification, the structure of each cluster can be further measured in terms of its breadth and depth. Cluster breadth is a measure of the diversity of industries or industry segments that share common inputs. For example, a region that has one very large employer in an industry is not a cluster, even if its employment concentration ratio is above the national average as a result. On the other hand, a region that has a large number of industries and companies serving similar markets and using similar inputs would be considered to be a cluster with great horizontal diversity. This type of cluster would be more resilient over economic cycles. Moreover, a cluster with a high ratio of both new enterprise formation and high survival would also be considered to have a healthy dynamism—in other words, the cluster would be dynamic, rather than static.

The depth of a cluster pertains to the percentage of the industry value-chain present in the region. For example, the value-chain consists of a continuum from administration and R&D through engineering, production, assembly, distribution, marketing and service. A cluster that has substantial depth may have one or more elements of the value-chain located in the same region. Having a large percent of the value-chain locally has become very rare as business activities have become decentralized from core locations to where they can gain the greatest advantage. However, in leading high tech centers of specific industries, several portions of the value-chain are likely to be found, such as administration, R&D and engineering.

The depth of a cluster is difficult to measure. One approach is to identify the top suppliers to each cluster industry, using an I/O model and then estimate the employment concentration of each supplier in the region. If the supplier ratios are higher than the US average, there is a surplus in capacity which is likely to mean that there is a strong base that presumably exports its capabilities to other markets or clusters. Estimates of cluster richness can also be derived by using interviews and surveys of industry, as well as using industry data bases to quantify the number of firms and output in specific supply categories. Many regions may have very 'thin' clusters in which there are many industries, but they are primarily specialized in one level of the value-chain, such as assembly and therefore also add less value within the region. These types of clusters—"industrial archipelagos" are more isolated, less dynamic and more vulnerable to economic cycles than are more deeply developed industry groups.

While from an economic vitality standpoint a region with a diversity of clusters is most healthy or robust, there are regions whose specialty is serving one particular level of the value-chain across many clusters. For example, there are

Figure 3

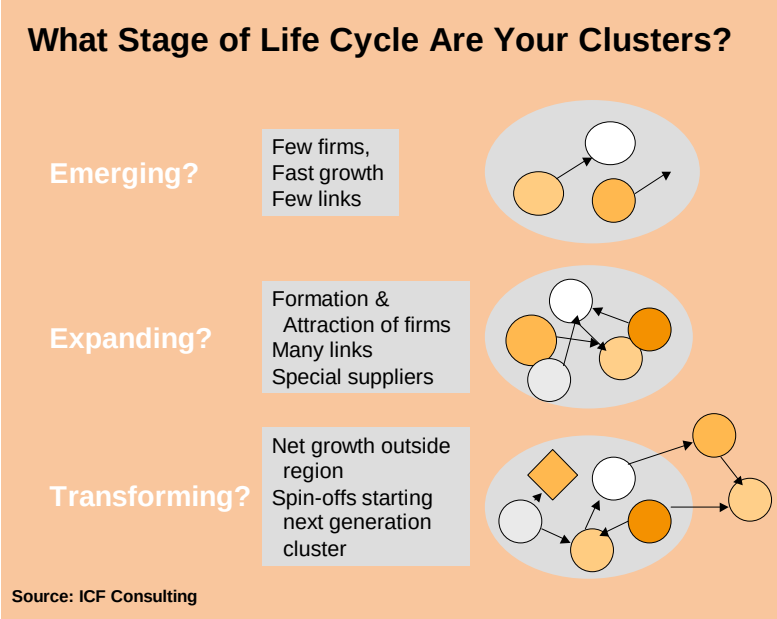
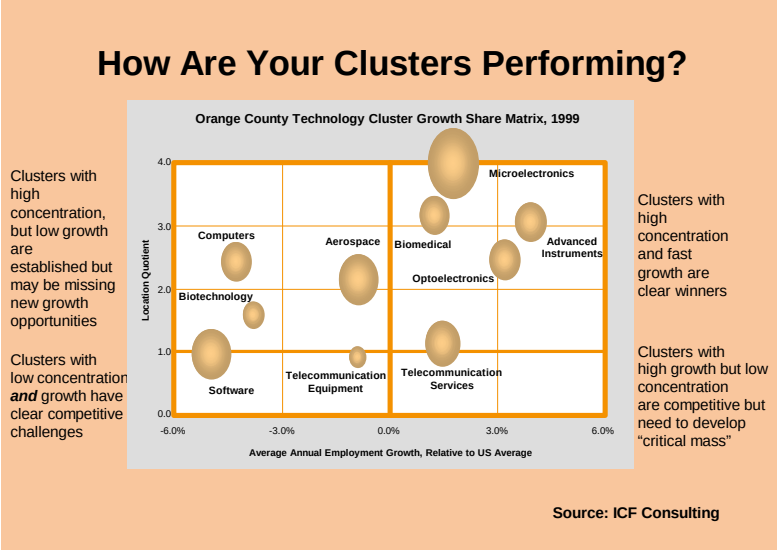


Figure 4



regions that may specialize in research and development or perhaps design. These regions may have R&D or design operations of many companies located there, but not other portions of the value-chain. Regions can also be specialists in manufacturing and assembly, with no distinct industry cluster at all, but distinct competency across production activities.

Cluster Stage of Life Cycle

Clusters have a development life cycle that moves from an emerging stage to an expanding stage and then to a transforming stage at which the cluster has changed its structure or given rise to new Spin-offs that are the beginning of a new cluster. A cluster can be in the emerging stage relative to its own region, in which case it has higher than national growth and a low employment concentration, or emerging relative to the nation, in which it has both a higher than the average national growth rate and a higher than national concentration. Expanding clusters have a high employment concentration and are growing faster than the national average, particularly their analogs in competing regions. Transforming clusters typically have high employment concentrations and below the national average of employment growth or comprise an industry group that is declining nationally.

Regional Evolution

Regions with a specialization at one level of the value-chain but no full cluster, are certainly dynamic, but have a different vitality than do regions with fully developed industry clusters. The reason for this is that regions with a specialized focus may capture less of the total value added than a full cluster, simply because they export their value to other users, whether R&D or design or the final stage of production. A region with a specialization in R&D, design or engineering may have very high quality jobs, but less diversity of opportunity and lower multipliers than a region with a greater degree of vertical depth in each cluster. These cross-cluster specializations can be the seed for the growth of one or more cluster, although this is not a necessary consequence of their presence.

In fact, specialization can reflect different stages of the lifecycle of an industry cluster. At the earliest stages, for example, a region may be home to the headquarters, design and engineering of companies. As these businesses mature they may identify partners for engineering, production and distribution within the region. At this expansion stage, the clustering process takes effect. Overtime, as the regional capacity to accommodate growth becomes constrained by land prices and competition for workforce, the cluster may begin to spin-off net growth to other regions. These growing regions, in turn, will first become centers of those portions of the value-chain that are no longer suited to the parent region and then over time, may acquire their own depth of value-chain as R&D, design and engineering is added to manufacturing, or production is added to R&D, design and engineering.

Regional clusters are not only continually taking shape, they form seeds, expand, and transform as both scale and requirements change over time. New clusters can emerge out of more mature clusters, if the surrounding environment is sufficiently dynamic and responsive to changing needs. (See Figure 3)

Measuring Cluster Competitiveness in the Region

This point is an essential reason for using the cluster logic to guide the conceptualization and development of S&T parks: An S&T park can be a vehicle for helping to capture, evolve and sustain regional clusters—if the developers and managers understand what they are and how they work.

Identifying clusters is only a beginning to developing a plan for their formation, expansion or attraction to a technology park. In determining which clusters and which companies to focus on, the S&T park team needs to understand how cluster development is taking shape in the competitive marketplace. For this reason, three steps need to be carried out. The first is to measure the performance of clusters within the region. This involves analyzing their employment and output growth over time and benchmarking their growth relative to the US average (and clusters in competing regions) for the set of industries that comprise the cluster. Then, by analyzing the concentration in the clusters relative to their growth rate (using US average for that industry as the midpoint) it is possible to determine how the region's clusters are performing from a strategic perspective:

- **High Concentration/High Growth:** Clusters that are highly specialized in the region and are growing better than the nation. This group represents the high growth, high share targets; the easier cluster to focus on and for whom the region has apparently been doing a good job in meeting input advantage requirements.

- **High Concentration/Low Growth:** Clusters in the region which are highly specialized but are growing less than the nation. This group represents a target for which the region must do a better job serving if it is to achieve a competitive position. Here the question is "what specific sources of advantage could be provided to enable this cluster to better perform?"

On the Corridor—CSU Long Beach

In the past few years, a number of military base reuse initiatives have focused on transforming former bases into science and technology parks. In three cases, a regional, cluster-based development approach was used to define market targets. The earliest case was the former Cabrillo base in Long Beach, approximately 30 acres of which was acquired by California State University/Long Beach. The cluster analysis for this site examined the greater Los Angeles region, emphasizing the commutershed surrounding Long Beach. Within this area, priority clusters identified included aerospace, transportation services, environmental services, and entertainment.

In terms of a match for the university's research and training interests in the park, direct assessment of cluster companies determined that a mixture of logistics technology and environmental services would be most attractive, leveraging the anticipated development of the Alameda Corridor—a multi-modal development to extend from the ports of Long Beach and Los Angeles to distribution points in downtown Los Angeles. The cluster development concept has been adopted by the university and its development foundation, and the research and training park has been moving forward.

- **Low Concentration/High Growth:** Clusters in the region which are less specialized but are growing faster than the nation. These are the emerging clusters and can be a high priority for supporting new growth. Typically, the region has something that is already working. The key is to create an environment that can accommodate and reinforce that growth.

- **Low Concentration/Low Growth:** Clusters in the region which are less specialized and growing slower than the nation (or in which the national growth is declining). This group is not a good focus for additional development, since it has a limited presence and is also not performing well.

Using Cluster Competitiveness Insights

For each of the clusters, the S&T park can evaluate the structure and position relative to national benchmarks. The next step in screening the set of prospective targets is to analyze how the region compares to specific competitors for its portfolio of clusters. This can help focus the market targeting process in important ways. The first question is which competitor regions to choose? Some regions choose metropolitan areas in surrounding states that are building their economies and S&T parks as logical benchmarks. Other regions choose the high

growth centers for the clusters that are already present in their region in order to gain an understanding of relative differences and opportunities for recruitment. Both are relevant steps to take, time and resources permitting.

Analysis of competing region cluster performance shows the relative size and specialization of clusters, historic growth and share of markets. The outcome of this analysis will tell the region or S&T park developers whether they are competing for the same cluster components as their neighbors or reasonably distinct clusters. After all, no two clusters are alike, given that clusters are groups of industries with different market foci and specialization. Another outcome of this analysis is identification of where the targets for recruitment may be: centers with the highest concentration of headquarters firms and prospective spin-offs that might be looking for a location for expansion. The conclusion of the analysis of cluster competitive position should provide developers with a set of priority target clusters, the location where those clusters can best be found, and, subsequently, a list of companies in those target regions as well as within the host region, with whom to begin building a relationship for attraction to a science and technology park. (See Figure 4)

Knowing Your Regional Home Turf

Why is understanding a region's cluster portfolio relevant to S&T park development? There are three reasons. First, this knowledge helps to define their home economy for the park—that is, the regional market from which most parks will draw a substantial portion of their tenants. After all, many firms in a region prefer to move locally to modernize or expand rather than leave a region. Second, the knowledge of which clusters exist tells the S&T park developer what agglomeration already exists to which other firms might be attracted, whether producers or suppliers. This is the potential for cluster synergy. Finally, by using cluster analysis of the region and its competitors, it is possible to actively identify which other regions are the major centers (e.g., headquarters) of clusters that the S&T park would like to recruit to this region (by providing new sources of advantage in critical inputs).

Implications of New Rules

Science and technology parks deserve to receive greater attention by virtue of their importance as tools for economic development. Whether urban or" greenfield," science and technology parks represent an opportunity for regional leaders, institutional stakeholders, corporations and real estate developers to become innovators in shaping next generation communities.

S & T park developers and their corporate, public or institutional sponsors and partners are beginning to increasingly think about their region and how it is evolving—because this is where the benefits of economic performance accrue at the end of the day: where we live. S&T park partners are also beginning to recognize that regional identity is driven by a portfolio of clusters—not single companies or industries but interdependent groups of producers, suppliers and input institutions—and that a successful S&T park success must link up with or leverage cluster dynamics. How to accomplish this pattern of development is the focus in the next part of this series. The article will explore how regionally focused, cluster driven S&T park development can be achieved through processes of collaboration that create economic input advantage.