University of North Carolina at Chapel Hill
Office of Economic Development

MAINTAINING COMPETITIVENESS IN THE NEW MILLENNIUM:

A PLAN TO ESTABLISH INDUSTRY CLUSTER RESOURCE CENTERS FOR NORTH CAROLINA

Final Report
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I. REPORT PURPOSE AND STRUCTURE

BACKGROUND

North Carolina's traditional industries continue to shed employment. Between 1989 and 1998, for example, the textiles and apparel, furniture, and tobacco manufacturing sectors lost nearly 100,000 workers in aggregate, or roughly one-quarter of their total workforce. At the same time, other sectors, including some that are new, have been growing, absorbing some of the displaced workers, but also inducing out-of-state workers into North Carolina. During the 1990s, the medical services, labs, and hospital sector added over 140,000 net new jobs; banking, finance and insurance created some 52,000 new positions; metalworking and industrial machinery, communications software and services, and value-added agriculture and food processing added more than 20,000 employees each. In addition, biotechnology and pharmaceuticals, multimedia and digital content, and logistics and distribution companies are beginning to sprout up around the state.

This wholesale transformation of the North Carolina economy presents some major challenges for the state's workforce and the North Carolina Community College System, which long has played a critical role preparing North Carolinians for quality jobs. Displaced workers, new job seekers, and migrants to the state need to be trained in the skills demanded by the new and expanding businesses. At the same time, those businesses need different kinds of assistance from the state than in the past. Successful firms now view education and training as a continual process. They need *knowledge networks* that can enhance their access to new skills and knowledge on a regular basis.

This report elaborates a bold new strategy for addressing the needs of the state's workers and its new and expanding businesses: the creation of Industry Cluster Resource Centers (ICRCs) to be developed and operated by community colleges on or near their campuses, in each of the state's seven economic development partnership regions.

ICRCs are conceived to be hubs of the new knowledge networks. As with other community college-sponsored programs (such as customized training), the ICRCs will employ the experience and expertise of community college staff. But they will not simply offer classes or provide advanced technology. Their challenge is to develop high-level and sustained interactions between and among firms in their regions that continually demand and produce knowledge. ***The ICRCs for North Carolina are intended to be one-stop shops for an industry cluster, somewhere member firms can go for help in translating their organizational needs into education and training requirements, or for expertise that can enhance their competitiveness.*** Because ICRCs are focused on specific industry clusters, their staffs can develop a deep

understanding of the cluster members' needs and establish a high degree of trust and interdependence. They will give similar companies access to larger and more specialized pools of workers who understand a particular business and how to apply their skills to it, as well as to the required technologies.

REPORT STRUCTURE

This report lays out the concept and implementation of ICRCs for the state. The NCCCS and others envision these centers as a way to help move the system into the 21st century and elevate North Carolina's economic competitiveness.

This project involved the following tasks:

- Reviewing best practices in North Carolina and elsewhere
- Prioritizing industries and suggesting locations for greatest impact. This included:
  - Analyzing regional cluster data on industries
  - Interviewing state and regional strategic leaders
- Suggesting organization, management structure, and likely costs
- Preparing final report

Section II of this report outlines the overall concept of Industry Cluster Resource Centers (ICRCs) and articulates some basic principles for their success. These are based on best practice cluster centers within North Carolina, the U.S., and Europe. Section II also establishes *why* such centers are vital for economic development in the new economy, as well as *how* they should be approached. At the close of Section II, we present general design principles and how they can be applied to North Carolina. (Section IV contains a more detailed discussion of how to design and execute ICRCs.)

Section III examines *what* the key industry clusters are in North Carolina and *where* ICRCs should be located. These are very difficult issues, for a number of reasons. First, identification of clusters is somewhat subjective. Academic literature calls cluster analysis "part science and part art." (For example, see Porter, 1991[1].) Whatever methodology one chooses to construct clusters requires data. Available data, however, are generally better suited to capture "mature" (or existing) clusters rather than "emerging" (or nascent) clusters. However, both types of clusters are important for the purposes of this project.[2]

Another challenge is developing an objective method for winnowing down the number of clusters for policy attention. Our analysis initially identified fourteen industry clusters in North Carolina. We have established criteria that reduce that list to eight. A related issue is geographic coverage. The principle (if not implementation) of "balanced development" is well-established in North Carolina. The community college system itself embodies that principle, with facilities

[1] Michael E. Porter, *Strategy: Seeking and Securing Competitive Advantage*, 1991.

[2] This is a classic problem in "industrial policy," which requires the government to pick targets for intervention. See Michael Luger (2000), "Cluster Analysis as a Mode of Inquiry," working paper. Chapel Hill, NC: Office of Economic Development.

spread across the state, in over half its counties. Our prioritization of clusters recognizes the importance of geographic coverage, and our research justifies the establishment of ICRCs in all economic development partnership regions. We provide suggested priorities for the first phase of centers and which region should host each one.

We recommend that the selection of host community colleges for the specified ICRCs be done through a competitive bid process, in response to a request for proposals (RFP). Section IV provides further detail about the process we recommend for the NCCCS and the RFP. Section IV details *how* both the system and interested colleges can establish ICRCs that are tied to the NCCCS but are fluid enough to be responsive to changes in the industries served.

The bid process and RFP reflect the principles of best practice and organizational design. They require each center to have close linkages with other community colleges, industry and universities around the state, as well as their host communities or regions. ***Each ICRC is envisioned as a statewide resource***, not simply a regional one, making these linkages critical to both their efficiency and effectiveness.

II. INDUSTRY CLUSTER RESOURCE CENTERS: THE CREATION OF THIRD GENERATION COMMUNITY COLLEGES

HISTORY OF COMMUNITY COLLEGE CENTERS TO SUPPORT INDUSTRY

From the 1950s to the mid 1980s, the economic development mission of community colleges around the country was to provide education and training to meet the needs and expectations of new and expanding industries regardless of product or industry location. While private companies in many states were directly contracting much of this activity, in North Carolina the use of continuing education or business and industry centers at community colleges to perform these activities was standard state policy. North Carolina was, in fact, a pioneer in the use of community colleges for customized training. Its community colleges became model institutions for training of front-line workers and supporting economic development. To support the needs of very large employers, a few colleges even formed partnerships with corporations and created dedicated centers that contained the equipment and used the processes of the partner employer. These centers, created to support large employers and company-specific skills, represented the **first generation** of centers.

One example is the Central Piedmont Community College-Okuma Technology Institute, formed when the Okuma Machine Tool Company of Oguchi, Japan selected North Carolina as a site for a production facility. Central Piedmont Community College was part of the regional development team charged with attracting the investment and as a team member crafted a plan for start-up training and continuing manufacturing training. The college manages the operation through its Corporate and Continuing Education Division, hires faculty, schedules classes, markets the institute outside of the company, and evaluates programs. Okuma provides classroom space and labs and access to equipment and assistance with course scheduling, context, and selection.

In the mid-1980s, a growing awareness of small and mid-sized enterprises (SMEs) in regional economies and their need for advanced technologies, combined with a skilled workforce to use them, led to a second generation of education and training centers. These second generation centers emphasized more advanced skills for the smaller modernizing firms as well as new and expanding companies. The need for technology and innovation among SMEs quickly became apparent to community colleges, which are closer to local industries, more flexible, and generally better positioned to help SMEs innovate and modernize.

To meet that challenge, community colleges created "Advanced Technology Centers" (ATCs) that enhanced and supplemented their core education and training mandate and allowed them to function as "technology intermediaries." The ATCs strengthened ties to industry, facilitated inter-firm collaboration, performed technology and skill needs assessments, and provided technical information, often in alliance with other service agencies with similar missions, such as the Manufacturing Extension Partnership. This **second generation** of centers to support modernization focused on advanced technologies and skills and on smaller firms. An example is the Regional High Tech Center, established at Haywood Community College in western North

Carolina. Created to help expose regional firms to the latest technologies, the Center uses flexible manufacturing cells both as a showcase for industry and to prepare a workforce that can use the equipment.

THIRD GENERATION CENTERS

Today, there is major structural change in the American workplace, popularly called "the new economy." While the press focuses on the Internet and information technologies, a more fundamental change driving firms in the American economy is that ***knowledge-based skills have become an essential part of competitive strategies***. Much of this was captured in a recent report from the New Expeditions Initiative 2000 of the American Association of Community Colleges (AACC). Its final report The Knowledge Net stated:

> Technology and globalization combine to further divide the haves and the have-nots – those with the skills and adaptability to navigate change and exploit opportunity and those for whom change means disruption, displacement, and detachment. Surviving and thriving in a changing world require that community colleges connect in multiple ways. They must create a network of pathways enabling people to traverse the maze successfully and profitably. To sustain these travelers in their journeys, colleges must help impart the knowledge people need to make the right decisions and choose the road that enables them to realize their potential. This is the network, the knowledge net, the nexus of pathways leading to empowerment through the acquisition of knowledge and the honing of skills that permit people to exploit change successfully.

All firms that wish to be competitive are faced with a fundamental challenge, also raised in the AACC report, of how to acquire the necessary knowledge to support a competitive strategy. The need for tacit and explicit knowledge about the marketplace and technology is not new. The fast-paced information economy, however, has raised the stakes. The speed of change makes it necessary for businesses to adapt continually, not periodically, as before. Businesses have generally acquired the information they need from their customers and their competitors. That has been a driving force behind agglomeration tendencies in that firms locate near their markets and other, similar firms. Recent research indicates that this "clustering" of economic activity has become even more important in the information age. Even though information technology allows firms to locate remotely, the need for face-to-face contact to share information (or, capture what literature calls "knowledge spillovers") has kept clusters intact. Competitive pressures also force businesses to keep tight controls on costs, and clustering allows businesses with similar needs to share like services and tap into the same pool of workers.

Increasingly, public policy is recognizing the importance of clusters in developing economic development programs. Efforts have been made to strengthen buyer-supplier linkages and to augment market provisions of common services that benefit the same types of firms. Today's common wisdom is that successful regional economies are collections of interdependent, rather than independent, firms. Governments are working to develop and strengthen clusters as a way to build that interdependence. In competing states, coalitions of state governments, community colleges, and industry are establishing cluster training centers as a cutting-edge strategy to maintain economic competitiveness. States that are pursuing this strategy include California, Oregon, Mississippi, Alabama, Michigan, South Carolina, and Virginia, among others.

One of the most important ways clusters work to enhance competitiveness is to give similar companies access to larger and more specialized pools of workers who understand a particular business and how to apply their skills to it[3]. Thus, the emerging **third generation** of centers are those that emphasize specialized technologies and knowledge and target firms within a particular cluster. This allows colleges to build strengths and develop expertise not possible if spread over many types of businesses. A partner in this center is not a large corporation or an equipment producer but an industry group or association. This third generation center has four discrete activities:

- *knowledge generation*: building a knowledge base through research adaptation, discovery, and experience in the cluster;
- *knowledge development*: transforming raw knowledge into codified principles and practices for the cluster;
- *knowledge transfer*: producing documentation and people that will facilitate knowledge delivery within the cluster; and
- *knowledge need and use*: implementing and adjusting knowledge to meet customer needs.

One tool to carry out these activities is an Industry Cluster Resource Center (ICRC) at or near a community college that would function as a "knowledge network." It will not simply hold classes, or provide advanced technology. Successful firms now view education and training as a continual process. They need *knowledge networks* that can enhance their access to new skills and knowledge on a regular basis. Community colleges are integral parts of those knowledge networks. For the colleges, the challenge is not simply to provide entry-level skills to workers but to develop ***high-level and sustained interaction with firms in their regions that continually transfer knowledge back and forth***. North Carolina's community colleges can play a central role in transmitting such knowledge to and among important clusters of firms in the state.

As knowledge network hubs, each ICRC will serve as a one-stop shop for an industry cluster, somewhere member firms can go for help in translating their organizational needs into education and training requirements or for expertise that can spur improvements in their competitiveness. We believe that community colleges must begin to concentrate their activities around the specific clusters of firms that they will serve in order to understand the business fully, remain at the forefront of advances in knowledge, earn the trust of the employers, and meet their needs. The Hosiery Technology Center at Catawba Valley Community College, a collaborative venture of the community college and an industry association, is an excellent example. With equipment ranging from the oldest to the latest computer-aided knitting machines, the center trains repair technicians, knitters, and managers and is developing training programs for dyers. The firms rely on this center not only for education and training, but also for information about technologies and markets, and as an intermediary to spur new technology R&D.

[3] Appendix A includes further discussion of clusters and their implications for knowledge and skills development.

FEATURES AND DESIGN PRINCIPLES OF A SUCCESSFUL CLUSTER HUB

To motivate and aid in the process, the project team has formulated an RFP (see Section IV) to develop, promote, and implement the Industry Cluster Resource Center as a new type of education, training, and knowledge resource at community colleges. It represents a new institutional focus for North Carolina community colleges, one based on the colleges as major suppliers of technical expertise and knowledge to specific clusters of firms in their regions and statewide. By emphasizing the development of specialized workforce skills, these ICRCs will play an important role in strengthening the competitiveness of the firms in their clusters. ***The main outcome from these ICRCs will not be more credit hours or student participation measures, but increases in employment and wages, job retention, and other such measures of economic growth, productivity, and competitiveness of the cluster.***

Distinguishing an ICRC from an ATC. The organization of an ICRC that is based on knowledge is fundamentally different from the Advanced Technology Centers (ATCs) that were established to accompany and stimulate the adoption of new production technologies in the 1980s and early 1990s. The ATCs are represented by the members of the Consortium for Manufacturing Competitiveness in the South, now the National Coalition for Advanced Technology Centers. The ICRC is knowledge-based, the ATCs technology-based. The cluster hub is driven by the customer/companies, while the technology center is more often driven by the equipment manufacturers. Early ATCs and their associations were influenced, for example, by equipment and software donations from Amatrol, Cincinnati-Milicron, AutoDesk, GE Fantus, and IBM.

Both ATCs and ICRCs operate as intermediaries and brokers, but the ICRC is more likely to have a broader set of partnerships across a narrower set of industries than the ATCs. The ICRC is more likely to target its resources to staff and content, and the ATC more to equipment, bricks, and mortar. Cluster centers have a greater need for well-equipped meeting space, while technology centers need well-equipped workspaces. ***The principal goals of the ICRC are to give students a solid contextual knowledge plus the technical skills that relate directly to a cluster.*** The principle goals of the technology center are to diffuse technologies to companies and to teach the technical skills needed to effectively utilize the technologies.

Okaloosa-Walton Community College is an example of a cluster center that began through the creation of a Technology Coast Manufacturing and Technology Skills Network among local electronics/defense contractors. The college first brought the companies together for a regional skills alliance and also to develop business connections, conduct cooperative research, and develop new products – all of which ultimately required additional skills. A subset of the network was trained and certified collectively as a major aircraft company supplier.

Some community college centers that began by focusing on technology have been able to make the necessary adjustments for developing a cluster knowledge capability. One of the reasons for this shift has been that the problems of SMEs, which were initially attributed to lack of technology, were more often found to be lack of technique and knowledge. Early ATCs began to focus more on soft skills, and emphasize Total Quality Management, ISO 9000, and lean manufacturing training. These drew more on external resources and often entailed organizing SMEs into networks to reduce unit costs.

One out-of-state example of a successful cluster center is Oklahoma State University Technical Branch at Okmulgee, which had an advanced technology center that, like so many others, was being under-utilized. It formed the Northeast Oklahoma Manufacturers Council to help shape plans and became the leading regional center for moving into electronic commerce and brokering government contracts for manufacturers.

Table 1 summarizes some of the differences between cluster and technology centers. Although the attribute of each type of center falls along a continuum and each center includes aspects of the other, the table indicates where the primary objectives lie.

Table 1
Comparison of Cluster Hubs and Technology Centers

Cluster Hubs	Technology Centers
Industry-based	Technology-based
Emphasis on soft, cluster-specific skills	Emphasis on hard, job-specific skills
Critical links to industry association	Critical links to equipment vendors
Uses business as context for educ. & training	Uses manufacturing process as context
Functions as information repository	Functions as demonstration site
Budgets stress staff and content	Budgets stress facilities and equipment

Design Principles. Based on an array of studies of clusters in various parts of the world and experiences with educational institutions that support business clusters, we have identified a number of general principles that appear to be associated with success[4].

A cluster center that maximizes its impact on regional and state economies:

Is demand driven
Its curricula, programs, and services are influenced by the current needs of the members of the cluster and by their emerging needs as best articulated by the cluster's leaders and innovators and by best practices. If the new hub serves the needs of business and industry, there will be high, long-term demand for its services that will sustain it financially.

Is industry-led
Industry is a true partner of the Center, not simply an advisory body. This implies, for example, an active role for firms – representing the cluster, not just their own interests – in center governance, resource allocation and staffing decisions.

[4] Case material from our review of other states' technology and cluster centers is included in Appendix E.

Is collaborative
The Center works closely with organizations with overlapping or complementary missions – e.g., industrial or cooperative extension services, development agencies, universities, non-profits, and colleges elsewhere in the state – directing customers to other organizations where appropriate.

Is semi-autonomous
Although administered through a community college, the hub must have the flexibility to react swiftly to market demands, and not be limited by hiring guidelines. The hub may challenge some components of the traditional organizational and decision-making structures of community colleges, thus requiring that these structures be modified to ensure that the hub can be successful.

Connects work-based to theoretical competencies
The college uses the cluster connections to embed theory in real experiences and to use real situations in the cluster to better teach theory – in all programs. Thus the cluster connection creates a context for learning that pervades other college programs.

Has in-depth expertise and experience
Its management and staff members have recent industry experience and connections and are active in industry and professional associations.

Exhibits and supports associative behavior
Successful clusters have high levels of social capital, and successful colleges both support collaborative activities and create structures that lead to associative behavior among firms. It promotes and facilitates, for example, regional skill alliances, supplier associations, business networks, and continuous user improvement groups statewide.

Is connected externally
The college is part of and participates in national and international networks and associations that help it to stay abreast of new innovation and best practices, access new materials and curricula, and help the cluster develop an international reputation.

Operates as a "knowledge network"
Successful firms view education and training as a continual process within the enterprise and they need *knowledge supply chains* that enable them to capture new skills and knowledge on a regular basis from their environment. The Center is an activating force in these chains, regularly upgrading the skills of the workforce to meet new challenges.

Addresses needs of under-represented populations
As students' preferences have shifted toward white-collar work, companies have seen it in their self-interest to target populations that have not historically held skilled positions in industry. This is even truer in today's tight labor markets, and what often have been social policies are now becoming best business practices.

Serves as a catalyst for broader economic development
By attracting more firms and/or expanding existing firms, centers should be an important new way for community colleges to play a positive role in the economic development of their communities, region, and the state.

Serves as a resource for all firms in the cluster anywhere in the state, and for all programs serving the cluster
Rather than narrowly focusing on the firms in their immediate geographic area, successful centers serve as a resource for the entire state. This broader focus stimulates cluster centers to think collaboratively and strategically about the needs of the entire cluster within the context of the state's economy.

Earns the trust of members of cluster
Perhaps most importantly, the successful center is trusted by the companies to understand their operations and needs, respect their confidences, speak their language, and treat them fairly.

APPLYING DESIGN PRINCIPLES TO THE NORTH CAROLINA CONTEXT

North Carolina's businesses are in head-to-head competition with other firms across the country and around the world. In order to succeed in this competitive global environment, North Carolina's industries require state-of-the-art modernization and training programs. The experience with these programs in North Carolina and other states demonstrates that they can deliver significant benefits to the state's economic development and deliver a good return on investment. However, these programs require a commitment of resources that is beyond the means of individual community colleges. For that reason, the NCCCS wants to establish a network of specialized training centers that would augment the existing programs of its member institutions. According to an NCCCS concept paper written in 1998, a system of specialized training centers would:

- give the NCCCS the capability of responding to identified business and industry needs that cannot be addressed effectively through normal delivery systems;
- provide specialized training programs that require costly, sophisticated equipment that couldn't be replicated statewide and yet are needed to serve the entire state;
- provide advanced training services to industries that have been identified as having vital, strategic importance to the state's economy; and
- provide resource assistance to the colleges in the NCCCS that offer similar, though generally more basic, training in the targeted areas (including curriculum and course design and materials, and instructor training).

We believe that North Carolina could benefit greatly from the creation of such a system of cluster centers. Based on the more general design principles outlined above, we suggest the following for a system of ICRCs in the state.

While cluster centers will each have an association with one or more community colleges, they must be statewide resources in both design and practice.

With 59 community college institutions across North Carolina, the state simply does not have the financial resources to be able to locate a cluster center at each community college. Therefore, it is extremely important that cluster hubs open up new forms of collaboration so that their programs and services can be a resource to different colleges across the state.

The current relationship between the NCCCS and the Piedmont Triad Center for Advanced Manufacturing (PTCAM) serves as one example of how such an arrangement might work. Under this agreement, PTCAM develops and refines the metalworking training curriculum used at community colleges, acts as a consultant to the NCCCS and its member institutions as needed, helps to train instructors both on-site at PTCAM as well as at remote locations, and develops and delivers training programs in order to support customized training through the New and Expanding Industry Training program and the Focused Industrial Training program. In addition, NCCCS has representatives on the PTCAM board of directors.

We recommend that as each center develops its structure, it think beyond the institutional borders of its host community college, for example, by including community college presidents working with the same industry cluster in other parts of the state on its board of directors. ***We also recommend that the NCCCS form an association for all the ICRCs so that they can share information on a regular basis and be a broader knowledge network of resources to each other.*** The NCCCS may also wish to form an independent board or advisory group to oversee all of the cluster centers. This group would not be involved in the administration of individual centers but would have the function of seeing that the system served the needs of the entire state, as well as its host colleges and targeted industry clusters.

Each center needs to collaborate not only with other community colleges, but also with industry and other partners.

We recommend that industry be given a strong role in resource allocation, curriculum, and staffing decisions. ***The board of directors of each cluster center should have a large proportion, if not a majority, of its membership coming directly from industry and industry associations.*** As appropriate, other partnership institutions could include the seven regional economic development partnerships, the Industrial Extension Service, the Small Business Technology Development Center, the North Carolina Rural Economic Development Center, a wide variety of university research and development programs, and industry-specific programs such as the N.C. Biotechnology Center, the Microelectronics Center of North Carolina, and PTCAM.

A new system of cluster centers should support and build on the success of existing cluster-centered programs and look to them as models.

As the development of ICRCs begins, three special cases within the North Carolina Community College System must be noted. One is the Hosiery Technology Center (HTC) at Catawba Community College that, because of its unique industry partnership, its record of achievement,

and its importance to its industry cluster, deserves continued support. The HTC is viewed widely in the United States and abroad as an innovative model cluster hub because of its committed industry support, breadth of programs and services, ability to network small firms, and impact on its cluster. It exemplifies relationships between industry and education and innovation that combine education and training with internal and external organizational and technological changes aimed at making the cluster more competitive. Because of its experience in creating a specialized center within the structure of a comprehensive community college, the HTC could become a model for North Carolina's new cluster centers as they develop their own structures and operating procedures.

A second special case is the Piedmont Triad Center for Advanced Manufacturing (PTCAM) in Greensboro, which represents a unique resource (within North Carolina) for the metalworking cluster. PTCAM was created in 1993 by the North Carolina General Assembly as a free-standing center that is supported by various educational institutions and the Manufacturing Extension Partnership to serve advanced manufacturing, but with a special emphasis on the metalworking sector. Its links to Guilford Technical Community College and to the metalworking cluster have been particularly strong. This center exemplifies a different model that requires effective regional alliances among institutions. Rather than beginning with skill needs, it begins by recognizing the need for new technologies and encouraging industry to adopt and adapt these. Then it uses the modernization to develop new skill needs and greater demand for education and training. Thus, it is important that any community college that proposes to provide services for the metalworking cluster find innovative ways to partner with and use the capabilities of PTCAM.

A third industry training center that we wish to make note of because of its cluster focus is the North Carolina Center for Applied Textile Technology (NCCATT) in Belmont. The NCCATT is not a college, but it is part of the NCCCS and works with many community colleges across the state. The Center's areas of training expertise include management skills, computers, quality assurance, industrial engineering, safety, and mechanical/technician training. A 45-member Technical Advisory Committee primarily includes representatives from the textile industry. Since the NCCATT already receives funding from the state, it does not need to be part of the competitive application process that we are proposing the NCCCS use to establish the ICRCs described in further detail below.

More information about each of these centers, as well as other existing technology or cluster centers in North Carolina, is included in Appendix F. ***Proposers of new ICRCs should be encouraged to connect to each of these existing resources*** as appropriate, rather than replicating or ignoring them.

The individual cluster resource centers will be called upon to serve firms across the state, as well as in their immediate geographic area. In order to serve this larger statewide function, they will need ongoing public financial support.

It is important to ensure that financial resources are available to cluster resource centers after their initial start-up phase. While the goal of each center is to achieve financial stability, the delivery of programs and services to the clusters of firms should be of greater priority than initial

financial self-sufficiency. If the purpose of these centers is to promote the economic development of the state, it may be inappropriate and inconsistent to expect that each college initiating an ICRC sustain any losses in the operation of the center. In some cases, industry centers forced to be completely self-sustaining have found that their focus becomes reduced to narrow fee-for-service types of activities. In such cases, the center's potential to create leadership and vision for the industry cluster and for the NCCCS is compromised.

We recommend that, as part of the entire package, the General Assembly establish a separate fund to provide resources to each of the funded centers on an annual basis to compensate for the delivery of services not otherwise recovered. The NCCCS may wish to require some matching funds from industry or other sources in order to access these funds. This aspect of the initiative is discussed again in Section IV of the report, which outlines the RFP process.

While building a close and supportive relationship to one or more community colleges, the centers need to maintain an adequate degree of autonomy.

One of the means by which centers will inspire the trust and participation of industry is by being able to act quickly and by hiring highly qualified staff with industry experience. In both cases, a certain degree of autonomy from the host community college is essential. For example, if a new firm is considering moving into an area and wants quick action on an agreement to secure training resources from the center, the center must be able to move independently and not slow things down. We also recommend that the NCCCS develop a protocol for hiring staff at the centers that allows for expedited decision-making. If current NCCCS compensation guidelines do not allow for staff to be hired at industry-competitive salaries, these policies should be reviewed and revised.

III. THE GEOGRAPHY OF CLUSTERS IN NORTH CAROLINA

The purpose of this initiative is to use community college-based programs to develop and strengthen clusters of economic activity in the state. Of course, *developing* clusters is not necessarily the same as *strengthening* them. In the former instance, there is evidence of a burgeoning cluster; in the latter, data indicate a significant concentration of activity already exists. We therefore distinguish "emerging" and "existing" clusters.

We define "cluster" in a way that is consistent with the intent of this project: as any concentration of economic resources that can be used to enhance the economic competitiveness of North Carolina. That includes, but is not limited to, the traditional way to define clusters, which are concentrations of businesses linked through input-output interactions, common markets, or common inputs. The specialized centers are expected to develop programs appropriate for industry but may also wish to address particular occupational clusters *within* those industries.

METHODOLOGY

As previously noted, cluster analysis is not a precise science. To begin the cluster identification process one typically starts with traditional clusters, performing statistical analysis on industry data to determine geographic concentrations of businesses that have strong buyer-supplier linkages.[5] The model identifies a "cluster" as a group of businesses (identified by their industry code) concentrated in a particular place. It is up to the researcher to give that cluster a name, usually based on its most prominent industries.

That procedure works fairly well for established manufacturing businesses that tend to trade intermediate goods. It is less useful, however, for the service businesses or the producers they serve, or for emerging manufacturing clusters that are just developing trading relationships. Those types of clusters may be widely recognized, but may not show up in the data.

Accordingly, we employed several methods to identify clusters. We performed a statistical analysis of the North Carolina Employment Security Commission's ES-202 dataset to create synthetic clusters based on buyer-supplier transactions among firms. However, we also surveyed and/or interviewed community college administrators, state industrial experts, and economic development partnership directors to get region-specific observations of the industrial landscape.[6] (Data from our community college surveys and expert focus group are provided in Appendices B, C and D to this report.) We used that information (as well as our own

[5] Bergman and Feser (1999), "National Industry Clusters: Frameworks for State and Regional Development Policy." *Regional Studies.*

[6] Roberts and Stimson note that interviews, surveys, and focus groups with experts knowledgeable about the regional economy are the most common method to identify clusters "They are the agents who know the region's industries in terms of basic practice, supply chains, current investment patterns and potential opportunities for new products." (Source: "Multi-sectoral qualitative analysis: a tool for assessing the competitiveness of regions and formulating strategies for economic development," *Annals of Regional Science*, 1998, vol. 32.)

experience) to adjust the statistical clusters. This two-stage approach is commonly used in cluster analysis.

INDUSTRY CLUSTERS IN NORTH CAROLINA

In the first stage of the analysis we generated a list of fourteen clusters. The clusters we have identified differ in four important respects: some are more concentrated spatially than others; some are already large, others are emerging; some are growing, others are declining; and some are oriented to the local market, while others are export-oriented. This information is summarized in Table 2.

Table 2
Overview of 14 Key N.C. Industry Clusters

Industry cluster name	Degree of concentration (high, medium, low)	established or new/ emerging?	growing/ stable or declining?	local or export oriented?
Agriculture, food processing, natural resources	medium	established	mixed	both
Banking, finance, and insurance	high	established	growing/ stable	export
Biotechnology and pharmaceuticals	high	emerging	growing/ stable	export
Chemicals and paper	medium	both	growing/ stable	export
Furniture and wood products	medium	established	declining	export
Information technology	medium	both	growing/ stable	export
Logistics and distribution	medium	both	growing/ stable	both
Medical services and laboratories	low	both	growing/ stable	local
Metalworking and industrial machinery	medium	both	growing/ stable	export
Plastics and composites	medium	both	growing/ stable	export
Printing and publishing	low	established	growing/ stable	both
Textiles and apparel	medium	established	declining	export
Tobacco manufacturing	high	established	declining	export
Tourism/retirement/recreation	medium	both	growing/ stable	both

As with any taxonomy, the entries in Table 2 are somewhat subjective, based on our interpretation of the data. The degree of concentration reflects existing location patterns and evidence of emerging activity that does not yet show up in secondary data sources (such as 1998

ESC reports). The banking, finance, and insurance cluster is concentrated in the Charlotte and Triad regions; pharmaceuticals and biotechnology is concentrated in the Triangle and Triad (although several other regions are trying hard to develop the industry); and tobacco manufacturing is concentrated in the Triad and Charlotte regions. The other clusters have a sizable presence in more than two regions, and in some cases (low concentration), five or more of the regions.

Differences among the clusters are illustrated as well in Table 3, which shows employment levels and growth rates.

Table 3
Employment in 14 N.C. Industry Clusters

Cluster	Employment		
	Number Employees 1998	Percentage Change 1989-98	Share of Total **NC Employment 1998**
Agriculture, Food Processing, Natural Resources	117,808	29.0	3.2%
Banking, Finance, Insurance	203,894	34.2	5.5%
Biotechnology and Pharmaceuticals	32,323	28.2	0.9%
Chemicals and Paper	67,840	8.3	1.8%
Furniture and Wood Products	108,239	(0.7)	2.9%
Information Technology:			
Communications Services/Software	37,670	164.3	1.0%
Media and Digital Content	34,520	83.5	0.9%
Communications Equipment	114,020	14.9	3.1%
Logistics and Distribution	98,572	14.5	2.7%
Medical Services and Laboratories	366,521	62.4	9.9%
Metalworking and Industrial Machinery	153,248	23.9	4.1%
Plastics and Composite Materials	48,611	3.4	1.3%
Printing and Publishing	33,646	10.6	0.9%
Textiles and Apparel	223,771	(28.4)	6.1%
Tobacco Products	16,151	(34.0)	0.4%
Tourism/Retirement/Recreation	97,751	42.1	2.6%

Source: N.C. Employment Security Commission, ES-202 files.

Based on the information in Tables 2 and 3, on our interviews and survey data, and on our own knowledge of the state, we adjusted the initial list of clusters in our stage two analysis from fourteen down to eleven. We eliminated from consideration clusters that were losing employment nationally and in North Carolina (furniture and wood products, textiles and apparel, and tobacco manufacturing), and thus, not likely to provide many new job opportunities for un- and underemployed workers in the state.[7] We also eliminated the printing and publishing cluster

[7] We recognize that traditional industries, like tobacco and textiles and apparel, are likely to continue to produce in North Carolina for niche and export markets, using higher-tech equipment. The modernization needs of some of those industries, notably textiles and apparel and furniture, are being met by existing centers in the state.

because it is what Porter refers to as a "highly traded" cluster[8] – those, like printing and publishing, stone and clay products, and construction materials – that are related to any local population concentration, rather than to production for export. Direct and indirect employment opportunities associated with those clusters also are limited. Finally, we omitted tourism/retirement/recreation because most of the related jobs pay lower than average wages.[9] The exception is for jobs in the gerontological medical sector, but those would fall under the cluster named for medical services and laboratories.

We also fine-tuned the interpretation of the initial cluster list, based on further interviews[10] with representatives of industry and industry membership organizations, the N.C. Department of Commerce and other policy officials, and training experts, as well as our own understanding of the emerging North Carolina economy. ***We broke down the information technology cluster into three important sub-clusters: Communications Services, Software, and E-Commerce; Media and Digital Content; and Communications Equipment***.

This screening and reconfiguration of the initial cluster list left us with eleven candidate clusters that satisfied, to varying degrees, the following five criteria:

- the cluster's further development (or strengthening) is consistent with strategic plans for economic development in its region and the state;
- the businesses within the cluster are sufficiently well-organized (and networked) to be able to relate well and relatively quickly to a newly-developed cluster center;
- the businesses within the cluster have specific needs (for example, for training) that an ICRC could meet, thus providing a high "bang for the buck";
- the businesses within the cluster will provide sufficient numbers of moderate- and high- paying jobs in their region; and
- the major concentration of businesses in the cluster, or a secondary (or linked) concentration of those businesses is in a region of the state that otherwise would not have an ICRC, so that there would be balanced economic development.

Table 4 identifies the remaining clusters, along with the partnership region(s) in which they are concentrated, to greater ("primary") and lesser ("secondary") degrees.

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[8] Michael E. Porter, *Strategy: Seeking and Securing Competitive Advantage*, 1991.

[9] For example, according to N.C. Employment Security Commission data on "Statewide Hours and Earnings for 2000," average hourly earnings for the related industries of hotels and other lodging ranked 58th out of 59 industries listed; laundry and cleaning ranked 57th, retail trade ranked 51st, and general merchandise 52nd. No data are reported for tourism or recreation as separate industries, or for eating and drinking establishments.

[10] A list of the individuals contacted during this study is included in Appendix G.

Table 4
Alphabetical List of Industry Clusters with Associated Regions

Industry Cluster	Region(s) of greater concentration	Region(s) of lesser concentration
1. Agriculture and Natural Resources	Northeast, Southeast, Global Transpark	Advantage West
2. Banking, Finance, and Insurance	Charlotte Region	Research Triangle, Piedmont Triad
3. Biotechnology and Pharmaceuticals	Research Triangle	Piedmont Triad, Global Transpark, Advantage West
4. Chemicals and Paper	Northeast, Southeast	Charlotte Region, Piedmont Triad, Advantage West
Information Technologies:		
5. Communications Services, Software and E-commerce	Charlotte Region, Research Triangle	Piedmont Triad
6. Multimedia and Digital Content	Research Triangle, Charlotte Region, Southeast	Piedmont Triad, Advantage West
7. Communications Equipment	Research Triangle, Charlotte Region	Piedmont Triad
8. Logistics and Distribution	Charlotte Region, Piedmont Triad, Global Transpark (emerging)	Southeast, Northeast, Advantage West
9. Medical Services and Laboratories	Advantage West, Global Transpark, Research Triangle, Southeast	Piedmont Triad, Charlotte Region, Northeast
10. Metalworking and Industrial Machinery	Piedmont Triad, Charlotte Region	Global Transpark, Research Triangle, Advantage West
11. Plastics and Composite Materials (including fiber optics and boat building)	Advantage West, Charlotte Region, Northeast	Southeast, Piedmont Triad, Global Transpark

DESCRIPTION OF EACH INDUSTRY CLUSTER

Here we describe in further detail these eleven clusters, where they are concentrated, and some of the training and other resource needs of the firms within the cluster.

1. Agriculture and Natural Resources

Primary regions: Northeast, Southeast, Global Transpark
Secondary region: Advantage West

This cluster includes agriculture and related processing, environmental remediation, aquaculture, and other *value-added* production related to natural resources. Especially in the face of cuts in tobacco production and low commodities prices, instituting more profitable approaches to natural resource industries is a critical priority for North Carolina. There are several complementary approaches that an ICRC and its partners could take; for example: modernizing the state's many existing natural-resource based industries, helping farmers grow and market higher value crops (including fiber crops), establishing the processing businesses that allow the area to realize more of the profit from the end-product, and emphasizing processes that are more resource-efficient and environmentally neutral.

Extremely diverse, this cluster includes sub-clusters such as food processing, golf greens management, environmental restoration, horticulture, landscaping, and floriculture. The latter are expanding sectors that need trained personnel who could be supplied through the community colleges system. North Carolina would benefit competitively by securing more of the value added from secondary food processing. An expanded food processing industry could replace some of the jobs and income in the more rural parts of the state that have been lost in other traditional industries. Environmental remediation is an important tie-in to agriculture, fisheries and aquaculture, and forestry.

According to the North Carolina Farm Bureau, members often express a need for computer training to execute spreadsheets, to evaluate the hardware and software they need for diagnostics and sampling, to track export markets and other aspects of e-commerce, and to facilitate interaction with the government in the area of regulatory oversight.

In addition to the information technology needs of producers, the Cooperative Extension Service at North Carolina State University cited several areas of strong demand for trained workers across the state:

- Golf greens management/horticulture/landscaping/floriculture
- Biotech
- Animal science/aquaculture
- Agribusiness
- Agricultural engineering
- Environmental sciences and management

The top three needs for more trained workers are in greens/landscaping, environmental science and management, and biotechnology. Extension Service personnel mentioned Lenoir, Lane, Sampson, Haywood, Wilkes, and Beaufort community colleges as having strong programs that coordinate well with the Extension Service programs at local high schools. Their high school program enrollment has increased by about 30 percent over the last five years, from 29,000 to 37,000.

In the food processing cluster, a staff member of the North Carolina Agribusiness Council said there was a need for both general and sector-specific training related to OSHA and health protection. According to the recent cluster analysis conducted by Feser and Renski[11], the employment growth in the processing cluster has been driven largely by poultry and hog processing in the Global Transpark region. They also note there are only a few links to higher value-added sectors and that wages tend to be low.

In the area of sustainable agriculture to encourage the growth of small-scale producers, Central Carolina Community College has established a Sustainable Farming Program that draws future organic producers from Chatham and Orange Counties, where many organic farms are clustered. The North Carolina Farm Stewardship Association was instrumental in getting the program going and existing organic producers are the instructors. They are now in their fourth year and provide participants with a certificate after the completion of core courses. Students can choose one of three specializations: vegetables, livestock, or nursery management. Asheville-Buncombe Tech has a smaller but similar program in place using organic producers as instructors, though they don't limit their offerings to organic production and don't provide a certificate to graduates. Recently, both Central Piedmont and Edgecombe community colleges held workshops on this topic. The Farm Stewardship Program received a grant from the North Carolina Rural Center to produce a template for certificate programs in order to standardize instruction for use in other programs. In terms of a regional focus, the Farm Stewardship Program suggested three training nodes for sustainable agriculture efforts: Orange/Chatham Counties, Asheville-Buncombe, and somewhere in the coastal plains area. These three areas have very different soils and each has an emphasis on different types of production, which would allow for program application across the state.

In the area of environmental remediation and management, the U.S. Fish and Wildlife Service has a special training program in Shepherdstown, West Virginia, the National Conservation Training Center, that could be involved in bringing the science side of any training efforts to the state. This is particularly urgent in the environmental remediation of wetlands. There could also be training provided in the heritage, eco-, and agricultural tourism sectors as a possible offshoot of any horticultural program, specifically in the area of guide services. These are some of the more profitable sectors within tourism.

[11] Edward J. Feser and Henry Renski (2000), *High-Tech Clusters in North Carolina*. Prepared for the N.C. Board of Science and Technology as part of Governor Hunt's Vision 2030 project. Available electronically at www.governor.state.nc.us. This research by our UNC colleagues was a starting point for this study.

2. Banking, Finance and Insurance

Primary region: Charlotte Region
Secondary regions: Research Triangle, Piedmont Triad

This cluster has shown tremendous growth in employment and influence on the state's economy, most notably in the Charlotte region but also in the Research Triangle and the Southeast. The Charlotte region has developed into an industry leader not just for the Southeastern U.S. but for the entire country as well. The growth of the cluster in the Charlotte area is also driving the growth of other sectors. In the Research Triangle, the cluster includes a strong securities and insurance component. This cluster has growing training needs that overlap with the information technology sector to some degree but could also be considered separately.

According to a source at First Citizens Bank, the industry has a need for technology training aimed at improving the productivity of office employees. Most of the needed training is general in nature, rather than being specific to the banking industry. The industry-specific context can be conveyed to the employee after hire and on-site. The examples given were the need for employees to be more proficient in word processing and spreadsheet programs, to be able to negotiate the Internet in order to transfer and download files, and to master the skills needed to measure and report data. Whether employees are hired out of community colleges or four-year degree programs, the experience of First Citizens is that finding personnel with these skills is the exception rather than the rule.

The same source at First Citizens said that community colleges do a good job of providing after-hours training. However, employees want to be reimbursed for the time or tuition they spend on skills upgrading. The industry would prefer to have customized training delivered to a specific group of employees during regular office hours. He reiterated that the training program should be short-term, impart general skills in demand by specific employers, and ideally result in certification such as that imparted by Cisco or Microsoft. Local Area Network (LAN) administrators were cited as a specific class of employees for which there is a growing need.

The more general, as opposed to cluster-specific, nature of the training needed for this industry raises the question of whether an Industry Cluster Resource Center is an appropriate model. A narrowly defined cluster may present problems for industry investment when employees are acquiring general skills that can be, and are, easily transferred from one employer to another. However, if we broaden the definition of the cluster to include high-end services more generally by adding such industries as insurance, legal services, advertising, and real estate, it is possible to conceptualize a center that would provide IT/office skills with a more short-term, customized training regime. Rather than having an exclusive focus on the Banking and Finance cluster, this ICRC would focus not only on businesses that produce communications services and software, but on businesses, such as banks, that are heavy consumers of them. For this cluster, a center that would rely heavily on distance learning would make the greatest sense since the technology requirements can be easily delivered through this mode. If the cluster includes a broad group of potential beneficiaries, it may be possible to obtain the required level of commitment from industry.

3. Biotechnology and Pharmaceuticals

Primary region: Research Triangle
Secondary regions: Piedmont Triad, Global Transpark, Advantage West

While clearly centered in Research Triangle Park, this combined cluster has an impact on a much broader geographic area that extends across the Research Triangle region, and to a lesser extent, elsewhere in the state. Some of the cities and towns with major firms in this cluster are Durham, Franklinton, Clayton, Sanford, Wilson, Burlington, Winston-Salem, and Wilmington. The Piedmont Triad would like to further develop a biotechnology presence centered in Winston-Salem that is tied to both the new Piedmont Triad Research Park and the Bowman Gray School of Medicine.

According to a source at the NC Biotechnology Center (NCBC), "the diversity of manufactured products and markets is enormous, ranging from bulk commodity chemicals to high-value pharmaceuticals straight out of the research lab. What this group of companies share is the technology, a common regulatory framework, and the training needs."

The industry includes numerous small start-ups that are 100 percent R&D focused; these will not have employment needs in the short term for anyone other than PhD and other graduate-level workers. Most of the unmet training needs stem from the large bioprocessing companies including Bayer and Novo Nordisk. Two of the most acute needs within the bioprocessing industry are for process technicians and lab technicians, both of which can be trained at the community college level. The curriculum and equipment requirements would be different for each of these. A bioprocessing technology curriculum[12] would perhaps be more of a niche to serve the cluster, whereas lab technicians could be trained at numerous colleges that have science curricula and equipment. Process manufacturing jobs make up about 60 percent of the total workforce in the bioprocessing cluster. Although high school graduates now fill most of these jobs, companies are expressing a greater interest in people with associates degrees in science. In a 1997 survey, employers estimated that they could potentially employ two to four times as many AAS graduates as they did currently.

Vance-Granville Community College (VGCC) is developing a lab for process technicians, thanks to a donation from Novo Nordisk. Other colleges with relevant programs or resources are as follows:

- Alamance Community College, Biotechnology Program
- Central Carolina Community College, Bioprocess Manufacturing Technology
- Wake Technical Community College, Pharmaceutical Manufacturing Technology
- Piedmont Community College, Industrial Laboratory Technology

[12] Bioprocess manufacturers share similar technology with some chemical manufacturers, such as companies that make resins or fibers, but less so with those industries such as plastic injection molding companies.

The graduates of these programs are readily employed at good wages in biotech, pharmaceutical, or chemical companies. However, enrollment in these programs (as well as in most other technical, scientific, or engineering-related curriculum programs) is extremely low. Low enrollment has many causes and it will require some major recruitment efforts to address them.

Therefore, one important role for the training center in this cluster would be to attract more people into the labor pool for the cluster, through aggressive marketing of its programs. The jobs are plentiful and pay very attractive wages. For biotechnology and pharmaceutical or chemical process manufacturing, the technician labor pool is almost non-existent. As the 1997 NCBC survey indicated, there might be three times as many bioprocessing technician jobs as there are total number of graduates. Enrollment in the 2-year colleges is barely at the break-even point, and the colleges don't have sufficient resources for advertising or faculty networking.

The NC Biotechnology Center has developed a 90- to 96-hour course to train entry-level process technicians in chemical, pharmaceutical, and bioprocess manufacturing, which was field-tested at VGCC in January 2000. It could be a centerpiece of an ICRC, and ultimately, taught in colleges statewide that have microbiology labs and faculty trained to teach it.

Centennial Campus leaders at NCSU are discussing the construction of a bioprocessing facility for undergraduate and graduate level teaching and training. Presumably most of the technology transfer in this cluster would come from the research universities, so these would be important linkages for the ICRC as well. NCBC also plans to develop a business incubator that would be important to tie into the ICRC.

4. Chemicals and Paper

Primary regions: Northeast, Southeast
Secondary regions: Charlotte Region, Piedmont Triad, Advantage West

While the Paper cluster is concentrated in the Advantage West and Northeast regions, the more diverse Chemicals cluster is found in four regions: Piedmont Triad, Charlotte, the Southeast, and the Northeast. Chemicals can include industrial chemicals, agricultural chemicals, dyes, and special chemical processes. In the Charlotte region, the Polymers Center for Excellence provides education and training to the chemicals cluster (as well as to the plastics cluster) while also providing research and development. In the Piedmont Triad region, Guilford Technical Community College hosts a Chemical Process Technology program and is hoping to expand its focus on chemicals manufacturing.

In the Southeast, the cluster is linked to technologically advanced industries and pays high wages. The cluster in the Southeast is made up of smaller sub-clusters such as tires and inner tubes, industrial organic chemicals, and organic fibers. In the Northeast, the cluster is tied to the manufacture of phosphate fertilizers.

The chemicals and paper cluster has shown an impressive rate of growth over the past decade of close to four percent a year. The future growth of the cluster should be enhanced by the strong

research capability in chemical and chemical engineering research out of both UNC-Chapel Hill and North Carolina State University.

5, 6, and 7. Information Technology

Primary regions: Research Triangle, Charlotte Region, and Southeast
Secondary region: Piedmont Triad, Advantage West

Information Technology is a large and diverse cluster that, according to the North Carolina Electronics and Information Technology Association (NCEITA), can be broken down into seven major sectors:

- Digital Content (includes filmmaking)
- Electronics
- Internet Services
- Research and Development
- Software
- Telecommunications
- IT Professional Services

Since it would be impossible to have an ICRC for each of these sectors, we reconfigured the seven into three sub-clusters:

- Communications Services and Software;
- Multimedia and Digital Content; and
- Communications Equipment.

Each of these three sub-clusters is growing, has identifiable training needs, and is important to the economic growth of the regions where it is concentrated.

In terms of geographic concentration, as of February 2000, there were 4,527 IT companies in the state, with 30% of them in the Research Triangle region, 20% in the Piedmont Triad, and another 20% in the greater Charlotte region. The remaining 30% were spread out across the state. Training needs are proportionate to where companies are clustered. In terms of targeting rural areas, NCEITA staff felt that growing the workforce first was the only strategy that was going to work.

In terms of the specialized industry training idea, NCEITA supports the idea and felt it was a good concept. The Research Triangle, Piedmont Triad, and Charlotte regions would be logical places for training centers. The New Hanover/Wilmington area is a logical place for a Digital Content (film, multimedia, etc.) center. In the Charlotte region, the focus of activity is fiber optic cable manufacturing and splicing and is concentrated in Catawba and Cabarrus counties. IT manufacturing has grown rapidly statewide in the past two years, and training programs are very much in demand.

NCEITA staff suggested that one way to get around the difficult politics of everyone wanting a center in their region is to sell a distance-learning concept so that all community colleges can

benefit. That way, geography would not matter and it would be much easier to organize the industry to donate equipment. Having a center focused on digital content should facilitate this. However, NCEITA also admitted that the state has a way to go towards making this a real possibility and felt that, at present, the community college system needs to be reengineered to fit the IT mode of flexibility and a fast changing environment.

8. Logistics and Distribution

Primary regions: Charlotte Region, Global Transpark, Piedmont Triad
Secondary regions: Southeast, Northeast, Advantage West

The Charlotte region has a strong existing logistics and distribution cluster with solid employment growth and both the Global Transpark and Piedmont Triad regions are emerging logistics and distribution centers that rely on multi-modal transportation. In the Southeast region, the cluster includes an important shipping component but most of the growth of the last decade has been driven by land-based transportation. It is important to note that there is a significant information technology component, including software development and programming that constitutes the skill needs in this cluster.

The new Global Transpark Education and Training Center must be incorporated into any ICRC for this cluster. The Global Logistics Technology Program there is the first in the nation to have a high-tech focus on the logistics cluster. Its emphasis is relating just-in-time manufacturing to supply-chain management and distribution systems. Specific areas of technical training under development include global tracking systems, bar code technology, automated conveyor systems and robotics. The center's technology is state-of-the-art.

The Center works with a consortium of eleven community colleges in the region. Rather than designing courses itself, the Center responds to industry training needs by going to member colleges and contracting with them to provide the relevant training. Their facility is large enough to accommodate large groups of students at one time. For example, when Frigidaire came to the region and needed 850 workers trained while they built their plant, no facility existed that was big enough to accommodate that number of students. The Center can now fill that need.

In terms of where they see themselves five to ten years down the road, Center staff talked about the infrastructure improvement to the Global Transpark that would spur some major development: the extension of the airport runway so that it can accommodate 98% of fully loaded cargo planes, improvements to the interstate system, upgraded telecommunications, etc. Staff also mentioned that the military was starting to work with them to facilitate rapid deployment operations and they saw it as another potential future user of their facilities.

When asked about potential cooperation with the logistics and distribution cluster in the Piedmont Triad, Center staff said that they saw themselves as a statewide resource. As more distance learning technology is put into place, their resources should be available to any community college in the state.

9. Medical Services and Laboratories

Primary regions: Research Triangle, Global Transpark, Advantage West, Southeast
Secondary regions: Piedmont Triad, Charlotte Region, Northeast

The growth of North Carolina's medical and health related service economy has been rapid. This cluster has significant training needs and workforce shortages. This cluster is focused around the several medical research and hospital facilities in the Research Triangle, as well as those found in the Global Transpark region at East Carolina University. Considered on the basis of absolute numbers of employees, smaller but significant clusters are also found in the Piedmont Triad and Charlotte regions. Because Advantage West and the Southeast have high concentrations of their total employment in the cluster, we also included them as primary regions. In both Advantage West and the Southeast, the growth of the cluster has been driven, in part, by the influx of retirees.

The North Carolina Hospitals Association recently did a survey of all their members to find out where their vacancies were in allied health workers. In addition to severe shortages of RNs and pharmacists, the association cited training needs for certified nurses aides, physical therapy assistants, and various lab technicians that can be trained at the community college level.

The clinical research sector is another area where this cluster has shown tremendous employment growth, particularly in the Research Triangle region. Demand for trained research technicians has grown accordingly. While much of this research is used by firms in the biotechnology and pharmaceuticals sector, the training needs in clinical research are different enough to warrant considering them separately from the training needs of biotech companies.

This cluster also includes many emerging biotechnology and other high-tech health research-related sub-clusters such as testing laboratories, medical informatics, medical imaging technology developers, commercial physical research, and pharmaceutical preparations.

In addition to the health professions employed by this industry, there are numerous data processing, imaging, accounting, insurance and other technology-using jobs associated with the medical sector. A training center focused on this industry should cover both the health and administrative needs of the cluster.

10. Metalworking and Industrial Machinery

Primary regions: Piedmont Triad, Charlotte Region
Secondary regions: Global Transpark, Research Triangle, Advantage West

This industry is largely an outgrowth of the vehicle supply and assembly industries in the Piedmont Triad, Charlotte, and Advantage West regions on the I-77 corridor. The state has approximately 250 auto suppliers located west of the Research Triangle that are within just-in-time distance of every major auto assembly plant established within recent years. In the Northeast, our industry experts noted that a small cluster is developing in response to the needs of Nucor, as well as to the needs of the automotive metals industry in Newport News, Virginia.

However, the level of employment in the Northeast is still very low compared with that in other regions.

In Advantage West, the cluster includes medical instrumentation technology and tool-makers. Also in Advantage West, in at least two cases metalworking firms have allied themselves in order to implement a shared training program that has included a cooperative machining center. According to Feser and Renski, in the Southeast the cluster is just emerging and is not well diversified -- over 50 percent of employment is in firms making power-driven hand tools.

This industry has a strong demand for technical training, which is key to the continued expansion of the industry. Specific training needs include machinists, tool and die makers, and maintenance technicians for metalworking machines. The industry is becoming more automated and computer-oriented and there is a continual need to upgrade worker skills. In addition, skilled workers in the cluster are aging and retiring more quickly than replacements are arriving, and attracting younger workers into the field will be an important challenge for any center.

Because of the history and existing state resources invested in the Piedmont Triad Center for Advanced Manufacturing (PTCAM), we recommend that PTCAM, in cooperation with a community college, become a lead resource in any expanded initiatives for this cluster. One possibility would be to have PTCAM be the focal point for training and services with a lead college plus satellite centers in other regions. However, for this to work well, PTCAM must broaden its focus beyond its region and view itself as a statewide resource. Metalworking and industrial machinery is more dispersed across the state than other clusters, and thus the demand for the expertise of a specialized training center would be widely distributed.

11. Plastics and Composite Materials

Primary regions: Advantage West, Charlotte Region, Northeast
Secondary regions: Piedmont Triad, Southeast, Global Transpark

This cluster comprises several distinct sub-clusters: one linked to the automotive industry, one to composite materials, a third to the fiberglass boat industry, and a fourth to pharmaceutical products. The diversity of these four sub-clusters, and the different skill sets required in each, may ultimately require more than one center to meet the range of needs of the entire plastics and composites cluster.

For lead ICRCs, we identified Advantage West, Charlotte, and the Northeast regions as possible locations. In the west there is a long-standing concentration of high-end plastics molding that is tied to pharmaceuticals, medical design and technology, furniture, and somewhat to automotive. The cluster is also adding employment in Advantage West and is fairly well diversified. This geographic area is also starting to develop some composites and advanced materials, specifically in Rutherford County. The Plastics Technology Training Partnership, with twelve participating companies to date, has already put together both basic and advanced certification programs, with industry providing instructors and equipment. In the Charlotte region there is a concentration of fiber optics companies around Hickory and Concord. In the Northeast, the cluster is heavily linked to the fiberglass boat industry. Because of the emergence of boat building in the east, we

have included the Northeast as a third possible center in plastics to specifically meet the needs of this sub-cluster.

In the Advantage West region -- as an outgrowth of a survey and employer focus group conducted by the Workforce Development Board in 1999 -- seven companies, the Mountain Area Workforce Development Board, and Asheville-Buncombe Technical Community College (A-B Tech) partnered to design and implement a plastics technology training program. This was a response to a shortage of trained plastics technicians that was projected to worsen as the industry expanded. The firms designed the curriculum, contributed equipment, and provided instructors from the industry. Currently the programs offered at A-B Tech consist of a Machine Operator Program (12 weeks) and a Process Technician Program (32 weeks).

Mountain Area Job Training Services has taken the lead in working with this program as well as trying to expand the offerings of other community colleges in the region. They have designed a workshop for community college and industry personnel on how to put together a training alliance similar to the one that exists at A-B Tech. They also put together a major grant proposal to the U.S. Department of Labor to fund and expand the operations of the program at A-B Tech. Unfortunately, it didn't get funded and the initiative is in need of additional resources. From all accounts, this appears to be a very successful alliance between private industry and a community college and is viewed as a model worth replicating in other parts of the region and in other industries (especially metalworking).

In the area of composite materials, activity is concentrated in both the Advantage West and Charlotte regions. In Advantage West, Isothermal Community College, which serves Rutherford and Polk counties, focuses on composites testing and polymers. In the Charlotte region, there is a burgeoning cluster of fiber optics manufacturers in Catawba and Cabarrus counties. A plastics and composites ICRC located in either Advantage West or the Charlotte region should be able to serve the needs of firms in both regions in a concentrated way, as well as to work with firms statewide.

In the boat-building cluster, firms are fairly evenly spread up and down the coast, covering the Northeast, Global Transpark, and Southeast regions. The Northeast probably has a slight edge over the other two in terms of an industry concentration. Boat building may or may not be a long-term growth cluster for the state, despite its recent growth. In terms of the plastics industry, the boat-building cluster is a heavy user of fiberglass and polyester resins. For medium-sized boat builders, fiberglass molds are generally made off-site and then the resulting parts fabricated on-site. Either very small or very large operations may make their own molds, but particularly large builders, that have their own engineering staff.

The Northeast has the first college-based boat building apprenticeship program in the state at the College of the Albemarle. The program covers both fiberglass and rigging technologies, two areas where there is a shortage of trained workers. The College has also received $50,000 to develop computer-based training materials to go with the apprenticeship program, from which both new and existing personnel in the industry are expected to benefit. Private companies have also designed their own on-site apprenticeship programs. An example is Jarrett Bay boat builders, which has a program in custom cabinetry and designing boat interiors. The demand for

trained workers in the industry is expected to continue to expand. Currently, the cluster works through two primary associations: the Composites Industry Network at the Center for Applied Technology at ECU, and the North Carolina Marine Trade Association.

In the Southeast, the cluster is linked to technologically advanced industries and pays high wages. The cluster is made up of smaller sub-clusters such as tires and inner tubes and organic fibers. In the Global Transpark region, the emerging cluster is tied to food processing and to pharmaceuticals. In the case of the Piedmont Triad, Feser and Renski classify this region as having an emerging, rather than an established, cluster in this area.

MATCHING ECONOMIC DEVELOPMENT REGIONS WITH CLUSTERS

As part of our investigation of the feasibility of establishing a system of specialized training centers, the NCCCS asked that we match candidate industry clusters with specific economic development partnership regions. In devising these matches, we took into consideration each of our individual sources of statistical analysis and qualitative input:

- the original ES-202 cluster data analysis performed by Feser and Renski, as part of UNC's work for the state's Vision 2030 project[13];
- the survey of community college presidents;
- our discussions with staff from each of the seven economic development partnership regions;
- our focus group of experts to ascertain their sense of statewide and regional industry trends;
- a follow-up survey of experts around the state that asked them to rank industry clusters across nine different criteria; and
- our discussions with personnel across a range of industries to ask them specifically about their training needs.

Bearing in mind this set of data, we then went through our own internal process of assessing each industry cluster across four dimensions:

- The **Strategic Importance** of the cluster to the future economic development of the region and the state as a whole;
- The strength of **Industry Organization** and perceived commitment to support and participate in a new training initiative;
- The possibility that **Regional Equity** in economic development would be enhanced through the direct and indirect effects of the ICRC's activities in the region; and
- The **Job Creation Potential** of the cluster if its training needs are met, in particular the potential to create middle or higher wage jobs.

Based on these four criteria and our investigation of the emerging economy of the state and each region, we recommend that the state make an initial investment in eight ICRCs and present our recommendations for matching regions with clusters. In Table 5, we present our list that in most cases matches each economic development partnership region with a single industry cluster.

[13] Documents are available at http://www.governor.state.nc.us/govoffice/vision2030.

Table 5
Proposed Priority Cluster Centers by Region

Region	Industry Cluster for an ICRC
Advantage West	- Plastics and Composite Materials
Charlotte Region	- Communications Services, Software, E-Commerce - Communications Equipment (includes fiber optics)
Global Transpark	- Medical Services and Laboratories
Northeast	- Value-Added Agriculture and Natural Resources (includes food processing, aquaculture)
Piedmont Triad	- Metalworking and Industrial Machinery
Research Triangle	- Biotechnology and Pharmaceuticals - Communications Equipment (includes fiber optics)
Southeast	- Multimedia and Digital Content

The special case concerns the location of a resource center for the Communications Equipment cluster that includes fiber optics. Because of where the cluster is concentrated, this cluster center should be located in either the Research Triangle or Charlotte regions. Research Triangle is the clear state leader in electronics while Charlotte hosts a larger concentration of activity in fiber optics. The NCCCS may wish to solicit a proposal for this ICRC from both regions and should anticipate that the emphasis of each proposal may be slightly different, reflecting the different industry mix in each region.

The second issue concerning the location of an ICRC for the Communications Equipment cluster is that the regions that are the most compelling for its location -- Research Triangle and Charlotte -- have also been matched with two other clusters. As shown in Table 5, we matched Biotechnology and Pharmaceuticals with Research Triangle and Communications Services and Software with Charlotte. As outlined below in our discussion of why we chose to match a particular region with a particular industry cluster, we felt there were compelling reasons to do so. Our dilemma is that all three of these industry clusters -- Biotech, Communications Software, and Communications Equipment -- should be extremely high priority for expanded training initiatives. In our survey of industry experts, the economic development partnerships, and community colleges, these clusters emerged as consistent top choices. For these reasons, we didn't feel that we could exclude any of them in our list of candidate clusters for the first phase of

investment. The result is a realistic, and we feel workable, but imperfect mapping of eight priority clusters to seven regions.

Again, we wish to stress that each Industry Cluster Resource Center should be designed to serve its cluster firms *across all regions of the state*. However, the high concentration of cluster firms in particular regions makes certain regions the logical choices to take the lead for particular clusters. We also wish to stress that, while we arrived at our configuration of regions and clusters after careful consideration of a broad variety of both statistical and non-statistical information, this is not the only possible configuration that we, or others, could propose for the following reasons:

- Most industry clusters have a presence in a number of different regions;
- The economic landscape of the state and its regions is changing all the time. By the time funding is secured to put an ICRC plan into place, new developments may need to be considered;
- The weight given to specific criteria, for example regional equity, may shift depending on how the RFP and proposal review process is carried out;
- The capacity of the state's community colleges is changing and expanding all the time and the NCCCS will want to develop an ICRC system that will build on the strengths of its member institutions.

While other configurations of regions and clusters are possible, it is also important to guard against the notion that one configuration is as good as another. For that reason, we advocate that, if a different configuration is proposed, it be approved by a technical advisory committee made up of experts who are neutral in regard to specific region/cluster matches. Here, we discuss each region/cluster match in greater detail.

1. Advantage West: Plastics and Composite Materials

This cluster is strategically important to the state's economic development, is geographically dispersed so that many regions would benefit from an expanded training initiative, and has good potential for new job creation at above-average wages. The Plastics and Composites cluster has tie-ins to several industries (automotive, pharmaceuticals, electronics, fiber optics, boat building), which increases its potential to benefit a variety of sectors and geographic areas within the state.

Our choice of Advantage West for the location of a Plastics and Composite Materials ICRC is based on the following:

- The concentration and diversity of the cluster within the region. Of all the regions, Advantage West has the highest percentage of its workforce in this industry already. While the aggregate number of jobs in the cluster is not large in the region (less than 8,000), experts predict the sector will grow rapidly.
- The existence of an organized industry presence to support a center. This industry support is evidenced by the fact that industry in the region has articulated training needs and has organized and supported significant training initiatives through the Plastics Technology Training Partnership that it wishes to expand.

- The existence of the Composite Testing and Training Center at Isothermal Community College.
- The identification of this cluster as a high priority by the Advantage West Economic Development Partnership, the North Carolina Department of Commerce, and other statewide industry experts through our focus group.
- The potential of the cluster center to provide a spur to economic development in a region that has had slower economic growth than some other regions of the state.

2. Charlotte Region:

A. Communications Services, Software, and E-Commerce

This sub-cluster of information technology ranks high on strategic importance to the state's economy. The geographic dispersion of the industry means that almost every region could take advantage of the services that a training center would have to offer. This sector of the IT industry is already large, continues to grow at a healthy rate, and pays wages considerably above the average.

An additional reason that we chose Charlotte for the location of this ICRC is that it has the potential to address the training needs of the Banking, Finance, and Insurance (BFI) cluster, which is most concentrated in this region. Discussions with representatives of the BFI cluster indicated that it needed broadly-defined information technology training for its employees, rather than training that was very specific to the industry. For this reason, we have folded the needs of the BFI cluster into this Communications Services ICRC and advocate that this be reflected in the request for proposal that will go out to community colleges in the region.

Our choice of Charlotte as the lead region for this center is based on the following:

- The concentration of the cluster in the region and its continued expansion, which has outpaced national job growth trends over the last decade. Relatively more of the labor force is in this cluster in the Charlotte region than in any other, except Research Triangle.
- The potential of the cluster center to provide support to the region's Banking, Finance, and Insurance cluster, which has identified information technology training as a major need.
- The selection of the overall Information Technology cluster as a high priority for expanded training by 75 percent of the community colleges in the region that replied to our survey.
- The identification of this cluster as a high priority for training and economic development by the Charlotte Regional Partnership, the North Carolina Department of Commerce, and other statewide industry experts.

B. Communications Equipment, Including Fiber Optics

This sub-cluster of IT includes the production of electronic equipment, lasers, wireless devices, fiber optics, and MEMs (switching devices), among others. North Carolina produces forty percent of the world's fiber optic cable and the industry is expected to grow.

Our choice of Charlotte as the lead region for this center is based on the following:

- The concentration of the cluster in the region—there are almost 24,000 employees already, and a relatively high percent of the region's workforce is in this sector.

- The concentration of the Fiber Optics sub-cluster within the region, particularly in the Concord and Hickory areas.

- The selection of the overall Information Technology cluster as a high priority for expanded training by 75 percent of the community colleges in the region that replied to our survey.

- The identification of this cluster as a high priority for training and economic development by the Charlotte Regional Partnership, the North Carolina Department of Commerce, and other statewide industry experts.

3. Global Transpark: Medical Services and Laboratories

This cluster received high marks for job creation potential. It also garnered good scores on its strategic importance and for broad benefits across regions because it is so geographically dispersed. Because of the geographic dispersal of cluster firms, perhaps more than any other this center will need to be designed with a statewide focus.

One of the key roles of this center will be to recruit and train workers to address the critical labor shortages in many of the lab technician and associates-level health professions statewide. We also envision that in the Global Transpark region, it is a potential catalyst for expansion of the region's emerging biotechnology and other high technology health research-related sub-clusters that would benefit from diversification. Examples of such sub-clusters include testing laboratories, medical imaging technology developers, commercial physical research, and pharmaceutical preparations. Coupled with the expanded training services of an ICRC, East Carolina University's national leadership in the delivery of health services through telemedicine could also be a catalyst for the growth and recruitment of more cutting edge medical technology companies into the region.

In addition to spurring the growth of health services jobs, which are among the highest-wage of service occupations, this center would train workers with the types of IT skills that would make the labor force attractive to many other types of employers. Technicians and clerks who can use current technologies to process medical records, lab results, medical images, insurance claims and the like for the medical sector would be attractive to any number of other employers who require business services staff with similar skills. A critical mass of such IT-trained labor would also help the region recruit more logistics companies into or near the Global Transpark.

Our choice of Global Transpark as the lead region for this center is based on the following:

- The size of the cluster in the region. Along with Advantage West, Global Transpark has more workers in this cluster relative to the overall employment base than any of the five remaining regions.

- The strong presence of cluster resources at East Carolina University, and innovations in telemedicine and regional outreach occurring there, can be a catalyst for growth in the cluster.

- The potential of the ICRC to be a spur for economic development in a region that has lagged behind some other regions in terms of its economic growth.

4. Northeast: Value-Added Agriculture and Natural Resources

Agriculture and Natural Resources is strategically important to the state's future development, particularly the development of non-urban areas that could greatly benefit from capturing more potential value from cutting-edge developments in agriculture, aquaculture, food processing, forestry, and horticulture. This center's mission should be to train workers in cutting-edge applications of natural resource management that are profitable and can help make this sector more competitive statewide and globally. This cluster center will require strong linkages with the R&D capacities of North Carolina State University and other schools. A few of the specific types of training that might help improve competitiveness in this cluster include: processing technologies, operations management technologies, marketing and export promotion, land management practices, and global positioning system (GPS) reading.

Our choice of the Northeast for this cluster resource center is based on the following:

- The concentration and importance of natural resource-based industries in the region. This region has more workers in this cluster as a percent of the workforce than any other region.

- The potential for this cluster to be a catalyst for economic development in a region that has lagged other regions in economic growth.

- The prevalence of this cluster in the list of priorities cited by the region's community colleges in our survey.

Given our choice of the Northeast for this center, we envision a strong emphasis on marine activities in the region such as aquaculture, environmental remediation, and marine resource management, as well as ties to the higher value-added aspects of tourism.

5. Piedmont Triad: Metalworking and Industrial Machinery

The Metalworking and Industrial Machinery is viewed as strategically important to the development of the state, has a fair degree of internal industry organization, is geographically

dispersed so that a training center could benefit many regions of the state, and has considerable job creation potential if training needs are met. An expanded training effort for this cluster is viewed as a potential large draw in terms of both recruitment and expansion, particularly with the growth of the auto parts manufacturing and assembly industries within North Carolina and surrounding states.

Our choice of the Piedmont Triad as lead region for this center is based on the following:

- The concentration of the cluster in the region.
- The experience, industry involvement, and positive track record of the Piedmont Triad Center for Advanced Manufacturing (PTCAM). Any community college proposing to host an ICRC for metalworking should articulate a clear working relationship with PTCAM.
- The proximity of the region to two other regions with metalworking training needs: Charlotte and Advantage West.
- The identification of this cluster as a priority for the region's economic development by our focus group of industry experts, as well as by some of the region's community colleges.

6. Research Triangle:

A. Biotechnology and Pharmaceuticals

Biotechnology and pharmaceuticals ranked high on both strategic importance to the state's global economic competitiveness and the strength of the industry cluster. Currently concentrated in the Research Triangle region, the cluster's dispersion into the Charlotte, Piedmont Triad, and Global Transpark regions means that a biotechnology resource center could benefit regions beyond the Triangle if it were organized with that goal in mind. The cluster's wages are high and, as an emerging industry, biotech holds great promise for future employment development for the state if enough workers can be trained by the community college system and its partners. The cluster's training needs are evident and well-defined by the industry.

Our choice of the Research Triangle as lead region for this center is based on the following:

- The strong concentration of the cluster in the region – there are now over 13,000 jobs in the cluster in the partnership area and relatively more workers are in this cluster than in any other region.
- Support of the region's industry for a training center.
- The ability to build on the work of the Biotechnology Center, already located in the RTP region.
- The existence of several community colleges in the region that have existing biotechnology programs that they wish to expand.

- The identification of this cluster as a priority for training and development by both the Research Triangle Regional Partnership and our focus group of statewide industry experts, in addition to several community colleges in the region through our survey.

B. Communications Equipment, Including Fiber Optics

This cluster includes the production of electronic equipment, lasers, wireless devices, fiber optics, and MEMs (switching devices), among others. The Research Triangle region is the state's leader in electronics and instruments, with approximately twice the employment in this sub-cluster as the Charlotte region. The cluster is a major driving force behind the region's economic growth and that of the state.

Our choice of the Research Triangle as lead region for this center is based on the following:

- The strong concentration of the cluster in the region – over 50,000 jobs and 6.5 percent of the workforce.

- Support of the region's industry for a training center.

- The ability to build on the work of the Telecommunications Center in Sanford, already located in the RTP region

- The existence of several community colleges in the region that have existing communications equipment-related programs that they wish to expand.

- The identification of this cluster as a priority for training and development by both the Research Triangle Regional Partnership and our focus group of statewide industry experts, in addition to several community colleges in the region through our survey.

7. Southeast: Multimedia and Digital Content

Multimedia and Digital Content is a third sub-cluster of information technology. It includes film production and instructional multimedia design technologies. We envision that this center will not only serve the emerging film industry in the region, but will serve as a locus of the multimedia instructional technologies that will be needed by all the ICRCs in the other regions as they strive to serve their clusters and link colleges through distance learning across the state.

Our choice of the Southeast as lead region for this ICRC is based on the following:

- The rapid growth of the cluster in the region.

- The support of the primary industry trade association (NCEITA) for this cluster in the region.

- The potential of an ICRC to be a catalyst for the development of an emerging but potentially important new industry for the state.

INDUSTRY CLUSTER CONCENTRATIONS BY REGION

As a final step in assessing our assignment of cluster resource centers to particular regions, we examined how well our cluster/region matches reflected the concentration of cluster employment across regions. Within each of the eight industrial clusters proposed for an ICRC, we ranked each region according to the percentage of its total regional employment represented by the cluster in 1998. For example, in the case of Agriculture, Food Processing, and Natural Resources, the Northeast has the highest share of its total workforce employed in this cluster (8 percent), followed by the Global Transpark (7.2 %) and so on[14]. Listed from highest to lowest concentration, the regions sorted out as shown in Table 6.

Table 6
Concentration* of Cluster Employment by Region, 1998
(Regions Ranked in Order of Highest to Lowest Concentration)

Agriculture, food processing, and natural resources	**NE**, GTP, SE, AW, RTP, CR, PT
Biotechnology and pharmaceuticals	**RTP**, GTP, AW, PT, CR, SE
Communication software and services	RTP, **CR**, PT, SE, AW, GTP, NE
Communications equipment	**RTP, CR**, PT, AW, GTP, SE, NE
Multimedia and digital content	RTP, CR, PT, AW, **SE**, GTP, NE
Medical services and laboratories	AW, **GTP**, SE, RTP, NE, PT, CR
Metalworking and industrial machinery	CR, **PT**, GTP, RTP, AW, SE, NE
Plastics and composite materials	**AW**, CR, PT, SE, GTP, RTP, NE

* Concentration is defined as the percentage of each region's total employment in 1998 that was found in each cluster. The region listed in the far left of each row has the highest percentage of its total employment in that industry cluster when compared with the other six regions. In the case of biotechnology and pharmaceuticals, the Northeast region is not listed because our data from ESC show no employment in this cluster in that region.

In Table 6, the region in **bold** type is our recommendation for lead region for the associated ICRC. While we did not choose the lead region on the basis of its concentration of a particular cluster, it turns out that our choices do track this criterion very well. With one exception (Media and Digital Content), our proposed lead region has either the highest or second highest concentration of its employment in the cluster we suggest for its ICRC when compared with other regions. In the case of the Media and Digital Content cluster, we feel that the fifth place position of our suggested lead region of the Southeast reflects the limitations of cluster analysis in picking up the growth trends of small, emerging industries such as this one. The support of the North Carolina Electronics and Information Technologies Association (NCEITA) for this

[14] The data table for this analysis is included in Appendix H.

choice, as well as the support reflected in several conversations with industry experts, leaves us confident that this match is the best one for the region and for the state.

IMPLICATIONS FOR SOLICITING PROPOSALS

In practical terms, the ***NCCCS should invite proposals from community colleges in designated regions for each ICRC***. For example, we recommend that the NCCCS limit applications for an ICRC in Plastics and Composite Materials to community colleges in the Advantage West region, for a Biotechnology and Pharmaceuticals ICRC to those in the Research Triangle region, and so on. Based on the strength of all the proposals it receives from all seven regions, the NCCCS will then decide which proposal it will fund in each region and the order of funding priority to each of the seven ICRCs. To maximize the impact of the ICRCs on the state, the applicants will have to detail how linkages will be made to community colleges, especially those with capacities and resources relevant to that cluster, in other regions.

As outlined in Section IV in some detail (and further in Appendix C), ***the success of any ICRC will depend in large part on building an effective web of relationships between the industry cluster, the community college(s) involved, and an array of other partner institutions.***

Once each region has received funding for the establishment of an ICRC, the NCCCS can then consider funding a second round of centers. In Table 7, we present a list of the remaining high priority clusters that could benefit from an expanded training effort and the possible regions with which each cluster could be matched. How many of these centers will be funded, and where, will depend on the available resources and the strength of a new round of proposals.

Table 7
Additional Cluster Centers with Possible Regional Locations
(In alphabetical order)

Boat Building	Northeast
Chemicals and Paper	Piedmont Triad, Advantage West, Southeast, Northeast
Logistics and Distribution	Global Transpark, Piedmont Triad, Charlotte Region, Southeast

We did not include Banking, Finance, and Insurance (BFI) as a separate additional cluster center because we felt its needs could be folded into the Communications Services, Software, and E-Commerce ICRC proposed for the Charlotte region, the heart of the state's BFI cluster. As outlined previously, discussions with representatives from the cluster revealed that broadly-defined information technology training that would be suitable for a variety of high-end service

clusters was its primary need, as opposed to training with an express focus on banking, finance, and insurance.

In addition to the first eight ICRCs, we recommend the NCCCS consider a second round of investment in three additional centers that would serve the industry clusters of Boat Building, Chemicals and Paper, and Logistics and Distribution, as money becomes available. While important in specific regions, these three cluster areas were not ranked as highly on our criteria as the eight described above.

These three clusters were not matched with regions for the first round of funding for a variety of reasons. In the case of Boat Building, which was a clear possible cluster for the Northeast, we felt that its small employment size and the cyclical nature of the industry argued against it being chosen over Value-Added Agriculture and Natural Resources, our first choice. In addition, an agriculture-related ICRC has the potential to benefit a greater number of regions because this cluster is more geographically dispersed across the state. Lastly, the new boat-building program at the College of the Albemarle should be able to address the training needs of the cluster in this region, at least in the short to medium run. Our recommendation to the NCCCS is that it work with the cluster and with this program to build an expanded training initiative sometime in the future.

In the case of the Chemicals and Paper cluster, the arguments for putting other clusters in the possible lead regions (Piedmont Triad, Advantage West, and Southeast) were simply more compelling, as outlined above. Also, the Chemicals cluster is often paired with Pharmaceuticals or Plastics in cluster analysis. Since we have designated related clusters (Plastics and Composite Materials, and Biotechnology and Pharmaceuticals) for ICRCs in two regions, some of the needs of a more broadly defined cluster should be met by these centers. Lastly, while plastics, biotechnology, and pharmaceuticals were all repeatedly mentioned by industry experts and economic development partnership staff, chemicals and paper were rarely mentioned in the top tier of clusters with the most pressing training needs.

For Logistics and Distribution, our sense is that the new Global Logistics Training Program at the Global Transpark should be able to meet the training needs of this relatively small cluster in the short term. An expanded training initiative for this cluster would certainly be an appropriate investment for the state but we don't feel the cluster would be harmed if that investment were made in the second round. Again, we wish to be clear that all eleven clusters, including these final three, should be high priorities for the state's economic development and training focus.

IV. PROCESS FOR ESTABLISHING ICRCS IN NORTH CAROLINA

In this section, we review the main features of ICRCs and discuss the financial resources necessary to implement this program. We then specify the steps NCCCS should take in order to move forward on these centers.

Based on the premise that the community colleges themselves are best positioned to develop the programs, funding, relationships, and other features of the ICRCs, we propose a process commonly used for initiatives of this type: the issuance of a request for proposals (RFP) by NCCCS that establishes the intent of the ICRC program, parameters for completion of the proposals, and criteria for selection of award recipients. We detail the RFP/proposal process in the last part of this section.

MAIN FEATURES OF ICRCS

The main functions of the ICRCs are to:

- develop education and training programs in collaboration with an identified group of firms that comprise a local economic cluster that provides jobs and economic development to a community and/or assist an emerging cluster of firms to develop in the state;
- create new standards for the operation of successful economic development programs at North Carolina community colleges. While the specific curriculum content and delivery methods utilized for these new programs will be locally determined, they will be less driven by enrollment formula and standard curriculum programs, and more around targeted specialized training and education for a specifically identified group of firms; and
- supplement existing programs and establish/strengthen collaborative efforts with other community colleges and with clusters of firms. The ICRCs may not require new buildings.

FINANCIAL RESOURCES

We estimate that establishing eight ICRCs will cost approximately $30 million in startup funding, of which $22.5 million would come from the State and the rest (25%) from a local and industry match. Once the centers are established, they will each require appropriations for ongoing operations of approximately $400,000 per year. NCCCS will have to work with the Governor's office and the General Assembly, and explore non-state funding sources, to secure these funds. Two potential sources of funds outside the state are important to consider. First, the National Science Foundation has allocated funds for the establishment of Advanced Technical Education Centers, which are intended to improve the education of technicians using the resources of two-year colleges. Second, the U.S. Department of Labor has funds available for establishing regional skills training alliances in order to improve workers' job skills necessary for employment in specific industries.

Over the first five years, the bottom-line total cost, as shown in Table 8, is $43 million for eight centers. This is based on our judgment that each center will require about a $5 million

investment over the first five years to become viable. We assume that the bulk of these funds would be used to construct new or renovate existing facilities, purchase and lease equipment, hire staff, and develop programs. Specific budgets will be expected as part of the proposals (discussed below). We developed the sample five-year budget, summarized below, as a way to estimate the average cost of a center.

Table 8:
Estimated ICRC Costs for a High-End Center
(Five Years of Support)

	State	Local/Industry	Total
Startup (yrs. 1-2)			
Building	2,400,000	800,000	3,200,000
Equipment	375,000	125,000	500,000
Center planning	37,500	12,500	50,000
Total startup costs per center	2,812,500	937,500	3,750,000
Total startup costs, 8 centers	$22,500,000	$7,500,000	$30,000,000
On-going (yrs. 3-5)			
Staff	225,000	75,000	300,000
Program development	75,000	25,000	100,000
Equipment maint./deprec.	37,500	12,500	50,000
Utilities and bldg. maintenance	75,000	25,000	100,000
Total ongoing costs per year	$412,500	$137,500	$550,000
Total for 5 years per center	4,050,000	1,350,000	5,400,000
Total 5-yr. cost, 8 centers	$32,400,000	$10,800,000	$43,200,000

The various cost elements and assumptions are described in more detail as follows.

1. *Building construction and renovation*: Construction costs for standard new educational structures normally run $140 –170 per square foot. Renovation typically is 50 to 67 percent as costly as new construction. This means even a modest building of 16-17,000 square feet would cost between $2.3-3.2 million to build, and around $1 million to renovate.

2. *Leasing of equipment*: Equipment costs vary widely. Metal machining equipment, for example, often runs $85,000-100,000 per unit. CAD equipment may be as high as $30,000 a station. And, a 10 - 12 unit computer lab can run $35-50,000, considering the costs of machines, printers, appropriate furniture, and teaching aides. Moreover, there should be funds available for the updating of equipment. We estimate an initial $500,000 for equipment – with about 10 percent, or $50,000, set aside for updating and replacement each year.

3. *Staff:* Personnel with the appropriate training and experience is vital to the success of ICRCs. The individuals we envision, with industry experience, often command much higher salaries than what is currently paid in North Carolina community colleges. We assume that staff costs will range between $250,000 and $300,000 per year after year 2.

4. *Program development:* This should only be start-up cost – with contributions and fees for services coming from the firms to be served. We assume $100,000 for each of years 3 through 5.

5. *Utilities and facilities maintenance:* About $100,000 should be allocated for recurring facilities costs, assuming $6 per square foot and 17,000 square feet.

While $5 million dollars per center for the first five years may seem expensive, especially in light of competing needs, we believe that the amount is justified for a number of strategic reasons.

- If one of the goals of these "third generation" centers is to change the North Carolina Community College System, a larger amount of funds concentrated in a few centers can better serve as a living laboratory to accomplish that end.
- We believe the financial "carrot" has to be large enough to induce community colleges to change their way of doing business, especially to initiate joint proposals or collaborate in the very submission of a proposal.
- Concentration of the funds into a few centers will allow for quicker visible results, which might increase the chances of obtaining greater legislative support for allocation of future funding of more centers.
- The awarding of larger amounts of funding to a small numbers of centers breaks with one of the conventional means of educational funding, i.e. dividing available funds into small amounts so that all institutions get something. Breaking with that tradition would be extremely useful for a program that intends to introduce change within the community college system.

Finally, ***we recommend that one percent of the total $43 million cost of the program, or $430,000, be devoted to a thorough and objective review and monitoring process***. This effort needs to be started at the outset of the program, and continue as long as it is in place. At least initially (for the first two years of operation of each ICRC, or for the first five years of the program) it should be conducted by an outside, neutral organization that would have credibility within NCCCS, the General Assembly, and the wider educational and economic development and business communities. NCCCS can use this evaluation/monitoring process more widely, and to increase its own internal capacity for ongoing review of NCCCS programs. We do not envision the external monitoring/evaluation team just as an auditor, but also as a resource for NCCCS and the individual colleges who need guidance in the preparation of acceptable proposals and in other management and programmatic areas.

STEPS TO BE TAKEN BY NCCCS

The following represents a proposed series of steps to be taken by the NCCCS to initiate these activities. It assumes the state legislature has acted to grant the funds. We specify time intervals for the process, with the recognition that they may be altered as it is finalized.

1. Through normal channels of communication with the presidents of the colleges, a letter will be drafted which describes the mission and scope of the RFP (described below). It encourages their participation in the project, and establishes a date for a bidders' meeting. Furthermore, it encourages them to come to the bidders' meeting or send high-ranking staff. The goal at this point is to establish institutional commitment at the highest levels of the institution.
2. There need to be two rounds of bidders' meetings in each of the seven regions, tailored to the requirements of the cluster center designated for that region. The first will be held for community college staff to discuss a) the definition of industrial clusters overall and for that region, b) economic development strategies of the state, and c) the role of community colleges within that process. The RFP (see below) or appropriate variant will also be shared at the end of the meeting. A briefing book will be compiled that lists relevant readings and part of a web site reserved for those who wish to write follow-up questions on the concepts and the process. This first round of briefings will be primarily information and policy oriented.
3. A second briefing meeting would be held 30 days later, at which interested community colleges could come with members of their "team," i.e. private sector representatives of the "industrial clusters," local and regional economic development agencies, and other organizations that may be interested in the project. At this meeting the goal would be to jointly examine the RFP with partners to discuss the scope of activities and goals that could be realized at the project. This second meeting will allow the community college to assemble a team, and provide leadership to the process, as well as solicit direct private sector input into the process. Both meetings should be led by a specific team of people who will be the bulk of the review committee. In both meetings, it would be useful for top leadership of the NCCCS to be present to lend credibility to the concept.
4. After the second bidders meeting, proposers would have 30 days to develop a conceptual plan as outlined in the RFP.

THE REQUEST FOR PROPOSALS AND PROPOSAL PROCESS

This section includes draft text of an RFP, with sections on the process for NCCCS interjected to show the intended chronology.

The purpose of this RFP is make available to North Carolina community colleges and their partners (approximately) $43.2 million for the creation of eight Industry Cluster Resource Centers (ICRCs). These centers will provide educational and training services to specifically targeted clusters of firms within the service delivery area of their districts. The centers should be be functioning as cluster resources within a year after the award of the grant, although

construction of permanent facilities may take longer in some cases. Each center proposal will require no less than a 25 percent match in the form of actual dollars, value of equipment and property, or contributions of staff time. Each center must be under the administrative control of a North Carolina community college.

The NCCCS will award these funds based upon a grant application process. ***A committee of experts in community college workforce and economic development strategy will review the applications in both rounds one and two of the process. None of these individuals will have an affiliation with community colleges within North Carolina.*** They will utilize established criteria to review all applications, score all proposals, and submit their results to the President for consideration. The board of the NCCCS will make the final decision on the award of the centers and the amounts awarded, based on recommendations from the President.

Proposal process, round one – for applicants. There will be two rounds in the proposal process. In the first round, community colleges within the region designated for each cluster will be encouraged to submit a proposal of no more than 15 double-spaced pages, describing their organization, any partnerships and their general approach for an ICRC serving that cluster. These proposals will be due 30 days after the second bidders' meeting. This pre-proposal will address the following items:

1. The mission of the organization: Delineate the cluster of firms to be served, the nature of the training and education issues challenging this cluster of firms, and the economic development advantages that will accrue to the state as the result of the creation of this ICRC.
2. Description of the programs and activities to be created: There will be a broad overview of the programs and activities that will be conducted by the center, with a rationale based upon how they will serve the specific needs of the targeted cluster. In this section there should be a discussion of how the resource center will relate to other parts of the college, and partner with other sources of education and training in the state.
3. Description of the center, organization, and staffing: Centers must serve cluster needs, as a result, the proposal must indicate the location, staffing and key personnel, and governance structure including a specific plan for private sector roles in the leadership of the Center. It should also include existing expertise in and experience with the targeted cluster.
4. Budget: A general budget will be submitted with the initial concept which will be broken out in terms of a) staff costs, b) program development, c) new construction and equipment needs (if any) d) an indication of how the matching funds will fit into the budget and e) an initial business plan for the maintenance of the center if the initial funding is discontinued.
5. Private sector partners: Include a list of private sector firms with names of specific individuals and letters of endorsement that indicate support for the project and the ways in which they will interact with and share responsibility for the center.

Proposal process, round one – for NCCCS. The purpose of round one is to present a conceptual design that shows how a community college will utilize the funds to create an ICRC

within its economic development region. To familiarize the colleges with some of the concepts, such as clusters and knowledge chains, used in this proposal, the NCCCS will host a one-day bidder's meeting in each region. The purpose of these meetings will be to present information on clusters, information from the appropriate regional, state and local planning agencies on the economic development strategies of the state of North Carolina, and to release the RFP for that region's cluster center.

A six-person review committee, with four of the six members from outside the state (who have expertise in community college workforce and/or economic development) and two members from within North Carolina (who understand the local context, but have no connection to the NCCCS or its constituent colleges) will evaluate all proposals within 30 to 45 days of receipt. Depending upon the overall allocation of funds in the program, the committee will select no more than 3 proposals per region that received the highest rating. Those community colleges will be invited to submit full proposals for consideration in the second round. Each proposal selected also will be given a specific set of questions concerning their conceptual design to address in their detailed proposals.

The criteria used by the review committee in round one will be:

- The economic development impact of the proposal upon the region and state in terms of retention or expansion of high skill, high wage employment;
- The private sector support for the proposal and willingness of targeted firms to utilize the programs and activities of the center;
- Demonstration that the proposal fulfills important unmet needs in the region and state;
- The extent to which the proposed activities leverages other state and local resources including K-12 systems, state universities and colleges, workforce development agencies, and economic development agencies;
- The capability of the institution – in terms of technical resources and organizational strength – to develop the center; and
- Potential learning for the state of North Carolina concerning the relationship of community colleges and economic development.

The committee will examine the entire design proposal and make a decision on how effectively and creatively the initial proposed design fits with the intention of the program. Each of the 2 or 3 proposals selected for each region may be awarded $5,000 that may be used by the institution to aid in drafting the final proposal. These funds may be used in any of the following ways:

- To conduct research to develop a greater understanding of the specific need of the clusters and the impact of the cluster on the economic development of the region and state;
- To develop private sector support for the concept of the resource center (support defined to include financial resources, loaning of technical personnel, and the awarding of contracts to the center for services);

- To hire architects and other building/development professionals if construction of facilities or adaptation of present facilities are anticipated;
- To review curriculum and capabilities of the proposing institution and its partner institutions elsewhere in the state to provide technical support for the process;
- To provide technical support or staff development to the institution in areas of clusters and economic development, and travel expenses to learn about exemplary technology centers; and
- For consultants to aid in the preparation of the proposal.

The proposals for round two will be due 60 days after the announcement of the semi-finalists.

Proposal process, round two – for applicants. This proposal will be a more detailed treatment of how the college intends to create the ICRC. While the first round emphasized concept and significance to the community in the proposal (the conceptual issues), this round provides a detailed description of the activities to be performed by the community college and its partners (the implementation issues) in the establishment of Industry Cluster Resource Centers. In this proposal, the colleges must present detailed plans in a number of important areas. All proposals must cover the following topics.

Identification of the cluster to be served:

Central to the proposal is the definition of the cluster and its relationship to the economic development activities of the region and state. ***The material in Section III of this report should be used to establish the broad parameters for each cluster.*** The initial bidders meeting is intended to develop a clear understanding on the part of the proposers regarding the significant clusters that currently exist in North Carolina and its component regions. The economic development research performed by many state agencies and research institutions should be utilized in the determination of the specific clusters to be served.

Once a cluster has been identified, there needs to be a systematic gathering of information about the needs of this cluster. Proposals should detail their research plans and indicate how they identified the particular needs of the firms in their communities and elsewhere in the state. Much of this detail must be developed through an interaction with the industries to be served. The proposal must demonstrate the present needs of these firms for such a center, the future challenges that will face these firms, and how the center will be utilized to serve the needs of the industry. If possible, any empirical data used to justify this part of the proposal in terms of numbers of firms served, the linkages between the firms, and the proposed growth of the firms within the North Carolina economy, should be presented. Finally, the proposal should detail the linkages between these clusters and other parts of the state economy and how the new center will impact these sectors.

Economic development impact:

The proposal needs to detail specifically the cluster of firms to be served by the ICRC. This will include a review of the process and products produced by this cluster, its impact on the region in

terms of employment, tax revenues, the human resource challenges faced by this cluster of firms, and how the proposed center will aid in furthering the development of this group of firms. In some instances, it may be possible to argue that an ICRC will serve to stimulate a cluster of firms that is just developing in a certain part of the state.

In the development of this section, it would be useful for the proposal to indicate the depth of community support for the ICRC. References to local economic development strategies, state planning documents, and letters of support by significant organizations and private sector firms would be useful. Partnerships between organizations, as long as the community college becomes the hub for the partnership, are also encouraged. The proposal needs to demonstrate how the new centers will play a vital role in the economic development and global competitiveness of the state.

Since the main mission of the resource centers is to serve clusters and all clusters extend across many service delivery areas, community colleges will be expected to consider linkages with other colleges with similar or related needs and opportunities related to the proposal. Indeed, preference will be given to proposals that are developed jointly or with clearly defined collaborative activities.

Facilities:

The proposing organization must describe the physical location and equipment that it intends to employ in operating the ICRC facility. These must be congruent with the mission of the center and the needs of the cluster of firms. While the building and equipment do establish a tone for the center, there is no need to construct an entirely new facility – adaptation of present structures may be an even better use of resources and will save money for curriculum development and other activities. The funding agency does not expect these centers to have cutting edge technology, and innovative approaches of the college to use work-based learning and technical training within the existing facilities are encouraged, including distance learning where feasible. The building and equipment should flow from the mission of the institution and the needs of the cluster of firms to be served.

Staff and administrative structure:

Proposals must delineate how the facility will be staffed. How will the staff be accountable not only to the institution, but also the firms that will be served by the facility? How will the responsibilities for staffing be allocated if there are partners in the facility? Proposals must clearly describe their plan and rationale for using existing staff, or recruiting and hiring new staff for instructional or support services.

In addition, there must be an administrative structure that permits direct input from the clusters of firms to be served by the center. These must be guided by the input of the industry and selected economic development agencies statewide. If the proposed center is going to be developed or administrated by a (formal or informal) consortium of organizations, then it is important to characterize the role of each of the partnering agencies. In any coordinated effort, there must be systems in place for accountability of the staff to the mission of the center.

Finally, ultimate accountability for the center rests with the community college, and the relationship between institutions must be made clear.

Funding issues:

The initial grant for the ICRC will cover the start up and maintenance costs of the center for the first two years of operation. Then it is anticipated that each center will require annual funding (from all sources) for ongoing operations that will average $550,000. The NCCCS may wish to structure funding awards for ongoing support in a way that encourages or requires centers to solicit matching funds from the colleges, cluster firms and/or other organizations in the participating regions. A five-year business plan must be submitted that indicates:

- anticipated sources of matching funds for years 3, 4, and 5;
- plans for the maintenance of equipment utilized by the center;
- a strategy to finance the activities that will be undertaken at the center;
- financial targets and goals set for each year; and
- if new staff are hired, how their salaries will be covered after year 2.

In this section, it is entirely appropriate to list corporate contributions or support for the center as a means of funding the activity. In addition, although state support is an important factor in the centers' early success, it should not be assumed by applicants that state funds will be available on a recurring basis, especially at the initial levels, after the first five years.

Activities and services to be provided:

Once a cluster of firms has been identified, and their impact in terms of economic development justified, the task becomes to detail the activities and services that the ICRC will provide the firms. These activities can include:

- formal classes both for credit and non-credit
- providing research and technical assistance
- development of technology awareness seminars
- assessment of new workers
- providing space for company sponsored training programs
- serving as a site for technology vendors to the industry
- developing a continuous quality users group
- becoming a distance learning center
- computer awareness and training

These activities must be detailed, with an indication of how they will be performed, whether firms will pay for these services, and what outcomes will be expected. The goal of this section of the proposal will be to indicate what activities will be performed within the proposed center that presently do not exist in this region. If there are services present, and they are inadequate, that should be detailed in the proposal. If there are activities presently ongoing with these firms, how will the development of a new center serve to align, and/or advance these interests? The

proposed set of activities must be justified within the main mission of the center: to develop a knowledge supply chain with a cluster of in-state firms.

In developing measures of accountability for the specific activities proposed, it is important to maintain the overall objective of the centers, which is to serve the economic development of the state and the regions in which they are located. Thus, it becomes critical, when discussing measures of accountability, to refer to ways in which the clusters of firms will benefit, and the region and state will benefit from the proposed interaction.

Institutional impact:

One goal of this initiative is the transformation of the workforce development mission of North Carolina community colleges. If successful, the new Industry Cluster Resource Center should have an impact on the rest of the community colleges and their programs. The proposal must state how the center will relate to the rest of the institution's programs, including workforce development, customized training, and economic development as well as other occupational and academic fields. In some cases, this may mean the center will align, consolidate, or extend activities to existing programs.

Demonstration of regional industry support:

Since the primary mission of the program is cluster-based regional economic development through the retention and expansion of their current economic base, the proposal must indicate evidence that it has the support of local and regional industry and governmental leadership. This support can be demonstrated in a variety of ways: (a) commitments to work with the center on programs, (b) willingness to finance workers to attend the center activities, (c) placing of technical/administrative staff at the facility by private employers, and (d) direct grants from other local private and public bodies that would maintain the new center.

Timetable:

In this proposal a timetable must be presented which indicates the specific steps the college intends to take to fulfill the activities of the proposal. If new construction is anticipated, the timetable must be embedded within the proposal. In general, the goal of the program is to have activities of the ICRC underway within one year after the award of the project. The timelines for the project should be made in a reasonable manner, but they should reflect the steps the community college administration is willing to take to ensure that the project can be completed.

Compliance process:

All proposers must be willing to abide by a compliance process instituted by the NCCCS to ensure that the accountability measures will be met by the institution. A team of experts, selected by the Department, will be asked to serve as a review panel for the first two years the ICRCs are in operation. This panel will have responsibility for monitoring the progress of the centers and pointing out if modifications are necessary to the plans, and if there is slippage in the projects. In some instances, there may be applied research conducted by the panel. The panel

will also be responsible for the annual report that will disseminate the best practices of the centers to other community colleges in North Carolina. Each proposal must address how the institution will report to this panel, and how it will develop accountability measurement for the activities of the grant.

Proposal process, round two – for NCCCS. Once submitted, the proposals will be reviewed again by the same six-person team. The team will consider each proposal from the perspective of how well the proposal offers a reasonably detailed approach to the construction of an ICRC, and how well the proposal was able to meet the concerns of the committee in the original design for the center. The criteria used by the committee will be:

- all of the same criteria of round one;
- how well the concerns of the committee were considered in the revised proposal;
- the financial capabilities of the proposers to carry out the intended activities;
- the measurements of accountability;
- the community support for the proposal in each region affected (not just the host region);
- the private sector support for the proposal in each region affected (not just the host region);
- the impact upon the economic development of the regions served and the state; and
- a specific timetable which indicates that cluster support activity can start within one year of the awarding of the funds.

In addition, the committee may choose to send representatives to the sites themselves to talk with college officials and private sector employers concerning the proposals. The site visits are for further information gathering. A site visit is neither an indication of acceptance nor rejection of a proposal.

Announcements of the winning proposals will be made within 30 to 45 days after receipt of the round two proposals. The NCCCS should work with colleges who are not awarded a grant, but whose proposals had merit, to connect them as partners to the colleges selected to host an ICRC.

The process of using an outside review panel will help ensure that the selection of host colleges will be as objective as possible. ***It is imperative that the best institutions and partnerships be selected to enhance North Carolina's competitiveness in the rapidly changing economy and create quality jobs statewide.*** Once selected, the cluster centers must be sustained by both the public and private sectors and networked together for greatest impact as a system.

APPENDICES

Appendix A:
Clusters and Their Implications for Knowledge and Skills Development

The "industry cluster" is an old concept that has become a relatively new economic development strategy. Yet the term "cluster" is frequently misunderstood and therefore misused. One definition of a "cluster" that emerged from discussions among a group of international experts and practitioners convened by Regional Technology Strategies, Inc. in 1996 is:

> *a geographically bounded concentration of similar, related, or complementary businesses, with active channels for business transactions, communications and dialogue, that share specialized infrastructure, labor markets and services, and that are faced with common opportunities and threats.*[1]

Clusters, which are characterized by interdependencies, however, are often confused with networks, which are self-selected groups of companies working collaboratively toward a common goal. Clusters also are confused with sectors, which are firms categorized by products, normally according to Standard Industrial Classifications. While usually defined by hard data, clusters are operational systems that rely heavily on social relationships for their success. Clusters are distinguished from one another by key commonalities (e.g., products, resources, technologies, or markets). They comprise lead companies/exporters, suppliers, specialized services and expertise, special infrastructure, and labor markets.

Clusters derive most of their synergies from collective efficiencies, which are the sum of external economies and joint actions. Collective efficiencies are benefits that accrue from scale and concentration. These generally are unintentional and do not require "cooperation." Joint actions are the results of intentional inter-firm collaboration and learning that typically are planned. The synergy that a cluster is able to produce is a function of the ease with which information, knowledge, innovations, skills, capital, materials, and people flow through the system. Thus, the social infrastructure represents one of the more important "active channels" in the definition that mediate and facilitate the flows that are critical to the success of a cluster and allow for collective efficiencies.

Skills, Schools, and Clusters

Factors related to human resources, notably the labor markets, skills, education, and workforce development, have been found to rank at or near the top among the many external economies that draw firms together. By recognizing and targeting a cluster, a community college can strengthen the member firms and thus the regional economy by providing a:

- pipeline for skilled workers
- repository of expertise and information about the cluster
- source of skill upgrading and incumbent worker training
- intermediary function for forming networks and skills alliances, benchmarking, etc.

The number one regional economic development advantage of having a community college target a cluster is that it expands the labor pool that is not only highly skilled but also familiar

with the operations of the businesses that comprise the cluster. A specialized labor market is the advantage most frequently cited by businesses for operating near like firms, many of whom are competitors.[2] A recent international study of regional economies notes, "the existence of localized knowledge pools, a specific kind of industry culture, and, increasingly, the availability of high-quality knowledge centres such as universities, are externalities of tremendous importance."[3] The schools are expected to produce sufficient numbers of workers with the highly developed skills that result from both formal education programs and opportunities for informal learning.

A second advantage is that specialized college hubs can create external economies for firms. They can operate as a "one-stop shop" for a cluster that can respond to a wide range of business needs but also offer in-depth knowledge. In the typical support function, college staff may be asked to respond to questions from hosiery manufacturers, auto suppliers, and furniture companies; but it is virtually impossible to be knowledgeable in all these industries. The specialized cluster hub is better able to provide, or make a referral to someone with, the specialized skills, services, and information needed. Further, due to the scale of demand, they can offer a wider range of credit and non-credit education and training programs more frequently and at lower costs and are more likely to have staff and faculty with relevant industry experience and more current industry-influenced curricula.

Perhaps the most under-rated and undervalued contribution of technical colleges to technology based development is its nurturing of social capital by facilitating interaction and learning among people in different organizations. Faculty who are well-connected to industry become the purveyors of the "untraded transactions" that represent technology and knowledge transfer and diffusion. Pro-active colleges organize business alliances that accelerate such learning and collaboration. Colleges promote collective efficiencies by mediating or brokering various forms of inter-firm cooperation, including regional skill alliances.

Finally, there is a recruitment dimension for plants drawn to the cluster. If the college becomes known as a true center of excellence, it enhances the region's ability to attract other new businesses to the cluster.

Educational Advantages of Cluster Resource Centers

Not only do community colleges with specialized programs and expertise targeting clusters enhance the competitive advantages of the clusters, but they also improve the skills, employment, advancement, and entrepreneurial opportunities of individuals who enroll in programs that are related to the employment in the clusters. Those educational benefits to students are based on the propositions that linking knowledge, skills, and experience to realities of local industry clusters improves the:

- content and quality of education and training (codified knowledge)
- rates and means of informal learning (tacit knowledge)
- access to employment information and career ladders (labor markets)

Technical education, most educators agree, is more effective when rooted in experience, and when the experiences of a large number of students are common enough to be shared. A local cluster creates a real life context for learning that is likely to be relevant to the lives of many students and provides opportunities for more effectively sharing among students and extending their range of knowledge to the industry. W. Norton Grubb found that despite the widespread support for SCANs type competencies (i.e., communication, problem solving, critical thinking), employers prefer industry-specific skills and experience. "It is usually crucial to have experience in work specifically related to a firm's production process."[4] This does not diminish the importance of SCANs competencies; it only suggests that competencies are more highly valued by industry when related to a particular industry environment and requirements. Harvard Business School competitiveness expert Michael Porter concludes that high skill levels are insufficient to spur a region's growth; they must be tailored to the region's key industry clusters. "The human resources most decisive in modern international competition, for example, possess high levels of specialized skills in particular fields. These are not the result of the general educational system alone but of a process closely connected to competition in particular industries..."[5]

Tacit knowledge—the ability to attribute meaning to perturbations in the work process and have a frame of reference for solving problems—is equally important to employers, and is often embodied in experience. Tacit knowledge is the know-how that comes from a "detailed understanding of the physical medium to which the skills are applied"[6] and cannot be codified or even easily verbalized. This in large part is why employers value industry experience. Tacit knowledge is acquired through personal experience and informal learning about and from the experiences of others. If a college is able to add value to the social infrastructure of a cluster and create opportunities for interactive learning, it ought to enhance the flow of tacit skills throughout a region. In a mature and active cluster, like the furniture industry in northeastern Mississippi, learning is passed down through families and community civic organizations. In less concentrated clusters, the most common opportunity is student and faculty work experiences.

Programs linked to clusters also better meet labor market needs of both students and employers. Advantages students may gain include access to informal labor information systems in which news of new job or economic opportunities spreads quickly. Even in clusters where competition is fierce, clusters create unintended, unplanned career ladders because informal labor market systems make knowledge of job opportunities more easily available to students.

Where a college is well-connected to a cluster, employers gain the advantage of having direct knowledge of the quality of the programs and of the graduating students—which in most places employers lack. In the four clusters investigated by Grubb, firms were unfamiliar with the education institutions in their own area largely because they had no regular interaction with the schools and tended not to utilize colleges' placement offices when seeking new hires. They sought people with industry-specific labor market experience. Those firms that did express a preference for schools chose institutions based on the quality of the equipment in their workshops, not the quality of instruction.[7] Further, schools have had a great deal of difficulty finding any but the largest employers willing to provide workplace experiences.

The Meaning of Specialized Skills and "All Aspects of the Industry"

There is a difference between occupationally specific and cluster specific skill sets. Community colleges are accustomed to thinking in terms of occupational clusters but not industry clusters. The basic difference is that occupational clusters deal with the common elements of skill sets across related occupations regardless of the industry but cluster skills deal with the specific industry context in which skills are learned. Even where skill sets at first appear to be similar across clusters and generally are treated alike by educational institutions, there are subtle differences and distinctions that relate to their individual and special industry contexts. Employers recognize these differences, and therefore often express preferences for employees not just with educational qualifications but with experience in their particular types of business.

The cluster-based education programs utilize curricula and instructional processes that rely on the cluster to serve as a context for learning and use applications relevant to the cluster. This is what Congress most likely had in mind when it introduced the concept of "all aspects of the industry" into the federal vocational education legislation in 1984. The concept was based largely on philosophies developed within secondary agriculture education, which uses a form of cluster hub approach.

Mission Community College in San Jose, California pays special attention to the semiconductor cluster through its programs and services. Faculty from across all disciplines (from technical to languages) take summer paid "externships" at Intel, National Semiconductor, and other firms and are assigned to technicians. They are required to produce an improvement or innovation for the college at the end of the summer.

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[1] Stuart Rosenfeld, *Overachievers: Business Clusters that Work*. Report based on research sponsored by the Appalachian Regional Commission, Aspen Institute, and UDSA. Regional Technology Strategies, 1996.

[2] Stuart A. Rosenfeld, "Cluster/Community College Connections," *Economic Development Quarterly*, 14 (February 2000) 51:62.

[3] Philip Cooke and Kevin Morgan, *The Associational Economy: Firms, Regions, and Innovation* (London: Oxford Press, 1997), p.6.

[4] W. Norton Grubb, *Working in the Middle: Strengthening Education and Training for the Mid-Skilled Labor Force*. (San Francisco: Jossey-Bass, Inc., 1996), p.30.

[5] Michael E. Porter, *The Competitive Advantage of Nations* (New York: Free Press, 1990), p. 9.

[6] Shoshana Zuboff, *In the Age of the Smart Machine: The Future of Work and Power* (New York: Basic Books, 198), p. 187.

[7] Grubb, p. 173.

Appendix B: North Carolina CC Presidents Survey: *results by region*

Advantage West

For the final 5 entries for each college, 1 asterisk (*) indicates that the college hopes to work with this industry in the near future, 2 asterisks (**) indicates that the college has no current plans to work with this industry

College	Asheville-Buncombe	Blue Ridge	Isothermal	Mayland	McDowell
County	Buncombe	Henderson	Rutherford	Mitchell	McDowell
Region	AdvWest	AdvWest	AdvWest	AdvWest	AdvWest
Service area	Buncombe, Madison	Henderson, Transylvania	Polk, Rutherford	Mitchell,Avery,Yancey	McDowell
1) Current areas of training expertise	Plastics, Printing press, Machining, Culinary, Lodging	Enivron science, Tourism, Deaf interpreter	Polymers	Horticulture	Mfg certification
2) Training centers for specific industries	Flexible-automated manuf training ctr for plastics, printing & metal machining; Hospitality ed dept (culinary tech, foodservice tech, hotel & restaurant mgt)	Environ training ctr -dept	Composite testing & training ctr	Horticulture (regional resource and educational center)	
3) Specialized resources which the college offers	bubble film extrusion, thermolators, etc; Culinary/Lodging - equip, certified instructors, library & software, housekeeping facility, student-run lodge, restaurant facilities & equip	Environ science - center w/ high-tech equip, 3 labs, 3 classrooms & conference room		Horticulture - most horticulturally diverse region on the continent, greenhouses	
4) Outside resources utilized by the college	firms; Lodging/Travel/Tourism/Restaurant - facilities at regional hotels, casinos, country clubs, restaurants, resorts, visitors bureaus	Hazwoper on-line course, workshops - HMTRI, Kirkwood CC, Iowa	Composite testing - 3TEX plant		
5) Industry partnerships for education programs	Training Alliance of West NC - WNC Plastics Partnership; Foodservice tech - NC Dept of Corrections; Culinary program - ACF & Grove Park Inn; Sanitation & Safety - county health dept	Environ - NC Environ & Nat Resources; Tourism - AMADEUS computer terminals	Composite Testing Center - 3TEX	Horticulture regional seminars	Baxter Healthcare
6) Capacity to research economic development	Research Planning & Dev Office - feasibility studies, business & industry surveys, focus groups		Office of Institutional Quality and Advancement	Office of Institutional Advancement and Planning - regional surveys; Economic dev commission of Mitchell Co & Blue Ridge resource conservation & dev council	
7) Collaboration with other educational institutions	Computer training - Isothermal CC, Blue Ridge CC, Haywood CC; Foodservice program to prisons - area CCs; Psychology of eating - WCU	Environ science - NC State	Foothills Nursing Consortium - Cleveland, McDowell Tech CCs	Horticulture classes - Caldwell CC	
Targeted industry 1	Metal machining	Environ	Polymers		Forestry
Targeted industry 2	IT	Tourism			Crane Resistoflex
Targeted industry 3	Printing	Deaf interpreter			Healthcare
Targeted industry 4	Lodging, club, resort mgt	E-commerce*			
Targeted industry 5	Culinary arts & tech	Networking			

Advantage West

For the final 5 entries for each college, 1 asterisk (*) indicates that the college hopes to work with this industry in the near future, 2 asterisks (**) indicates that the college has no current plans to work with this industry

College	Southwestern	Surry	Tri-County	Western Piedmont	Wilkes
County	Jackson	Surry	Cherokee	Burke	Wilkes
Region	AdvWest	AdvWest	AdvWest	AdvWest	AdvWest
Service area	Jackson, Swain, & Macon	Surry, Yadkin	Graham, Cherokee, Clay	Burke	Wilkes, Allegheny, Ashe
1) Current areas of training expertise	Computer tech, Health tech	Viticulture, HVAC, Customized industrial training		Paralegal, BLET, Leadership/Mgt, Waste/Wastewater Mgt, Industrial Maintenance (PLC), Machining (CNC)	ISO 9000 &14000, Workkeys, CISCO academy, Automotive service certif, AS400 training, DiSC personality system, MBTI learning styles, 4MAT curriculum dev, Change cycle system, Career dev facilitator certif
2) Training centers for specific industries	Computer networking, IT, E-commerce, Telecomm - with units for technical support, business/industry training, & small business	Law enforcement & emergency training ctr; Small business & industrial training ctr		Waste/Wastewater	
3) Specialized resources which the college offers	Computer networks - 3 CISCO labs, 2 mobile labs, 900 computers, other types of hard & software	Viticulture degree program		Waste - water lab	Heavy equip & trans tech equip - certif programs, race car specialization available
4) Outside resources utilized by the college	Local interactive TV network w/ 12 sites		PLC & hydraulics training - Regional High Tech Ctr		
5) Industry partnerships for education programs	Internet provider - various libraries, schools & govt organizations; Software training - Real Estate firms, GTE, Smokey Mountain Systems & D-Net	Viticulture - Shelton Brothers Vineyard		Caterpillar employee training; Supervisory training - Southern Devices, Grace Hospital, Drexel Heritage	OSHA safety series - construction industry
6) Capacity to research economic development	Institutional research office	Small bus & industrial training ctr - surveys local businesses & industries annually	Planning & research dept - surveys of local industries	Advisory committees conduct industry surveys	Office of Institutional Effectiveness does planning and research
7) Collaboration with other educational institutions	Interactive TV network - WCU; IT training - Stanley CC, College of Albermarle; E-commerce - 11 CCs		Specialized tech training - Haywood, Southwestern CCs	Paralegal tech, Criminal justice	Appalachian Learning Alliance; Various collaborative agreements
Targeted industry 1	Computer software dev	Wine-making	Electronics	Water resource	Food products
Targeted industry 2	Internet service	Textiles & apparel	Autos	Caterpillar	Metal products
Targeted industry 3	E-commerce	Distribution & logistics	Recreational vehicles		Heavy equip & auto
Targeted industry 4	Telecomm	Automotive parts	Textiles		Electronics

Charlotte

For the final 5 entries for each college, 1 asterisk (*) indicates that the college hopes to work with this industry in the near future, 2 asterisks (**) indicates that the college has no current plans to work with this industry

College	Catawba Valley	Central Piedmont	Cleveland	Gaston
County	Catawba	Mecklenberg	Cleveland	Gaston
Region	Charlotte	Charlotte	Charlotte	Charlotte
Service area	Catawba, Alexander	Mecklenberg	Cleveland	Gaston, Lincoln
1) Current areas of training expertise	Furniture, Hosiery, Motorsports	Flexographic printing, IT, Trans tech	Info systems & networking, Machining, Industrial maintenance	Automotive, A/C & heating, Health
2) Training centers for specific industries	Furniture Tech Ctr; Hosiery Tech Ctr; Bobby Isaac Motorsports tech program	CAD/CAM ctr - engineering tech div	Info systems & networking (AAS programs); Machining diploma; Industrial maintenance diploma	Emergency services training ctr
3) Specialized resources which the college offers	Furniture & Hosiery Ctrs - equip includes computerized cutters, high tech routers, dyeing & finishing lab; Motorsports equip	Flexographic printing - printing press; Welding - equip; Programmable Logic Controlling - control devices; Auto CAD/CAM tech - computers & software; Trans tech - cars, trucks, steering & suspension equip, scan tools	Info tech - all classrooms are wired for web access; Machining - new CNC equip	
4) Outside resources utilized by the college	Motorsports - local racetrack; Hosiery - NCSU, local plants; Furniture - local plant facilities	Trucks & engines - donations from Freightliner, Mack, Peterbilt		Industrial training - McNaughton-McKay EleCtrical; Small Bus Tech Dev Ctr - Hickory
5) Industry partnerships for education programs	Hosiery - NCSU, Hosiery Assoc, Dept of Labor, Mfg & Industrial Extension organizations; Furniture - Furniture Mfg Assoc; Welding - ESAB Welding, ShurTape	See survey for corporate partners	Childcare - Cleveland Co Partnership for Children, JobReady Partnership for highschool students	Parenting classes - dept of social services; Banking classes - American Institute of banking; American Prod Inventory Control Society - certification classes; IT - Microsoft, Education to Go
6) Capacity to research economic development	Institutional research office - research, surveying	Planning & research office	Academic programs office - employer/graduated student satisfaction surveys	Institutional effectiveness office
7) Collaboration with other educational institutions	Charlotte Regional Workforce Dev Partnership; Computer aid design training - Central Piedmont CC	IT - area CCs; Construction - Charlotte Workforce Dev Partnership; Mfg - South Piedmont, Gaston, Rowan, Mitchell CCs	Healthcare Consortium - 2 CCs; Mechanical drafting - Gaston CC; Fire protection tech - Isothermal CC; IT - Charlotte Region Tech Consortium	Charlotte Regional Workforce Dev Partnership - 10 local CCs
Targeted industry 1	Mfg fiber optic cable	IT	IT	Metalworking
Targeted industry 2	Furniture	Trans tech	Metalworking	Auto supplies
Targeted industry 3	Hosiery	Criminal justice	Childcare	Textiles
Targeted industry 4	Co-ax cable mfg	Welding	Industrial maintenance	Public education
Targeted industry 5	Foam mfg*	Flexography		Plastics

Charlotte

For the final 5 entries for each college, 1 asterisk (*) indicates that the college hopes to work with this industry in the near future, 2 asterisks (**) indicates that the college has no current plans to work with this industry

College	Mitchell	Rowan-Cabarrus	South Piedmont	Stanly
County	Iredell	Rowan	Anson	Stanly
Region	Charlotte	Charlotte	Charlotte	Charlotte
Service area	Iredell	Rowan, Cabarrus	Anson, Union	Stanly
1) Current areas of training expertise	Industrial tech (including computer design, welding, machining, mfg), Law enforcement/Security services/Criminal justice	Welding, Industrial safety/maintenance, Machining		Computer tech
2) Training centers for specific industries	Workplace literacy project for 6 industries -basic skills dept			CISCO & Communications Workers of America -tech dept
3) Specialized resources which the college offers	Computer tech - distance learning			Computer tech - online CISCO router racks, Sylvan/Prometric testing ctr
4) Outside resources utilized by the college	Clinical training - area hospitals	Davidson CC - public safety facilities		Lab equip - donations from CISCO
5) Industry partnerships for education programs	Workplace literacy - ASMO, Dana-Spicer, Thor-Lo; Construction tech - area building contractors' assocs	Construction training - Wheels of Learning, Rust Contractors Alabama	Mfg program - chamber of commerce, JobReady, Joblink Career Center & local mfg firms	Train ex-military personnel - CISCO,CWA; Metalwork - ALCOA, Metal Forge
6) Capacity to research economic development	Office of institutional effectiveness does planning and research			Dept of institutional dev & small bus ctr - survey, research
7) Collaboration with other educational institutions	Motorsports mgt - Rowan-Cabarrus CC; IT lab program	IT - Central Piedmont CC & Charlotte Area Workforce Development Consortium	Emergency Med Services - Montgomery CC; Fire protection tech - Central Piedmont CC	Textile dyeing, Lean mfg - NC State; Online IT training - Albemarle, Southwestern CCs
Targeted industry 1	IT	E-commerce*	Healthcare	Computer tech
Targeted industry 2	Nursing	Telecomm*	Machining	Aircraft tires*
Targeted industry 3	Building tech	Construction	Agriculture*	Auto textiles*
Targeted industry 4	Law enforcement	IT		Lumber*
Targeted industry 5	IT	Motorsports		

Southeast

For the final 5 entries for each college, 1 asterisk (*) indicates that the college hopes to work with this industry in the near future, 2 asterisks (**) indicate that the college has no current plans to work with this industry

College	Brunswick	Cape Fear	Fayetteville	Sampson
County	Brunswick	New Hanover	Cumberland	Sampson
Region	Southeast	Southeast	Southeast	Southeast
Service area	Brunswick	New Hanover, Pender	Cumberland	Sampson
1) Current areas of training expertise		Engineering, Computers	Computer tech; Nortel training academy	Poultry & livestock
2) Training centers for specific industries		Fire & emergency services -continued education dept		
3) Specialized resources which the college offers		Engineering - machinery tech, instrumentation, electrical & computer engineering programs	Computer and networking - media integration lab, hardware training labs, router tech labs, Microsoft certif lab	
4) Outside resources utilized by the college				
5) Industry partnerships for education programs	Industrial - Dupont; Nuclear Engineering - CP&L, Wake Tech, NCSU, Florence-Darlington Tech	NC Machinery/CAD - GE; Plant maintenance - Corning	Telecomm network engineering - Sprint; Internet tech - Advanced Internet Tech; Wireless cable distrib - NCCCS Wireless Communications consortium	
6) Capacity to research economic development	Institutional effectiveness office	Small research dept	Research and planning office - industry surveys & curriculum dev	
7) Collaboration with other educational institutions	Aquaculture - NCSU, UNC-W; Plastic injection molding - NCSU Polymer Ctr		Specialized industry training - partnerships w/ CISCO, Nortel, Microsoft & Novell	
Targeted industry 1	Boat building	Manufacturing	Computers	Livestock
Targeted industry 2	Plastics	Service	Health services	
Targeted industry 3	Beverages*	Business	Education	
Targeted industry 4		Medical	Telecomm	
Targeted industry 5		Engineering		

Research Triangle

For the final 5 entries for each college, 1 asterisk (*) indicates that the college hopes to work with this industry in the near future, 2 asterisks (**) indicate that the college has no current plans to work with this industry

College	Central Carolina	Johnston	Sandhills	Vance- Granville	Wake Technical
County	Lee	Johnston	Moore	Vance	Wake
Region	Research Triangle	Research Triangle	Research Triangle	Research Triangle	Research Triangle
Service area	Lee	Johnston	Moore, Hoke	Vance, Granville, Warren, Franklin	Wake
1) Current areas of training expertise	Telecomm, Laser photonics, Metals	Business operations	Landscaping, Networking, Internet tech	Biotech	Global Partnership program, CISCO program, Mfg certif (partnered w/ Excel)
2) Training centers for specific industries	NC School of Telecomm - own dept	NC truck driver training service -industrial & applied tech dept		Biotech lab under construction w/ NCCCs office & NC Biotech Ctr	Plastics tech w/ 5 other CCs; Cooperative automotive tech w/ local auto businesses; CISCO certif; Real estate classes
3) Specialized resources which the college offers	Telecomm - America's only public, tech telecomm school; Laser photonics program	Environ sciences - Idowell Woods (environ learning land); Medical sonography; Truckdriver training		Biotech - specialized equip	Plastics tech - new lab under construction
4) Outside resources utilized by the college	Bioprocessing labs - Wyerth Ayerst			Biotech labs - NOVO Nordisk Niochem Intern	
5) Industry partnerships for education programs	Telecomm - NC Telecomm Industries Association; Laser Photonics - CP&L, NC Telecomm Industry Association; Bioprocessing - Eyeth-Lederle Vaccines, Wyeth Ayerst Labs	Greenhouse & grounds maintenance - Johnston Co Mental Health; Compensatory education classes - Johnston Co industries	CISCO	Biotech training - NOVO Nordick Biochem, NC Biotechnology Center & NCCCS	Auto tech - local businesses (soon to include an A/C, Heating & Refrig program); Electricity & electronics - BellSouth, Brotherhood of Electrical Workers & Carolina Electrical Contractors; Contracting - Occupational Extension AGC; Communication Workers & Plumbers Assocs; Triangle Apmt Assoc
6) Capacity to research economic development		Research and planning dept		Office of Institutional Effectiveness - economic dev services	
7) Collaboration with other educational institutions		Plastic Tech Consortium - 5 local CCs			Leadership dev training - Lowes Foods & 3 area CCs; Plastics tech program - 5 area CCs
Targeted industry 1	Telecomm	Pharmaceutical	Golf course mgt	Biotech	Landscape
Targeted industry 2	Bioprocessing	Electronics	Cooking tech		Biogenetics*
Targeted industry 3	Laser-photonics	Environmental	Landscaping		Metalcraft
Targeted industry 4	Metals tech	Retail			CISCO Systems
Targeted industry 5					Plastics*

Global Transpark

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College	Carteret	Coastal Carolina	Craven	Edgecombe	Lenoir
County	Carteret	Onslow	Craven	Edgecombe	Lenoir
Region	Global Transpark	Global Transpark	Global Transpark	Global Transpark	Global Transpark
Service area	Carteret	Onslow	Craven	Edgecombe	Lenoir, Greene, Jones
1) Current areas of training expertise	Aquaculture, Boat building, Tourism	Call centers, Software training, Marine/boat trades; Total quality mgt & statistical process control	CISCO academy; Welding, Electronics, Computer info systems & computer engineering; Tool and die/machine trades; Havelock Aeronautical Institute opening soon	Manufacturing, Distribution center, Baking	Electronics/PLCs, Industrial engineering, Welding
2) Training centers for specific industries		E-commerce & customer service support centers; Boat building; Software training; Total quality mgt	Specialized computer training w/ CISCO & IBM; Auto training w/ Chrysler; Machine shop/tool and die training; Plans for aeronautical training	Small education & industry ctr - industrial dept	WorkKeys partnership w/ 3 area CCs
3) Specialized resources which the college offers	Boat building - lamination equip	Boat trades - fiberglass chopper gun; Welding - spray transfer; 3D animation - computers & software	Machining tech program - shop equip, networked labs & training programs; Computer & networking tech programs - equip; Aeronatical Ctr - will soon be well equipped	Mfg tech	Industrial electronics, instrumentation & maintenance - process loop w/ instrumentation equip & other features
4) Outside resources utilized by the college	Boat building training - NC Maritime Musuem	Industrial recruitment, consulting & problem-solving - US Marine Corps		Equip resources - neighboring colleges	
5) Industry partnerships for education programs	Boat building - 2 local companies; Aquaculture - Sea Grant	Boat mfg - Tiara Yachts; Welding - Ravens; Quality mgt - local firms; Call ctr training - local companies; Construction - Homebuilders Assoc; Software training - 3D Animation, USMC	Chrysler factory training; IBM partner in Education; BSH Home Apppliances	Keihan Carolina System Tech; Sara Lee Bakeries; QVC	Partnership w/ American Mgt Assoc & county chamber of commerce; Regional Export Outreach Ctr
6) Capacity to research economic development	Research office to assess community needs	Ctr for bus & industry dev - training surveys & needs assessment	Institutional planning & research office - limited capacity to conduct scans	Associated with the State Employment Security Commission, ESC office on campus	Office of institutional effectiveness -surveys & data generation to direct training program
7) Collaboration with other educational institutions	Boat building - Craven, Pitt, Pamlico, & Albemarle CCs	Boat building trades- COA, Carteret, Brunswick CCs	Hosted NC CC's Curriculum Improvement Projects for Business Computer Tech; Provide network certif training for area college and high school instructors; Planning an East Carolina/Craven Computer Tech Ctr, Aeronautical tech - area CCs	Plastics - 6 area CCs	Global logistics tech & educ - Kenan Institute & Global Transpark Authority; 2+2 Engineering Program - NCSU, NC A&T
Targeted industry 1	Boat building	Tech training	Metalworking cluster	QVC	Frigidaire* (dishwasher division)
Targeted industry 2	Seafood prod	Call centers		Keihan CST	Synthetic fibers (DuPont, GlenRaven)
Targeted industry 3	Tourism	Boat building		Sara Lee	MasterBrand Cabinets
Targeted industry 4		Total quality management			Gas pumps (Marconi)
Targeted industry 5		Welding			

Global Transpark

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College	Nash	Pamlico	Pitt	Wayne	Wilson
County	Nash	Pamlico	Pitt	Wayne	Wilson
Region	Global Transpark	Global Transpark	Global Transpark	Global Transpark	Global Transpark
Service area	Nash	Pamlico	Pitt	Wayne	Wilson
1) Current areas of training expertise	Industrial training, Engineering, Utilities		Healthcare, Mfg, Service, Distance education	Airframe mechanics, Forestry, Machining & welding	Heavy equip operator, Dialysis technology, Spanish interpreter education
2) Training centers for specific industries	Business & industry ctr; Child dev ctr; NC Model Teacher Consortium		Healthcare; Mfg; Service degrees	Automotive service education program - separate dept; GMC auto industry - separate dept	
3) Specialized resources which the college offers	CISCO training; Organic chem lab; Electric Linemen training field; Business & industry ctr - electrical, mfg, programmable logic controllers & pneumatic systems training		IT - online degree; Customer service academy - in dev w/ local Economic Dev Commission	Airframe & power plant mechanics - airplanes, jet engines, labs; Computer numerical control - GPS system machine shop equip; Forestry - faculty	Heavy equip operator training
4) Outside resources utilized by the college	NC Info Highway - Area Health Ed ctr				
5) Industry partnerships for education programs	Cooper Standard Prod; Downeast Partnership for child grants; Consolidated Diesel; Abbott Labs; Carolina Power; Plastics companies		Wheels of Learning certif for construction industry - local association & public schools	CNC (Computer numerical control) machining and programming - Cooper Bussman & Modern Machine Co	Industrial maintenance - UNICO; Food service - local hospitals & restaurants; Electrical installation & maintenance - Watson's Electric; Cosmetology - Mitchell's Academy
6) Capacity to research economic development	Local surveys for businesses, industries		Office of IT - environmental & demographic research	Future search conf - 21st century think tank that addresses the digital economy	
7) Collaboration with other educational institutions	Plastics - 5 CCs; Electric lineman - 12 CCs; Occupational therapy - Pitt CC; Healthcare mgt - Pitt CC; Nursing - 3 CCs; NC Model Teacher Consortium; Engineering classes - NC State		Mfg certif - State dept of CCs	Plastics tech - Edgecombe, Johnston, Nash, Wake Tech, Wilson CCs	Mfg engineering tech (plastics concentration) - 5 CCs; Associate degree nursing - 3 CCs; Industrial pharmaceutical tech - Nash, Wake CCs
Targeted industry 1	Utilities	Farming**	Healthcare	Computers	Plastics mfg
Targeted industry 2	Machining	Fishing**	Construction	Gaskets & seals*	Construction trades
Targeted industry 3	Consolidated Diesel	Timber**	Service	Manufacturing	Food service
Targeted industry 4	Abbott Laboratories		Manufacturing	Machining	Industrial maintenance
Targeted industry 5	Education		Banking & finance*		Diesel trucking/agriculture

Northeast

For the final 5 entries for each college, 1 asterisk (*) indicates that the college hopes to work with this industry in the near future, 2 asterisks (**) indicate that the college has no current plans to work with this industry

College	Albemarle	Beaufort	Bladen	Halifax	Martin	Roanoke-Chowan
County	Pasquotank	Beaufort	Bladen	Halifax	Martin	Hertford
Region	Northeast	Northeast	Northeast	Northeast	Northeast	Northeast
Service area	Pasquotank, Dare, Chowan, Currituck, Camden, Gates, Perquimans	Tyrrell Hyde, Washington, Beaufort	Bladen	Halifax, Northampton	Martin	Northhampton, Hertford, Gates and Bertie
1) Current areas of training expertise	WorkKeys, Fiberglass boat building	Trans tech, Agricultural systems	Meat processing (struggling), Animal & food science tech ctr (awaiting funds), Welding	Pulp & paper tech	Refrigeration, Electrical	
2) Training centers for specific industries		Heavy equip & trans tech/agric systems - industrial tech div	Animal and food science tech ctr (awaiting funds)		Tech training for poultry industry	
3) Specialized resources which the college offers	Fiberglass boat building - certified instructors; WorkKeys - certified personnel	Agric - planting, harvesting & maintenance equip	Welding; Certification program for DOT jobs; Dept of Material & Testing Ctr		Commercial & ammonia refrigeration equip; HVAC pneumatic controlled trainer & energy mgt systems; Carrier brand puron w/ 4 zones	
4) Outside resources utilized by the college	Mfg - local industrial space; Lamination training - Albemarle Boats	Agric equip - donations from Eastern Equipment Dealers Assoc (EEDA); Trans equip - donations from North Carolina Industries for Technical Education (NCITE)				Truck driving school - Johnston CC
5) Industry partnerships for education programs	Fiberglass boat building - 2 local boat companies	EEDA; NCITE	Industrial maintenance program (welding, electrical, handyman, general maintenance skills)	Pulp & paper tech program - Champion International	A/C fundamentals - Weyerhaeuser; Poultry deboning - Purdue; Sprinkler fitting - Williams Fire Sprinklers	Industrial maintenance - Roanoke-Chowan Industrial Assoc
6) Capacity to research economic development		Office of Planning & Institutional Effectiveness			Job surveying & econ data review	
7) Collaboration with other educational institutions	Fiberglass boat building - Pitt, Roanoke-Chowan, Carteret CCs	Curriculum improvement project for heavy equip & trans tech - 13 CCs	Environmental science tech (inactive) - Cape Fear CC; Pharmacy tech (inactive) - Fayetteville CC; Livestock tech program - James Sprunt CC			
Targeted industry 1	Fiberglass boat building	Agric equip	Livestock & animal science	Wood products	A/C	Steel
Targeted industry 2	Construction	Care International*	Electronics	Co-generation engineering	Poultry	Aluminum
Targeted industry 3	Mfg skills certification*	Engines & hydraulics	Computers		Welding*	Rail
Targeted industry 4	IT**		Biogenetic engineering & farming*		Sprinklers	Livestock
Targeted industry 5			Pharmaceuticals			Bennet Box

Piedmont Triad

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College	Alamance	Davidson	Forsyth	Guilford Tech	Montgomery
County	Alamance	Davidson	Forsyth	Guilford	Montgomery
Region	Piedmont Triad	Piedmont Triad	Piedmont Triad	Piedmont Triad	Piedmont Triad
Service area	Alamance	Davidson, Davie	Forsyth, Stokes	Guilford	Montgomery
1) Current areas of training expertise	Biotech, Leadership 2000 certif, Industrial tech division	Plastics, Public safety services, IT	Allied health, Construction trades	Trans tech, Culinary tech, Chemical tech	
2) Training centers for specific industries		Fire & rescue training program for 6 CCs; Criminal justice ctr for 8 CCs; Smart Start child care; IT	Dept of Networking Administration & Support; CISCO Systems	Ford outreach program -contractual, self-supporting	
3) Specialized resources which the college offers	CNC machine capability; Lab instrument training; Leadership training	Plastics - equip & resources; Tool, die & moldmaking - equip & resources; Public safety training - training facilities; Computer tech - resources & CISCO lab	Info Systems - CISCO labs; Radiography - imaging labs; Medical & cardiovascular sonography - lab; Nuclear med - lab; Radiation therapy tech - lab; Respiratory care - lab; Heavy equip & trans tech - Volvo trucks; Auto systems - race car engine & fabrication shops	Trans tech - mfg partners, equip	IP Video; NCIH
4) Outside resources utilized by the college	Medical lab - LabCorp; Impact training - Raleigh; NC State Ext services - Greensboro; PT Cam - Greensboro; HRD - Greensboro; BI training ctr - Raleigh	Labs - industry plants; Facilities - public safety agencies; Equip - mold-making industry plants	Hospitals & healthcare facilities	CNC machining classes - Piedmont Triad Ctr for Advanced Mfg	Mfg training - Hosiery Ctr/Catawba Valley CC Hosiery Ctr
5) Industry partnerships for education programs	Medical - LabCorp; Construction - Home Builders' Assoc; Biotech - Proctor & Gamble; ISO 9000 - injectronics; Safety - Glen Raven Mills; Machine operator training - industry partners; SPC - plastics companies; Spanish - workplace programs	Plastics & tool/die/moldmaking - area plastics mfg, Society of Plastics Engineers	Info Systems - Cisco Systems,IBM,Microsoft,Novell; Construction Trades - Carolinas Association of General Contractors; Graphic Arts & Imaging - Print Industry Council of America; Architectural Tech - American Institute of Architects, Heath Tech - 3 area hospitals	Chemical process tech - LEA, NC labor, local chem companies	Industrial training - Stanly CC; Plant maintenance personnel training - Jordan Lumber
6) Capacity to research economic development	Campus statistician conducts surveys & special studies	Institutional research office - surveying & strategic economic dev w/ Davidson Co	Office of Environ Research - survey students & community	Limited research by Business & Industry division	
7) Collaboration with other educational institutions	Lowes Foods program - 3 CCs; Pander Correctional Institution program - 1 CC; Parker-Hannifin program - 1 CC; Ametek - 1 CC	Public safety services - 12 CCs; Paralegal - 4 CCs; Computer tech - 1 CC; Allied health - 3 CCs; Auto - 2 CCs	Emergency med services - Guilford CC; Radiography - Catawba Valley, Wilkes CCs; Early childhood education, Business administration & accounting, Info systems - Winston-Salem Univ	IT program - UNCG, WSSU, Bennett & Greensboro CCs	Water pollution control - Mayland CC
Targeted industry 1	Biotech	Plastics	IT	IT	Hosiery
Targeted industry 2	Textile	Public safety	Heavy equip & trans tech	Trans tech	Wood products
Targeted industry 3	Carpentry	IT	Construction trades	Chemicals mfg	Furniture*

Appendix C:

Summary of Focus Group of Statewide Experts to Identify Emerging Industry Clusters for each Economic Development Partnership Region, 5/25/00

In attendance:
Project personnel: Leslie Stewart, Michael Luger, and Lucy Gorham (Office of Economic Development), and Stu Rosenfeld (Regional Technology Strategies, Inc.).
Department of Commerce: Doug Byrd, Jim Nichols, Keith Henry, Jonathan Morgan.
NC Rural Economic Development Center: Chris Beacham.
Industrial Extension: Bob Edwards.
SBTDC: Scott Daugherty and Virginia Hopley
NCCCS: Scott Ralls.

The group was asked to focus on three questions in thinking about emerging industry clusters:

- What kind of industry clusters does the state need to strengthen from a strategic standpoint?
- What higher training needs should be addressed?
- Where geographically does this need to happen?

Stu Rosenfeld added that in today's reconfigured industries, workforce skills that are derived in the context of a specific industry are everything. Without the industry context, skills are not as highly valued by firms.

The group began by discussing emerging industry clusters in each region.

Advantage West:

AW has both a traditional side, as reflected in the inclusion of transportation and metalworking, and an Information Technology side that is newly emerging. While there is no auto assembly in the state, there are 250 auto suppliers that cluster from the Triangle west and that are in just-in-time distance of every auto assembly plant established within recent years. The only negative with a focus on this industry is that it is consolidating and there is likely to be some fallout along the way.

Automotive supply related to metalworking predominates -- e.g. clutch and bearing manufacturers. There is a circle of plants that stretches from Hendersonville to Catawba to Charlotte, related to Greenville/Spartanburg auto cluster.

In the area of Plastics, there is a concentration in Rutherford County that is longstanding and that is tied to pharmaceuticals, furniture, and some auto. This area is also starting to develop composites and advanced materials.

Retirement was identified as an industry missing from the list, particularly in the Brevard area. Medical should also be in the emerging list -- tied to serving the existing population, rather than an export industry.

Natural gas is a big issue -- in some areas five times as expensive as in the east so difficult to site large plants if they need natural gas.

In terms of a location of any center or hub, should be centrally located. Gave the example of losing a project to SC because of a welding center. Any center needs to be easily accessible. There is a dire need for qualified welders in the state, as well as for tool and die makers.

They think of AW in terms of three subregions: West of the Balsams where there is an IT cluster for six counties; Ashville area; and the area around Murphy. In Ashe County, there is a small cluster of metals firms growing and they want a center in Ashe County.

In terms of existing services, Scott Daugherty of SBTDC mentioned that they don't have staff who specialize in particular industry clusters, instead focusing on fast-growing firms within any industry and on management issues. He raised the question of whether we focus only on emerging industries while leaving the declining industries in the dust. This is a political question. He added that it would be helpful to have the state develop a more universal set of industries on which to focus diverse services to enable greater coordination.

Bob Edwards of Industrial Extension said that they were going through a reorganization of sorts. Their existing staff expertise included Plastics in Charlotte, PTCAM in Greensboro, and Metalworking in Raleigh.

Charlotte Region:

Jim Nichols noted that it is difficult to choose just 2 or 3 industries in this area. There is big presence of Corning and related companies. In Catawba and Cabarrus counties, a big demand for technicians to splice fiber cable. Also need engineering programs through a virtual environment.

Other important clusters include metalworking, e-commerce and financial services/IT (mentioned TIAA Kreff specifically), the Polymers Center, Automotive supply, and NASXAR/Motorsports/tourism. Noted that the Cameron Center may be a model for serving a variety of industries in this region.

In response to a question about training needs in these clusters, Scott Ralls mentioned the need for fiber optics training in three different geographic areas: Hickory, Concord, and Wilmington. Hickory is talking about a Telecommunications College that would tie in more advanced levels of engineering to production. It has more of a

university as opposed to CC focus at present. The center in Sanford is more service-related as opposed to manufacturing related. Sanford also has a photonics/laser program.

Piedmont Triad:

This is a region of tremendous change -- decline or consolidation of traditional industries at the same time as emergence of new industries. In terms of the logistics industry, it was suggested that a center with this as a focus should tie together the Triad and GTP.

Around the metals cluster, there is PTCAM. There have been continuing politics around its relationship to the CC system. Every year there are problems with the center's budget though NC A&T and the willingness of the state to fund it. But when the proposal is made to fund it through NCCCS, A&T resists.

Biotechnology has a presence in Winston-Salem in particular through new Piedmont Triad Research Park downtown. It is tied to Bowman Gray Medical School and is potentially a good target for the region but right now is a bit of a stretch.

IT could be tied to logistics to give it more of a focus. Also tie to RF Micro Devices.

Furniture -- potential but question how interested the industry would be -- see the industry as craft-based, not sure how training would be viewed.

Triangle:

Emerging clusters: IT and Biotech. Impact extends into Franklin, Granville, and Person Counties. The Biotech Center doesn't do any training but works closely with the NCCCS to determine training needs. They are building an incubator that could tie into this. The bulk of biotech is east of the Triangle proper when you get to the production/pharmaceutical side, and R & D side is more in the Triangle. One could move a center east to be more centrally located. Jim Nichols suggested locating it between the Triangle and the Certified Goods Manufacturer (?) training (required by FDA for pharmaceutical manufacturers).

Add to the list: Electronics should be listed separately from IT.

Global Transpark, Southeast, and Northeast:

Boat building has some presence in GTP, but is perhaps stronger in the NE. Emerging cluster in GTP is logistics/call center operations/IT combined. Also value-added food processing, including specialty meat processing. Currently can't process all the hogs that the state produces so must ship some out of state -- state loses the value added from that.

In the NE, boat building is an emerging cluster, also automotive/metals tied to Newport News. Nucor has spawned a growing agglomeration of metalworking firms.

Military institutions tend to agglomerate call centers because of the availability of spouses of military personnel for employment -- Fayetteville, Goldsboro, and Jacksonville.

In general:

"Automotive" is hard to define -- lots of skill sets involved, but could benefit from a cluster center in the future. No assembly plants right now [although there is a Freightliner truck assembly plant in the Charlotte region]. Same applies to semiconductors. Would be useful to build a more general facility that could be used by an auto assembly plant if one were to located in NC. Could be focused on trucks, motorcycles, boat building, etc.

For hospitals, labs, and specialty medical services, a survey of the industry is needed to determine whether there are training needs and, if so, where.

APPENDIX D: Industry Clusters by Region

Advantage West Region

Major Industry Clusters Identified for Each Economic Development Partnership Region

Industries Identified by Feser Cluster Analysis	Industries Identified by Community Colleges, 5/00		Industries Identified by Partnerships	Industries Identified by Focus Group of State Officials
[Vision 2030 project, '98 ES202 data] declining employment between 1989 and 1998*	*In no priority order. Parentheses note number of CCs that listed the industry. Asterisk notes industries CCs hope to work with soon.*			
Largest:	Metal Machining (2)	Electronics (2)	Plastics	Auto Parts Manufacturing
Apparel*	Information Technology	Autos/Heavy Equipment (2)	Automotive Components	Metalworking
Printing, Publishing	Printing	Recreational Vehicles	Medical Technology Mfg.	Plastics
Hospitals, Labs, Medical Serv.	Polymers	Textiles (2)	Metalworking	Retirement
Wood Products*	Plastics	Furniture	Composites	Information Technology
Regional Specializations	Forestry	Food Products	Printing, Publishing	Other needs: welders, tool and die makers.
Apparel*	Healthcare	Horticulture	Software Developers	
Wood Products*	Computer Software Dev.	Culinary Arts, Technology		
Fabricated Textiles*	Internet Service	Tourism/Resort Mgt.		
Leather Goods*	E-Commerce	Wine-Making		
Chemicals, Plastics	Telecommunications	Distribution/Logistics		
Motor Vehicle Mfg.	Computer Networks	Marble, Granite*		
Construction Materials				
Emerging				
Transportation Equipment				
Metals, Metalworking				
Plastics				
Instruments				

AW Existing Resources for Clusters:

Asheville-Buncombe Technical CC (plastics, metalworking); Western NC Plastics Technology Training Partnership; (Future) Mountain Resource Center - Regional Technology Center (advanced manufacturing)

Research Triangle Region

Major Industry Clusters Identified for Each Economic Development Partnership Region

Industries Identified by Feser Cluster Analysis	Industries Identified by Community Colleges, 5/00		Industries Identified by Partnerships	Industries Identified by Focus Group of State Officials
[Vision 2030 project, '98 ES202 data] declining employment between 1989 and 1998*	*In no priority order. Parentheses note number of CCs that listed the industry. Asterisk notes industries CCs hope to work with soon.*			
Largest	Telecommunications	Landscaping	Information Technology	IT/Telecommunications
Printing, Publishing	BioProcessing	Biotechnology	Biotechnology	Biotechnology
Hospitals, Labs, Medical Serv.	Laser-Photonics	Plastics Technology	Hospitals, Medical Serv.	Electronics
IT/Instruments	Metals Technology	Electronics		
Regional Specializations	Pharmaceuticals	Electronic Control Tech		
Tobacco Products*	Environmental	Business Operations/Logistics		
IT/Instruments	Retail	Cooking Technology		
Apparel*	Golf Course Mgt.			
Hospitals, Labs, Medical Serv.				
Emerging				
Printing, Publishing				
Legal Services				
Wood Products				
Chemicals, Plastics				

Research Triangle Existing Resources for Clusters:

Biotech Center; Textile Technology Corp; MCNC; MEP/NC State; UNC-CH; Duke; First Flight Venture Center; SBTDC Headquarters; NC Technology Dev. Authority; Council for Entrepreneurial Development; Piedmont CC: Business Dev. Center (Person County); Johnston CC: Plastics Tech. Consortium; Vance-Granville CC: Biotech lab; Central Carolina CC: NC Telecomm. Center and Laser

Southeast Region

Major Industry Clusters Identified for Each Economic Development Partnership Region

Industries Identified by Feser Cluster Analysis	Industries Identified by Community Colleges, 5/00		Industries Identified by Partnerships	Industries Identified by Focus Group of State Officials
[Vision 2030 project, '98 ES202 data] declining employment between 1989 and 1998*	*In no priority order. Parentheses note number of CCs that listed the industry. Asterisk notes industries CCs hope to work with soon.*			
Largest	Boat Building	Livestock (2)	Warehousing/Distribution	Call Centers
Paper, Printing, Publishing	Plastics	Glass (Plate Glass Mfg.)	Boat Building/Marine	Boat Building/Marine
Apparel*	Manufacturing	Automotive Parts Mfg.	Plastics	
Hospitals, Labs, Medical Serv.	Services	Railroading (CSX Center)	Wood Products	
Chemicals, Plastics	Business	Textile Mfg. Controls	Automotive Components	
Fabricated Textiles*	Medical	Electronics	Poultry Industry Supply	
Regional Specializations	Engineering	Pharmaceuticals	Military-Related	
Packaged Food Products	Computers (2)	Beverages*		
Chemicals, Plastics	Health Services	Biogenetic Engineering*		
Apparel*	Education	Telecommunications		
Fabricated Textiles*				
Clay Products, Stone				
Wood Products, Furniture*				
Emerging				
Hospitals, Labs, Med Serv.				
Securities, Insurance				

SE Existing Resources for Clusters:

Fayetteville State Univ; UNC Wilmington (esp. Center for Marine Science);
Brunswick CC: Aquaculture at UNC-W and Plastic injection molding with NCSU Polymer Center

Northeast Region

Major Industry Clusters Identified for Each Economic Development Partnership Region

Industries Identified by Feser Cluster Analysis	Industries Identified by Community Colleges, 5/00		Industries Identified by Partnerships	Industries Identified by Focus Group of State Officials
[Vision 2030 project, '98 ES202 data] declining employment between 1989 and 1998*	*In no priority order. Parentheses note number of CCs that listed the industry. Asterisk notes industries CCs hope to work with soon.*			
Largest	Agricultural Equipment	Rail	Boatbuilding/Repair	Boatbuilding
Paper, Printing, Publishing	Engines, Hydraulics	Livestock (2)	Metal Fabrication	Automotive/Metals
Chemicals, Plastics	Wood Products	Transportation/Heavy Equip.	Automobile Suppliers	Metalworking (Nucor)
Apparel*	Co-Generation Engineering	Fiberglass Boatbuilding	Aviation Technologies	Call Centers
Hospitals, Labs, Medical Serv.	A/C, Refrigeration	Construction	General Engineering/Design	
Packaged Food Processing	Poultry	Mfg. Skills Certification	(Plastics Injection Molding)	
Regional Specializations	Sprinklers	Biogenetic Engineering		
Packaged Food Products	Steel	Pharmaceuticals		
Chemicals, Plastics	Pulp, Paper	Computers		
Apparel*	Aluminum	Electronics		
Fabricated Textiles	Welding*			
Clay Products, Stone				
Wood Products, Furniture*				
Canned/Bottled Beverages				
Emerging				
Motor Vehicles, Related Industries				
Securities, Insurance				

NE Existing Resources for Clusters:

Elizabeth City State University: Technology Center; Martin CC: Poultry Industry (Refrigeration, Processing);
Beaufort CC: Heavy Equipment & Transportation Technology, Agricultural Systems, and Industrial Technology

Piedmont Triad Region

Major Industry Clusters Identified for Each Economic Development Partnership Region

Industries Identified by Feser Cluster Analysis	Industries Identified by Community Colleges, 5/00		Industries Identified by Partnerships	Industries Identified by Focus Group of State Officials
[Vision 2030 project, '98 ES202 data] declining employment between 1989 and 1998*	*In no priority order. Parentheses note number of CCs that listed the industry. Asterisk notes industries CCs hope to work with soon.*			
Largest	Textiles/Apparel (2)	Chemicals Manufacturing	Information Technology	Metals
Knitted Goods, Apparel*	Carpentry/Construction (2)	Hosiery	Electronics Manufacturing	Biotechnology
Paper, Printing, Publishing	Environmental Sciences	Wood Products	(cell phones, wafers)	Information Technology
Hospitals, Labs, Medical Serv.	Tourism	Metal Casting	Logistics	Furniture
Fabricated Textiles*	Deaf Interpretation	Wine-Making		
Metalworking/Industrial Mach.	Networking	Logistics		
Regional Specializations	Plastics	Furniture		
Knitted Goods/Textiles*	Public Safety	Hospitals, Health Care		
Tobacco Products*	Information Technology (3)	Automotive/Race Car		
Construction Materials	Transportation Technology (3)	Furniture*		
Wood Products, Furniture*	E-Commerce*	Commercial Printing*		
Canned/Bottled Beverages				
Emerging				
Chemicals, Plastics				
Paper, Printing, Publishing				

Piedmont Existing Resources for Clusters:

Piedmont Triad Center for Advanced Mfg. (PTCAM) w/ Wake Forest, NC A&T, UNCG, WSSU; Blue Ridge CC: Environmental Training Center

Global Transpark Region

Major Industry Clusters Identified for Each Economic Development Partnership Region

Industries Identified by Feser Cluster Analysis	Industries Identified by Community Colleges, 5/00		Industries Identified by Partnerships	Industries Identified by Focus Group of State Officials
[Vision 2030 project, '98 ES202 data] declining employment between 1989 and 1998*	*In no priority order. Parentheses note number of CCs that listed the industry. Asterisk notes industries CCs hope to work with soon.*			
Largest	Boat Building/Lamination (2)	Transportation/Diesel Tech. (2)	Pharmaceuticals/Med. Products	Logistics/Call Centers/IT
Printing, Publishing	Seafood Products	Aquaculture	Auto Parts/Metal Fabrication	Value-Added Food Processing
Hospitals, Labs, Medical Serv.	Tourism	Construction Trades (3)	Marine Equipment	Some Boatbuilding
Metalworking/Industrial Machinery	Technology Training	Food (2)	Clean Room Industries: Plastics,	
Apparel*	Call Centers (2)	Industrial Maintenance	Electronics	
Packaged Food Products	Total Quality Management	Health Care (2)		
Regional Specializations	Welding	Manufacturing (2)		
Tobacco Products	Utilities	Logistics		
Apparel*	Pharmaceuticals	Synthetic Fibers		
Clay Products, Stone	Machining (3)	Metalworking		
Packaged Food Products	Education	Banking/Finance		
Canned/Bottled Beverages	Distribution	Service		
Fabricated Textiles*	Computers (2)	Plastics Manufacturing*		
Emerging	Plastics (2)			
Construction Materials				

GTP Existing Resources for Clusters:

East Carolina Univ: East Carolina Technology Center; Wayne CC: Airframe mechanics, Forestry, Machining and Welding; NC Aquaculture Incubator, Logistics Training Center at GTP; Coastal Carolina CC: E-Commerce & customer service support centers, boat trades; Nash CC: Business and Industry Center; Global Logistics Technology and Education Program

Charlotte Region

Major Industry Clusters Identified for Each Economic Development Partnership Region

Industries Identified by Feser Cluster Analysis	Industries Identified by Community Colleges, 5/00		Industries Identified by Partnerships	Industries Identified by Focus Group of State Officials
[Vision 2030 project, '98 ES202 data] declining employment between 1989 and 1998*	*In no priority order. Parentheses note number of CCs that listed the industry. Asterisk notes industries CCs hope to work with soon.*			
Largest:	Metal Machining (2)	Industrial Tech./Maintenance (2)	Plastics	Auto Parts Manufacturing
Printing, Publishing	Fiber Optic Cable Mfg.	Nursing	Automotive Manufacturing	Fiber Cable Mfg./Splicing
Apparel*	Furniture	Building Technology	Biotechnology	Metalworking
Hospitals, Labs, Medical Serv.	Hosiery	Law Enforcement	Fiber Optics	Financial Services
Metalworking, Industrial Mach.	Coaxial Cable Mfg.	Construction	Plastics	E-Commerce/IT
Fabricated Textiles*	Information Technology (4)	Motorsports	IT, including Mfg.	Polymers
Banking, Advertising	Transportation Technology	Health Care	Financial Services:	Auto Supply/Metalworking
Motor Vehicles Mfg.	Criminal Justice	Machining	- Insurance HQ	NASCAR/Tourism
Regional Specializations	Welding (2)	Computer Technology	- Banking	
Tobacco Products	Flexography	Child Care	- Call Centers	
Apparel*	Metalworking (2)	Foam Manufacturing*		
Fabricated Textiles*	Auto Supply	E-Commerce*		
Wood Products	Textiles	Telecommunications*		
Motor Vehicles Mfg.	Public Education	Agriculture*		
Banking, Advertising	Plastics	Aircraft Tires*		
Emerging	Lumber*	Auto Textiles*		
Construction Materials				
Clay Products, Stone				
IT/Instruments				
Securities, Insurance				

Charlotte Region Existing Resources for Clusters:

UNC-C Cameron Applied Research Center: Biomedical engineering, Biotechnology, Electronics, Robotics, and IT; Central Piedmont CC: CAD/CAM Center and Engineering Technology Division (Printing, Advanced Manufacturing, Transportation Technology); Polymers Center of Excellence; Ben Craig Center (high-tech incubator); Catawba Valley CC: Furniture Center, Hosiery Center, and Bobby Isaac Motorsports Tech Program; NC Center for Applied Textile Technology

Appendix E

Community Colleges and Industry Training Centers: What Can We Learn from the Experience of Existing Programs?

In this appendix, we present lessons from our review of seventeen existing industry cluster, technology, and modernization programs. The first three cases are industry cluster centers, followed by nine other technology/modernization centers, and five additional centers located in North Carolina. A list of these programs follows:

Cluster Centers:

- Alabama Southern Community College Center for Forestry, Paper, and Chemical Technology
- Catawba Valley Community College (North Carolina)
- Itawamba Community College (Mississippi)

Other Technology/Modernization Centers:

- Bevill Manufacturing Technology Center (Alabama)
- Grand Rapids Community College (Michigan)
- Hagerstown Community College (Maryland)
- Springfield Community College (Massachusetts)
- Oregon Advanced Technology Center
- Oklahoma State University -- Technical Branch at Okmulgee
- Cuyahoga Community College (Ohio)
- Haywood Community College (North Carolina)
- Macomb Community College (Michigan)

Additional North Carolina Centers:

- North Carolina Center for Applied Textile Technology
- Piedmont Triad Center for Advanced Manufacturing
- North Carolina Hosiery Technology Center
- North Carolina Biotechnology Center
- Telecommunications Center at Sanford (Central Carolina Community College)

Profiles of several of the North Carolina centers are included in Appendix F.

General Observations

Here we include a discussion of some of the more general lessons that have been taken from the experience of these existing centers. A summary of this discussion is included as a list of principles for establishing cluster centers in the second chapter of this report.

The Importance of Vision

Nearly every successful program has been dependent on a visionary and resourceful leader who has been able to build support both inside and outside the college and also raise funds. With respect to modernization, some of the leadership has come from people with considerable industry experience. In other instances, it has been an educator who has recognized the potential value of closer ties to industry. In still other cases, it was someone from the public sector. Colleges also learned a great deal from each other. Colleges planning technology or cluster centers visited the early pioneers who created and operated the first technology centers.

Defining the Center's Mission

With the advent of computer based learning technologies, the need to have hands-on equipment training outside of the workplace is mitigated. "If we build it they will come" has not worked successfully for most community colleges. First, the tasks of raising money for the center and administrating the actual design and building process are often all-consuming for institutions. Attention to construction narrowly focuses the local community college leadership on getting the building done, and diverts them from the equally important task of insuring that what gets done has a strong set of customers who are really going to use the facility, etc. Often the industry participation in the actual construction of the center is more rhetorical than real. The result is that a fine building is completed, but it is unclear as to who are the customers to be served. Some of the best centers are really hybrid ones which have some private industry support, but also fulfill institutional missions of the colleges (i.e. need of classroom space, place to put a college facility such as restaurant etc.). Many sustain themselves by renting out space to vendors for training or offices for professional and trade associations. Stand alone, dedicated facilities are very difficult to economically justify and sustain by community colleges.

Also, many community colleges have developed advanced technology centers in order to promote careers in manufacturing. The colleges are convinced by the industry that the "reason" people are not entering a particular industry is because it is not perceived as attractive and rewarding. The building of a technology center, it is argued, will aid in the development of this new approach. Many times this view is articulated from one forceful industry leader or one particular firm. The center then becomes a marketing tool to attract new students to the industry and to the institution. This may be a sufficient basis to justify the cost of creating a new facility, but it more often than not is insufficient in the long run to sustain interest. Often when the original champion retires or the company changes hands, the enthusiasm and support for the effort wanes. The community college is then stuck with a building without a mission or a champion.

Designing the Center's Structure

Every college aspiring to become a full-fledged industry center is faced with some basic decisions about relationships to colleges, administration and governance, the degree of

concentration of any specific or groups of industries or technologies, and the extent of its autonomy or form of it links to existing academic programs and to other related organizations.

Many new technologies require an underpinning of strong theoretical skills, which argues for a close relationship between technology centers and academic programs. At the same time, technology programs try to distance themselves from bureaucratic structures so that they can have more flexibility in hiring and compensating staff, generating revenues, and marketing services, as well as more freedom from the bureaucracy that stifles innovation in public institutions. In addition to bureaucracy, the following obstacles to modernization efforts were cited by respondents to a survey of technology or industry center personnel:

- Problems associated with operating as a business within the infrastructure of a college;
- FTE process is detrimental to all types of outreach;
- Guidelines are too inflexible;
- State mandates restrict the use of company employees as trainers;
- Modernization is not yet part of the college's mission;
- Funding from the state is heavily weighted to college credit, while companies want non-credit training.

Not surprisingly, competing pressures within a center for both independence and close ties to the core college curriculum have been and remain a source of tension in many places. The more centers align themselves with other agencies or other educational institutions, the more they are apt to gain autonomy. Colleges' need for and ability to acquire independence depends largely on how well modernization matches the mission of the college, the interests and philosophy of the president, and the state's regulations.

Relationships with the Industry Cluster

Most centers realize that they depend on industry to (1) use the center for training of employees; (2) provide regular information about the skills and knowledge that they want their employees to have; (3) advise the center on changing technologies and methods; and (4) suggest what equipment and what services are needed to best meet their needs. The challenge is to define their responsibilities and engage businesses in ways that are useful and valuable to them.

Colleges tend to develop programs, services, or centers with the expectation that businesses will flock to them. Nearly all colleges use advisory groups of businesses, but too few involve them early enough to influence design and investments, even fewer treat them as full partners. Advisors are quite different from partners. The latter has a vested interest in the success of the center. Yet few centers have been willing to share control and too few business associations are willing to invest the time and make the commitment. The board of the center ought to have a majority of members from the cluster. This distinction is important because it signifies the difference between business *interest* and business *ownership.* These board members from industry should include representatives from small and medium-sized firms, as well as large ones. In the case where small and medium-sized firms lack an industry association, the center should consider being the catalyst for forming such an association to be part of its mission.

Colleges need to develop true partnerships, as contrasted with advisory boards with no real authority, and to find new ways to work with businesses on more intimate and even terms than in the past. In return, businesses need to accept the fact that they are part of a regional economy in which their prosperity depends in part on the competencies of other firms, and to consider the social good as well as their own.

Lastly, college centers that are successful also don't wait for cluster firms to find them -- they aggressively market their services. The effectiveness of their efforts is largely a function of how well they reach their region's industrial base.

Designing a Cluster Center Versus a Technology Center

Most of the experiences of community colleges are with technology centers, not cluster centers, and they are not the same. This distinction is important to the design and expectations. The technologies drive the former and the industry drives the latter. Most centers in the US have been technology centers catalyzed by vendors of technologies, not users. The primary focus of the technology center is to teach students to understand and use advanced technologies and to acquaint local companies with the products; the cluster context is less important.

In a cluster center, by contrast, context is everything. The use of technologies is framed in the context of problems associated with an industry. Students are expected to have a broader understanding of the industry, as in the original intent of “all aspects of the industry” in Perkins. The cluster center becomes an applied setting for teaching skills across disciplines. A cluster center addresses the common concern of employers that students may have technical skills but have no "business savvy.” A cluster center should encompass more than the technical programs but should find ways to introduce the cluster into non-technical programs. It also should be a repository of information and knowledge about and for the industry so that the cluster begins to view it as a valued resource. That information should include sources of education and training that complement or supplement what the college has to offer.

The Issue of Financial Self-Sufficiency:

In general, when community colleges have constructed technology centers as separate stand alone entrepreneurial efforts, they normally fail to be fiscally sustaining. The initial capital costs, and the continual need to update equipment, almost always exceed the revenue generated by new training classes and industry use. This is not surprising in a period when there are many competitive sources for education and training and, in most manufacturing industries, a shrinkage of new job growth.

Also, project developers and funders probably should neither expect nor want financial self-sufficiency as a goal because it reduces the services of the center to its lowest common denominator, i.e., doing only what businesses are willing to pay for. This is not to argue that the needs of business are not paramount. Instead, it recognizes the fact that firms may not be in a position to focus on anything other than short-term objectives. When achieving short-term

business objectives becomes the sole mission of a center, it loses the ability to act as a catalyst for advances that can't be immediately justified on an income statement but that may have large future payoffs for the cluster and for the region. If the center is in the public interest and for the public as well as the customer's good, the public ought to share in the cost. On the other hand, to keep the center relevant and accountable to the industry, customers ought to pay a reasonable share.

Resources and Funding Formulas

A common complaint among colleges is that state funding formulas limit their ability to serve small and medium-sized manufacturers and to carry out non-traditional service activities. For example, in some states the funding of community colleges is based on a full-time equivalent (FTE) formula and the state requires a minimum number of students per instructor. These requirements limit the ability of colleges to serve industries or firms where small-group instruction is needed or where the skills needed can be taught in a much shorter period than the typical college credit program. A different approach needs to be used if industry training centers are expected to provide training that goes beyond the typical classroom model.

Staffing

The building of the structure and even the accumulation of "state of the art" technology often obscures a more fundamental issue, i.e. the need for technically trained faculty. Finding, recruiting, and retaining qualified staff is one of the biggest issues that centers face. Faculty must be able to provide the teaching leadership within these technologies, and moreover, understand how they are implemented within the specific targeted industries. You can be an instructor of Computer Aided Design (CAD), but not know how CAD is utilized within the auto supplier community. If the center services these groups of firms, this is vital information that should shape its programming.

An additional issue is that, not only are the faculty often not "up to date" in their technical proficiency, they also lack the knowledge of modern teaching methods so they can successfully utilize them in their new environment. They do not apply new principles of curriculum integration, and do not use the modern learning technologies (distance learning, etc.) that are often found within the new facility. Instead, they view the specialized new equipment as a set for a giant new laboratory for "hands-on" applications. They tinker and play with CIM Cells and other activities, while students need basic hands-on work with equipment that is not as specialized.

Another staffing problem is the failure to give faculty the time and resources to update their own knowledge of the cluster. They rarely have funds to visit other cluster centers or schools that specialize in the same cluster. The colleges that have programs for the chemical processing industry, with the support of the American Chemical Society, have such a network.

Lastly, recruiting people with cluster experience who are known and trusted by the members of the cluster may mean competing with industry salaries. College pay scales are well

below consulting rates and industrial wages. Unless the college can find a way to get around or supplement state pay scales, it must rely on retired industry managers or less experienced and capable staff. Any current constraints on salaries in the North Carolina system need to be understood so that this problem can be avoided.

Choosing and Maintaining Equipment

There is always a tension within these centers between the demonstration of the "state of the art" equipment and the utilization of less sophisticated, but more useful, teaching equipment that can introduce students to the technical training needs of the industry. It requires a strong administration, closely connected with the private sector, to insure that real equipment is used for real training.

Many centers also fail to provide adequate funds for regular updating and maintenance of the present equipment that is placed within the center. The shelf life of "state of the art" equipment is rather short, and without regular funds expended to maintain and expand the equipment base, it rapidly deteriorates. In addition, there is the problem of equipment selection. If an industry being served has many different vendors, the centers must maintain a diverse number of machines or equipment, complicating maintenance and updating issues. These are often resolved in one of two ways. First, many centers become training centers of one particular equipment vendor—so that the vendor continually upgrades and expands the equipment. But the center is then really under the control of the vendor and their willingness to provide updates. The second path often followed is company donations of equipment. This can be very irregular, and the equipment given may or may not fit the needs of the particular learning center. Sometimes companies give away equipment that they do not find attractive or equipment that literally cannot work well. As with the first option, the result for the community college is that the equipment may not suit the needs or the mission of the center.

Turfism within and among Organizations

Two forms of turfism and competition hamper colleges' efforts to work with industry. One is internal to the institution and is between the academic faculty and the center program staff. This competition often results from the higher salaries that are needed to attract qualified technical applicants, or from perceived competition for limited resources between academic and industry training programs. When college faculty view the center as a means to bring in new funding and an additional resource that they can benefit directly from, this problem can be avoided.

The second form of competition is among colleges and between colleges and other modernizing institutions or private consulting companies. Colleges compete for both enrollments and fees from customers and, where more than one institution offers the same program, some kind of agreement must be reached. In most states, colleges must take care not to use public subsidies to undercut the prices for consultants. Successful programs either charge market prices or use their early state assistance to increase demand for private consultants' assistance in implementation.

The way that a college interacts, or fails to interact, with other modernization services, other colleges, non-profit community organizations, and development or research organizations is a strong indicator of effectiveness.

Lack of Recognition by Industry of the Value of an Associate Degree

Graduates of specialized industry training centers often face the disappointment of learning that, when they become employed in the industry, their salaries are no higher than high school graduates. Unfortunately, many industries across the country do not recognize the value of having more technically trained employees. Not only is this discouraging for students and for colleges, it also reflects a lack of an appreciation of the role that better-trained students can play in upgrading the flexibility of the industry. Unless an industry is willing to put a monetary value on training through increased wages, it is difficult to argue that it will maintain a strong commitment to the goals of a specialized training center.

Achieving Diversity

For the most part, colleges are making some effort to identify and enroll minority and female students, some such as Alabama Southern quite successfully. However, most centers have not been very successful at attracting and training underrepresented populations and business has remained largely indifferent. In some cases where there has been an effort, it has stemmed from a genuine concern about improving opportunities for underrepresented populations. In many others, the impetus is financial -- the opportunity to build enrollments and, therefore, funding and access to special federal and state equal opportunity programs.

Continuity of Innovative Efforts

Because administrative support is so vital to strong programs, and because the industrial service function of colleges is not universally accepted as a priority, changes in the administration or leadership of the college or the state system can be threatening. A new president or dean who is more oriented toward the liberal arts and college transfer may not be as supportive of a college's role in technology applications and working with industry and, while allowing a program to continue, may not allow or encourage it to aggressively market itself. Unless centers have independent status or independent legislative support, political and administrative changes that take place within the college or system can alter programs before they have had sufficient opportunity to demonstrate their value. Federal and state programs alike are notorious for enthusiastically initiating programs and building capacity and then slowly withdrawing support before results can be demonstrated to businesses or governments.

Lack of Interest Among Youth in Manufacturing Occupations

A common concern virtually everywhere in the U.S. is that the youth best qualified for technical manufacturing occupations are opting for other careers. Despite the opportunities, the extensive publicity campaign to market modern industry, and the white coats worn in some

shops, blue collar work is still viewed by many youth as lower status and less rewarding than other occupations. African American youth, in particular, still view technical education as vocational education designed to direct them away from academic tracks. Many of the available manufacturing jobs are, in fact, still low-wage and low-skill, but at the same time, good production jobs in many regions are unable to attract applicants. In some North Carolina companies, for example, employees are offered bonuses for bringing friends to apply for jobs. This is a particularly vexing problem for colleges and industry.

Despite many efforts, neither colleges nor manufacturers have been able to describe effectively the new forms of manufacturing or to communicate the emerging opportunities to high school counselors and parents -- who still largely perceive industry jobs as low-status and in decline. One answer to this problem being considered both in the United States and abroad is to have four year degree tracks that incorporate an emphasis on technology and the needs of particular industries. The program is attractive to students who wish to obtain a bachelor's degree but also provides industry with a supply of trained personnel.

Visibility and Access

Much of community colleges' training has been directed toward recruitment or cost recovery. The result has been that large companies are the principal customers while small and medium-sized firms have benefited less. Most large plants have some sort of relationship with community colleges, while relationships to small firms are less common.

Appendix F:
Profiles of Selected Existing Resources within North Carolina

This appendix includes information about several existing centers that are either cluster-oriented, community college based, or both:

- Piedmont Triad Center for Advanced Manufacturing
- Hosiery Technology Center
- N.C. Biotechnology Center
- N.C. Center for Applied Textile Technology
- N.C. Telecommunications Center
- Regional High-Technology Center

These existing centers are an important resource for the state, represent models in some cases for ICRCs, and should be included as linked resources, not replicated, in proposed new ICRCs.

Piedmont Triad Center for Advanced Manufacturing

The Piedmont Triad Center in Greensboro provides manufacturing training to prepare students for the metalworking industry. The Center's curriculum is structured in the form of classes at area community colleges and on-site training programs at interested employers' facilities. The Center was founded by NC A&T and is also tied to industry groups through formal agreements and informal relationships. Revenue generated by the Center's programs covers 75-80 percent of expenses; all remaining costs are funded by legislative appropriation.

The majority of the PTCAM Board of Directors comes from North Carolina A&T University. The board has what the director described as a supportive but hands-off approach to the operations of the Center.

The Center was established in 1993 to pursue a "Teaching Factory" concept designed to increase the competitiveness of the metalworking industry in North Carolina. To carry out this purpose, the Center runs a 24,000 square foot "Teaching Factory" in Greensboro. This shared-use manufacturing facility houses PTCAM's administrative offices, demonstration and teaching facilities for state-of-the-market metalworking processes, conference rooms, a multimedia training room, and a computer learning center. Over 1000 visitors have toured the facilities, including prospective metalworking students, industries considering locating in the Piedmont Triad area, and educational awareness and improvement organizations.

The Teaching Factory is equipped with state-of-the-market machinery. PTCAM has negotiated unique equipment manufacturer agreements for current equipment at an affordable cost, allowing the center to utilize equipment for one year and then replace it with updated models. This allows PTCAM to match its training programs with current industry needs and to stay in line with modern equipment technology. PTCAM was originally conceived of as a high-tech R&D center. It has evolved into the training center

that it is to meet the needs of the market. A staff representative called the facility "the state of the market" rather than "state-of-the-art." There currently is little real R&D performed at PTCAM. Industry typically designs its own equipment.

PTCAM currently serves many counties throughout North Carolina. Most of its work is in Alamance, Guilford, Randolph, Rockingham, and six other counties in the region. Primarily, PTCAM provides focused industrial training. County economic development officials find prospects and then seek training help from PTCAM. PTCAM invests considerable resources in curriculum development. According to PTCAM, one advantage it has over community colleges is its greater flexibility. PTCAM is also closer to business than community colleges are. The content of its courses is often similar but the courses can be taught in shorter periods of time. PTCAM also teaches community college instructors. The Center is supported by its ten person FTE staff. PTCAM's instructors come from industry. The typical instructor profile is a machinist or CNC programmer who wants a change in profession and desires to teach. Instructor pay starts at $40,000 with an additional $10-20,000 in bonuses. That compares favorably with what they would have earned on the shop floor. The application engineering staff has the equivalent of a high school diploma and 10-15 years of progressive metalworking experience. The Director has an advanced engineering degree.

PTCAM is committed to providing flexible training for every business in the industry. Its sessions are offered on-site or off-site, in the daytime or evening. The community college curriculum in metalworking has also been designed with flexibility for industry needs. For example, to accommodate particular business's timetables and training priorities, PTCAM has arranged its community colleges in a modular format that can be modified to suit the preferences of individual companies. The teaching staff are Application Engineers with industry experience and solid teaching skills. The Center's courses consistently result in strong Community College test scores and good evaluations from both participants and area metalworking companies. In addition to focused job training, PTCAM teaches entry level training classes over five weeks that is particularly appropriate for displaced and underemployed workers. There is more demand by industry for graduates of this program than there are students.

PTCAM's partners in the field of education are Guilford County Schools, every community college in the Piedmont Triad (Greensboro Technical Community College in particular), and many other community colleges statewide. The NCCCS has recently articulated an agreement with PTCAM to recognize it as a specialized training center. Many industry groups collaborate with the Center as well, including the Industrial Extension Service, the Society of Manufacturing Engineering, the National Tool and Manufacturing Association, the Workforce Investment Council, the Department of Labor, and the Department of Public Instruction.

PTCAM's director, Steve Oneyear, talked about the development of the metalworking industry in the state, particularly in the Triad. Locally, most demand for metalworkers is from heavy equipment manufacturers such as John Deere and Caterpillar. There are also specialized fabricators and general job shops related to the

aerospace, tool and die, and auto industries. The Asheboro area has a concentration of injection molding and tool and die companies. Oneyear did not know much about the Northeast. Generally, employment in metalworking in North Carolina is not unionized, making it much cheaper than in the Northeast United States.

In terms of possible partnerships with PTCAM, Mr. Oneyear felt businesses in the Charlotte region, and the Northeast, where there are clusters of metalworking and related industries, were being well served by the local community colleges, including the one in Gastonia. Nonetheless, Mr. Oneyear saw considerable merit in interregional partnerships. He has not pursued them due to a lack of funding for any such innovative activity. One economy that he noted would be to move specialized equipment from site to site for different training classes, eliminating the need for each site to acquire its own equipment. Another large economy could be realized by the development of distance learning courses. That also has not been developed due to a lack of funding.

PTCAM has relatively little interaction with economic development partnerships for the North Carolina Department of Commerce. It does work cooperatively with the Manufacturing Extension Program (MEP). In fact, two MEP engineers have offices in the PTCAM building. They and PTCAM staff cross refer each other. They also co-sponsor and co-fund the stereolithography program that also has NIST funding. PTCAM networks with similar centers around the country. The strongest connection is with the National Institute of Flexible Manufacturing located in Meadville, Pennsylvania. That Institute served as a model when PTCAM was begun. PTCAM administers a test developed by the National Institute of Metallurgy to students for certification.

The Center's value is best affirmed by its successful track record in the Piedmont Triad Area. PTCAM is known throughout the Piedmont Triad's metalworking industry as a successful pioneer in providing unique metalworking training services. PTCAM has founded its training programs on the premise that companies have varied needs, and that these needs cannot always be met with pre-defined curriculum. PTCAM is also focused on the short-term as well as long-term workforce needs of the metalworking industry. As a result, PTCAM is actively involved in assisting high school as well as two and four year degree students in obtaining the necessary skills to succeed in the metalworking industry. PTCAM has been recognized nationally in Fortune Magazine and in numerous other articles on a local and statewide basis.

Last year 80 percent of PTCAM's budget was self-generated. The state provided $250,000. To keep its doors open PTCAM must concentrate on bread and butter activities. There is no latitude for loss leaders. Besides payment from industry for focused training, PTCAM takes on small projects for industry. For example, it will fabricate some parts that industry is not interested in fabricating, at least until the process is routinized.

Under contract, PTCAM will also go into shops that are not computerized and convert their manual operations into processes that are numerically controlled. It also sells time to metalworking businesses on its stereolithography machine. That machine is

used to create prototypes of various parts. Businesses are charged $55 an hour and one part may require 6 to 8 hours of machine time. Companies also can become members of the Stereolithography Center and then use the equipment for $30 an hour. The metalworking industry to date has contributed $2 million to PTCAM in financial and like-kind support. Many industry leaders continually donate their valuable time to PTCAM and the metalworking industry in order to ensure that North Carolina continues to be a strong metalworking state and a leader in workforce development.

North Carolina Hosiery Technology Center

Despite the high concentration of hosiery firms in North Carolina, that industry has been viewed widely as low-tech and, therefore, endangered. Catawba Valley Community College (CVCC) had provided minimal training over the years but was not prepared to meet the all the specific needs of the hosiery industry. As a result, a group of local hosiery firms went to CVCC to address the training needs that were rapidly emerging in the hosiery industry. This group was called the Catawba Valley Hosiery Association (CVHA), later renamed the Carolina Hosiery Association (CHA). The CHA formed in the late 50's mainly as a social organization but has changed its mission considerably over the years. At present the mission has expanded to address the need for new technologies, for new avenues for marketing products, and for new ways for firms to communicate with and learn from each other.

The CHA realized that the lack of trained workers was becoming a major barrier to local firms and that the community college was the best institution to deal with its skills issues. Members began to realize that the technology was beginning to move quickly and that they lacked workers with the skills to operate and repair the new machines. However, they could not generate sufficient funds through the college system to support a training center since most of the training they needed could not meet the FTE (full-time equivalent student) criteria for funding.

Therefore, CHA went directly to the state legislature and the Hosiery Technology Center (HTC) was established. CHA's Education and Knitting Technology Committee stated in their proposal for a center that even though CVCC "has substantial training resources in the industrial technologies.... the hosiery industry is unique in many ways," and "the current training programs cannot meet the needs for specific training in hosiery technology." With virtually no documentation of repair procedures and no place that novice technicians could tear down and rebuild machines, the educational process to produce highly skilled workers took about five years. In 1993, Senate Bill 938 was passed "to provide funding to disseminate hosiery technology through a Hosiery Technology Center under the supervision of the Department of Community Colleges."

In an unusual move, legislation gave the Hosiery Technology Center added independence by an authorization to serve the industry across the entire state. Industry serves in an advisory role in making decisions on staffing, allocation of resources, and programs. Since 1989, Dan St. Louis, with a Textile Technology degree from North Carolina State University and considerable industrial experience, has directed the operations of the Hosiery Technology Center.

In 1995, with a small planning grant from the NC Alliance for Competitive Technologies, (NC ACTS), the CHA and HTC led the industry through a strategic planning process that resulted in *Preserving Hosiery Manufacturing in North Carolina*. Many of the trends, weaknesses, and obstacles were education and training related. Among its seven suggested strategies were "increase funding for the Hosiery Technology Center," "use the NC Department of Labor and Commerce and community colleges for training and retraining." In 1996, with a grant from the German Marshall Fund of the United States, about a dozen company CEOs, staff from the CHA, HTC, and RTS, Inc., and NC government officials participated in a study tour to visit the prominent hosiery clusters of northern Italy and a hosiery technology center in Castel Gofreddo. That tour resulted in changes in the HTC, which increased emphasis on innovation, quality measures, dyeing and on marketing, and it resulted in a number of active business networks.

The center and the college serve as neutral ground for competing parties in hosiery. All firms are welcome at the center, large and small, and all have the opportunity to fulfill their training needs. For example, the HTC invited yarn suppliers to talk with knitters, dyers, and finishers about how to best deal with wax on the yarns, which is needed to avoid breakage. Thirty to forty companies got together to share information. St. Louis finds that when the firms get together in a neutral site and begin to discuss their problems, openness abounds. As the local saying goes, "there are no secrets in hosiery." In 1998, as a direct result of the trip to northern Italy, about 20 companies joined together and invested in an R&D project with graduate students at NC State University to help develop an automated boarding machine, the one major technology still not available in Italy.

The center recently moved from the main college campus into a commercial building about a half-mile away. Equipment ranges from the most basic to the most modern. For example, at one end of the room sit two manual machines produced in the nineteenth century and a Scott and Williams machine produced in 1907, where students can learn the mechanics of the production operations and better understand what goes on inside the newest computerized equipment. Students also can observe and learn how the technology progressed on machines dating from the 1930s through 1960s—many of which are still in use locally. Then they progress into the 1980s and right through the most up-to-date equipment, including Lonati, Sangiacomo and Busi from Italy and Uniplet from Czechoslovakia.

In 1995, the Center established a satellite center at Randolph Community College in order to provide services closer to the cluster of companies to the east.

The HTC has education and training programs and documentation for production workers through mill managers. Training courses range from a basic 20-hour "Knitting Operator" course to a 120-hour "Double Cylinder Technician" course, where students learn the intricacies of repairing state-of-the-art machinery. Education for managers includes both formal seminars and exposure to new machinery and products on display. Compiling training materials has been a particular challenge; curriculum materials are simply not available anywhere on the market. Other college staff often assists with

curriculum development, a valuable asset. For example, a training expert at the school suggested a system for documenting industrial processes. CVCC has an impressive library and a Deming-based Quality Center.

The newest equipment is in the lab on consignment, and local companies can purchase a machine if they choose—which allows the college to then acquire later models and stay current at minimal cost. "The companies will come here to see equipment," according to director St. Louis, "because nobody's trying to sell them anything." It's the one place, outside of the annual trade show in Charlotte, that they can compare different brands. Center staff will help them through the process of deciding whether they need new equipment and which best fits their needs but will not get involved in the final judgment. The center holds, for example, "lease vs. buy" seminars.

The college also operates as both an extension and technology hub for the hosiery industry, and as such partners with the North Carolina State University Industrial Extension Service, South Carolina Manufacturing Extension Partnership, and North Carolina Center for Entrepreneurship and Technology, and the National Institute of Standards and Technology Manufacturing Extension Partnership.

The HTC currently is trying helping the industry convert to e-commerce and e-business. It has developed and maintains a web site that provides industry trends, technical articles, market opportunities, employment and personnel needs, networking opportunities, etc. Currently there are over 800 hits a day on the “Legsource“ website.

Another major thrust at the HTC is the Sock Testing Consortium. This is a 2-year study involving hosiery manufacturers, retailers, testing labs, the NC State University College of Textiles, the American Association of Textiles and Chemists and the Hosiery Technology Center. This Consortium membership is made up of people from 42 hosiery manufacturers, 22 from schools and industry associations, and 13 from hosiery suppliers, 7 retailers and 2 testing labs. Trials have been run at DuPont, NCSU and the Hosiery Technology Center. To date there have been over 2685 different trials run on various testing devices on various sock types. This has been an industry venture with many contributors and has made significant progress. The goal is to standardize methods for testing hosiery products so that everyone is talking the same language. The areas that have been studied are Fit/Dimensional Stability, Abrasion and Wear Resistance and Colorfastness. The rollout of these new methods was held on September 18th, 2000 at the HTC with major retailers such as Sears, JC Penney, Target, Kmart and The Gap scheduled to attend.

Because of the type of services needed to serve an industry cluster, a different type of funding process needs to be established. The current full time equivalent (FTE) funding formula does not allow training people in small numbers, research and development, testing, website development and market-improving strategies that are often so important for small to mid size companies in this cluster. The HTC needs to be able to react quickly to the changing environment that these industries face; an FTE formula responds to the past. The hosiery companies cannot afford to bear the full cost of programs but can benefit greatly from an industry cluster approach with some help from

the state. A form of category funding would reduce the time and resources now spent "chasing money" for operations and allow more for the delivery of services.

North Carolina Biotechnology Center

The North Carolina Biotechnology Center (NCBC) is not a community college-based center, but has important ties to community colleges and other partners in the biotech cluster. NCBC was established in the Research Triangle Park as a private nonprofit corporation to enable biotech commercialization. It began as an initiative by the NC General Assembly in 1981 and remains dependent on the General Assembly for funding. Funding in 1999 was $10.6 million. About 45 FTE employees with a wide range of qualifications staff the Center.

The Center is located in a 40,000 square-foot headquarters building in RTP. Center staff spent the past year carrying out programs to convert scientific knowledge to commercial use, establishing the North Carolina Bioscience Investment Fund, and preparing for the growth phase of the biotechnology industry. The Center was proud to help fund the start-up of its 52nd biotech company and participate in recruiting several companies to North Carolina, including Bayer, BASF's seed division, and Diagnology.

The NCBC serves the biotech industry with the training courses it offers, the funding it provides for industry research, and the role it plays in business facilitation. To structure communication with businesses, the Center works in collaboration with several industrial committees. In addition, the Center has established alliances with educational institutions in the form of formal partnerships with the community college system and advisory relationships with colleges and universities. The Center assists science, education, business, and government at every step along the path from idea to commercialization, through several programs.

The Science and Technology Development Program helps North Carolina's universities recruit qualified faculty, develop state-of-the-art laboratories, initiate new research projects, and promote intellectual exchange. Capable universities generate many of the ideas, discoveries, and technologies that eventually become commercial products. . The NCBC itself does not conduct laboratory research, however grants from its Science and Technology Development Program, totaling $42 million, have strengthened North Carolina universities' research capabilities.

The Business and Technology Development Program helps provide access to science, technology, capital, and business assistance to biotechnology companies of all sizes and at all stages of development, to help them move ideas from the laboratory to the marketplace.. The staff assists companies with technology assessment, technology transfer, business plans, networking opportunities, venture capital placements, marketing strategies, strategic partnerships, site locations, and professional services.

The Education and Training Program promotes public understanding and work force preparedness through teacher training, teaching materials, grants programs, needs

assessments, and other activities at all educational levels throughout North Carolina. The Program has help to spawn biotechnology courses in public schools, community college and universities.

The Center, through its own surveys and ongoing contacts with the industry, has determined that it is becoming extremely difficult for biotech companies to find suitable recruits for entry-level positions, including for process technicians, and says it is imperative to attract people into such careers and provide them with the basic training they need. The Process Technician Training Course that the Center is now developing for the Community College System is intended to serve this purpose. NCBC had considerable industry input into the design of this course and companies are very interested in having it available for training new hires and incumbent employees.

NCBC works in active partnership with community colleges around the state in developing curricula and industry-responsive training programs. Vance-Granville Community College is currently building a laboratory and classroom specifically for teaching the Process Technician Training Course, funded in part by Novo Nordisk Biochem in Franklinton. The facility is located at the college's new satellite facility in Franklinton. It will be the site at which NCBC initially offers and fine-tunes the course, and will be equipped in part with donations from Novo.

Other colleges with relevant programs or resources are as follows:

- Alamance Community College, Biotechnology Program
- Central Carolina Community College, Bioprocess Manufacturing Technology
- Wake Technical Community College, Pharmaceutical Manufacturing Technology
- Piedmont Community College, Industrial Laboratory Technology

The graduates of these programs are readily employed in biotech, pharmaceutical, or chemical companies. However, enrollment in these programs (as well as in most other technical, scientific, or engineering-related curriculum programs) is extremely low. Low enrollment has many causes and it will require some major recruitment efforts to address them.

NCBC works primarily with biotechnology companies, but pharmaceutical and chemical firms often have similar labor force needs. NCBC notes an excellent teaching facility for the Chemical Processing Technology Program at Guilford Technical Community College. Cape Fear Community College serves a local concentration of pharmaceutical and chemical industry. Pitt Community College and Brunswick Community College may have access to specialized chemical technology training equipment at local companies.

According to the NCBC, no community college at present has an adequate facility with appropriate equipment for teaching all aspects of bioprocess manufacturing technology, and a strong enough faculty that could serve the state or region as a whole. Therefore it strongly supports the formation of a specialized training center for biotech.

In addition to the industry and the community college system, the Biotech Center's working partners include universities, in particular NCSU because of its Industrial Extension Service, and programs such as Biochemical Engineering, Sterile Packaging and Processing, and Food Science, all of which have some relevance to bioprocess manufacturing. Campbell University's Pharmaceutical Science degree program is also potentially a good partner. NCBC also partners with the GMP Institute and the International Society of Pharmaceutical Engineers, highly respected providers of professional training for the pharmaceutical industry; a partnership is just beginning with the GMP Institute to offer its workshops on community college campuses.

North Carolina Center for Applied Textile Technology

The NCATT is a member of the community college system. Its primary industry targeted by this center in Belmont is textile technology. The Center specializes in Continuing Education with training provided in the form of relevant class offerings, on-site programs for interested businesses, and the opportunity to attain a degree or diploma. Funding comes from a budget submitted to the state of North Carolina.

Industry is often the catalytic actor in the training process as employers fund and encourage worker retraining. The website for training programs targets employers as much as if not more than it aims at individual workers. In fact, the Technical Advisory Committee for the Center is predominately composed of industry representatives who view the center as beneficial to the competitiveness of their businesses.

The Center works jointly with many labor and education institutions and organizations, including: Charlotte Regional Workforce Development Partnership, schools from the Charlotte Region Information Technology Education Consortium and an additional 68 community colleges, several public school systems, and a forty-five member Technical Advisory Committee. Twenty-nine FTE staff members staff the Center.

Most of the Applied Textile Technology Center's clients turn to the Center as a result of specific needs or problems they cannot resolve on their own. For example, a client might need faculty expertise in setting up a TQM program in his plant. Another might want to create employee training manuals or videos. Whatever the issue, NCCATT's instructors work with the company to create a custom teaching experience. Instructors draw not only on academic backgrounds in this field, most also have personal experience in plant operations.

The Center's areas of training expertise include management skills, computers, quality assurance, industrial engineering, safety, and mechanical/technician training. Courses offerings also cover all aspects of textile manufacturing such as fiber science, yarn manufacturing, weaving, knitting, dyeing, and finishing. Finally, industry clients utilize the center's business support services, including employee assessments and needs analysis.

Students generally study in one of the Center's two certification programs. Students can pursue an Associate in Applied Science degree in Textile Management through the Center's two-year program for first-line supervisory responsibilities. Entry-level technicians can follow a one-year series of courses and receive a diploma in textile technology. In general, students work full-time while pursuing their degree or diploma with 60 percent of students coming from Gaston County and 35 percent from other counties. Although NCCATT is non-residential, there are on-campus activities from which students can benefit. The NCCATT Textile Club offers students networking opportunities and access to the latest trends in the textile industry through the club's affiliate memberships with the Southern Textile Association and the American Association of Textile Colorists and Chemists.

North Carolina Telecommunications Center

The Telecommunications Center in Sanford is devoted to training students to serve the North Carolina telecommunications industry. The NC Telephone Association and the community college system work in partnership with the Center, providing the funding and cooperation necessary to achieve the Center's goals. The CFO of the college is responsible for the budget process. The Center is staffed by approximately six FTE employees with various educational backgrounds and industry experience.

As an official part of Central Carolina Community College, the campus of the Telecommunications Center is dedicated solely to the training and certification of those in the telecommunications industry. Industry representatives from North Carolina, South Carolina, and Virginia serve as members of the advisory committee, but the telecommunications industry does not formally partner with organizations other the community college system. A dual-purpose facility, the Center provides certificate programs to prepare entry-level workers and, in addition, train current industry workers. The industry personnel come from Maine to Florida, and most states east of the Mississippi. Courses taught are within the A.A.S. program of the college; in addition some customized courses are provided on request.

Students mainly come from within a sixty-mile radius of the Sanford facility. The main industry clients are independent telephone companies, although other cabling companies, interconnect companies, and special groups utilize the Center as well. The largest user of the Center's service in recent years has been the U.S. military. Unfortunately the Center is impeded from meeting needs for expanded training. Facilities are in need of update, and the center is turning away students due to the lack of available space.

The Regional High Technology Center

Situated in an industrial park a few minutes from its host, Haywood Community College, the Regional High Technology Center (RHTC) is charged with providing training and technology services in a 17 county region of North Carolina.

The center receives annual funding from the state based on FTEs served through its training. The state also provides some additional funds to purchase high-tech equipment needed by the center. Less than 15 percent of funding is from sources other than the state legislature. Tuition from 98 percent of classes is not retained, instead it is sent to Raleigh to cover system expenses. Two large companies have provided assistance to the center both in appreciation for past service and to enable the center to provide automation systems training to the firms. Haywood County also provides about $10,000 annually, which mainly goes to general maintenance of the facility.

All of the agencies offered funding to the center to meet the four-pronged mission articulated by the college:

(1) The college would establish an engineering technology program through the center;
(2) The center would provide specific and traditional programs to existing industry or new and expanding firms,
(3) The center would offer short range educational opportunities, such as short workshops and seminars;
(4) The center would serve as a site for the college's community outreach program, with the facilities serving as a site for hosting community meetings and other events.

The center does work closely with industry in providing training services. The center offers two main types of training. First, it trains full time students in engineering technology. RHTC offers two-year degrees in electronic engineering technology and manufacturing electronic engineering technology. Both programs offer students A.A.S. degrees that prepare them for employment in such professions as electronics technicians, computer aided drafting and statistical quality control. In addition, the programs have transfer agreements in place with both the University of North Carolina at Charlotte and Western Carolina University to allow students to complete B.S. degrees in engineering.

Second, the industrial training the program offers is delivered through two main programs sponsored by the state of North Carolina. Occupational Continuing Education offers training to incumbent workers at area firms for a set cost of $35 per course, a fee mandated by the state. Another program, New and Expanding Industry, provides free customized training to new firms locating in North Carolina or companies expanding their operations. Types of training requested under these two programs range from training in automation systems to training on computer operations.

Although the center consistently serves certain employers such as Champion International, a paper company that is the largest in Haywood County, the center is not focused on any particular industrial sector. In addition, the center serves both small and large manufacturers, with the majority of employers having less than 100 employees.

The training is done both on the site of the center and at the company's facility, depending on the needs of the particular firm. The center is equipped with a variety of advanced equipment, some of which has been donated by industry. The majority of the equipment is purchased by the center. The center includes a computer integrated

manufacturing center, which allows industry personnel to get hands on experience using equipment they will actually use in the workplace.

The center's ability to provide these services results in part from the extensive partnerships it has been able to enter into with state, national and international organizations. The center houses a representative of the state's manufacturing technology center, which is aimed at serving small and medium sized manufacturers. The representative, an industrial engineer, provides consulting services to firms across the western part of the state. A representative of the state community college system's economic development program is also located at RHTC. This representative works with the new and expanding industry program, helping attract new firms to the western part of the state in part by advertising the extensive training services that the center provides. The center is also home to Haywood Community College's small business center, which provides start up and general business support to existing firms and prospective entrepreneurs.

The networks that the center established are not limited to work with the state. The center established NC/Advantage, a business and industry information center which works in partnership with the Southern Technology Application Center, a division of NASA. RHTC was a co-founder of the National Coalition of Advanced Technology Centers, the member organizations for over 80 similar institutions around the nation. RHTC also serves as Haywood Community College's representative to the Consortium of Manufacturing Excellence, a consortium of 17 schools in the southeast committed to improving the competitiveness of manufacturing firms in their region. RHTC has received over $200,000 in grants through its association with CMC.

Presently, 18 full time employees are located at the center. This total counts the representatives from the community college system and the manufacturing technology center. Other staff includes five full time instructors. The background of employees depends on the particular role the individual is playing at the center. Individuals working with industry usually have an engineering background. The center works with between 10 and 20 part-time faculty members who possess some expertise in a particular discipline.

Appendix G:
List of Persons Contacted

Bonnie Beam, Western Carolina University

Chris Beacham, N.C. Rural Economic Development Center

Lonnie Blizzard, Global Transpark Global Logistics Technology Program

Leslie Boney, N.C. Department of Commerce

Paul Butler, Southeast Regional Partnership

Ray Burrows, N.C. Department of Commerce, Western Office

Doug Byrd, N.C. Department of Commerce

LuAnn Coe, N.C. Agribusiness Council

Dale Carroll, AdvantageWest Partnership

Joe Cooper, First Citizens Bank

Don Dalton, North Carolina Hospital Association

Gif Daughtridge, Nucor Corporation

Peter Daniels, N.C. Farm Bureau

Scott Daugherty, Small Business Technology Development Center

Wayne Daves, N.C. Department of Commerce

Darrell Davis, East Carolina University

Bob Edwards, North Carolina State University, Industrial Extension Service

Carlos Evans, Bank of America, Charlotte

Jim Fain, N.C. Department of Commerce

Lydia Faulkner, Office of the Governor, State of NC

Connie Fitzgerald, First Citizens Bank

Tom Greenwood, Global Transpark Regional Partnership

Charles Hayes, Research Triangle Regional Partnership

Mark Heath, Charlotte Regional Partnership

Kathy Heilig, N.C. Hospital Association

Keith Henry, N.C. Department of Commerce

John Irion, S.C. Manufacturing Extension Partnership

Virginia Hopley, Small Business Technology Development Center

Kathleen Kennedy, N.C. Biotechnology Center

Don Kirkman, Piedmont Triad Regional Partnership

Tony Kleese, N.C. Farm Stewardship Program

Beth Lucas, JobReady Program, State of N.C.

Joan Maxwell, Regulator Marine

Dave Merrick, Rowan/Chowan Community College

Jonathan Morgan, N.C. Department of Commerce

Joan Myers, N.C. Electronics and Information Technology Association

Jim Nichols, N.C. Department of Commerce

Steve Oneyear, Piedmont Triad Center for Advanced Manufacturing

Mikki Sager, The Conservation Fund

Dan St. Louis, N.C. Hosiery Technology Center

Marshall Stewart, N.C. State University Extension Service

Mitchell Ward, Bank of America

Rick Watson, Northeast Regional Partnership

Larry Wooten, N.C. Farm Bureau

Appendix H: Growth and Share of Employment in Selected Clusters

	North Carolina			Advantage West			Charlotte Region		
	No. employees, 1998	Change in employees since 1989	Share of total employment, 1998	No. employees, 1998	Change in employees since 1989	Share of total employment, 1998	No. employees, 1998	Change in employees since 1989	Share of to employmer 1998
Agriculture, food processing, natural resources	117,808	26,514	3.2%	11,383	1,281	2.8%	19,159	1,157	2.
Banking, finance, insurance	203,894	51,953	5.5%	12,277	1,251	3.0%	71,376	25,577	7.
Biotechnology and pharmaceuticals	32,323	7,111	0.9%	3,776	464	0.9%	3,832	932	0.
Boat building	2,994	(1,966)	0.1%	14	2	0.0%	72	(88)	0.
Chemicals and paper	67,840	5,212	1.8%	6,632	(428)	1.6%	18,086	1,777	1.
Communications equipment	114,020	14,779	3.1%	8,742	(866)	2.1%	23,768	1,999	2.
Logistics and distribution	98,572	12,500	2.7%	9,118	1,054	2.2%	29,361	512	3.
Furniture and wood products	108,239	(732)	2.9%	24,668	(417)	6.1%	30,711	620	3.
Leisure, recreation, retirement	97,751	28,972	2.6%	18,364	5,291	4.5%	21,522	8,193	2.
Media and digital content	34,520	15,704	0.9%	2,702	1,378	0.7%	9,077	4,042	1.
Hospitals, medical, labs	366,521	140,812	9.9%	47,665	15,912	11.7%	77,565	29,961	8.
Metal working and industrial equipment	153,248	29,532	4.1%	12,347	1,211	3.0%	58,867	11,906	6.
Plastics and composite materials	48,611	1,607	1.3%	7,668	(1,591)	1.9%	16,452	696	1.
Printing and publishing	33,646	3,237	0.9%	2,876	566	0.7%	9,882	(174)	1.
Communications software and	37,670	23,417	1.0%	605	502	0.1%	14,023	9,561	1.
Textiles and apparel	223,771	(88,612)	6.1%	32,480	(12,046)	8.0%	61,578	(27,502)	6.
Tobacco products	16,151	(8,339)	0.4%	-	(1)	0.0%	2,495	779	0.
Total Employment			3,693,245			407,722			944,6

Appendix H: Growth and Share of Employment in Selected Clusters

	Piedmont Triad			Research Triangle			Southeast		
	No. employees, 1998	Change in employees since 1989	Share of total employment, 1998	No. employees, 1998	Change in employees since 1989	Share of total employment, 1998	No. employees, 1998	Change in employees since 1989	Share of employ 199
Agriculture, food processing, natural resources	11,114	(288)	1.5%	18,966	4,968	2.5%	19,214	8,238	
Banking, finance, insurance	40,320	9,402	5.6%	39,783	8,346	5.2%	14,539	2,580	
Biotechnology and pharmaceuticals	4,342	2,393	0.6%	13,415	4,515	1.7%	776	(321)	
Boat building	141	(425)	0.0%	54	51	0.0%	108	(887)	
Chemicals and paper	14,078	1,993	1.9%	9,737	3,718	1.3%	7,811	(587)	
Communications equipment	17,062	(386)	2.4%	50,340	14,261	6.5%	5,178	347	
Logistics and distribution	24,207	5,318	3.3%	12,446	1,844	1.6%	10,042	2,330	
Furniture and wood products	33,468	(2,417)	4.6%	8,946	2,590	1.2%	4,586	166	
Leisure, recreation, retirement	14,088	3,754	1.9%	22,292	7,914	2.9%	8,806	2,675	
Media and digital content	6,729	3,207	0.9%	9,070	5,023	1.2%	1,908	72	
Hospitals, medical, labs	65,403	22,119	9.0%	82,139	36,304	10.7%	38,171	17,112	1
Metal working and industrial equipment	28,358	4,119	3.9%	25,647	7,382	3.3%	9,529	2,201	
Plastics and composite materials	9,128	1,711	1.3%	5,663	1,012	0.7%	4,392	139	
Printing and publishing	8,465	1,100	1.2%	6,856	1,295	0.9%	1,800	26	
Communications software and	4,087	545	0.6%	16,576	10,960	2.2%	650	525	
Textiles and apparel	70,922	(13,033)	9.8%	19,273	(9,721)	2.5%	20,109	(9,890)	
Tobacco products	9,374	(8,258)	1.3%	1,223	(862)	0.2%	102	97	
Total Employment			725,461			769,605			352

Appendix H: Growth and Share of Employment in Selected Clusters

	Global Transpark			Northeast		
	No. employees, 1998	Change in employees since 1989	Share of total employment, 1998	No. employees, 1998	Change in employees since 1989	Share of total employment, 1998
Agriculture, food processing, natural resources	26,646	9,593	7.2%	9,908	1,989	8.0%
Banking, finance, insurance	14,547	1,901	3.9%	5,554	1,862	4.5%
Biotechnology and pharmaceuticals	4,718	(88)	1.3%	6	(46)	0.0%
Boat building	1,718	(624)	0.5%	887	5	0.7%
Chemicals and paper	4,764	98	1.3%	5,005	354	4.1%
Communications equipment	7,422	(765)	2.0%	1,155	67	0.9%
Logistics and distribution	8,031	(200)	2.2%	3,380	851	2.7%
Furniture and wood products	4,005	(173)	1.1%	1,070	(1,546)	0.9%
Leisure, recreation, retirement	7,975	1,270	2.2%	4,259	650	3.4%
Media and digital content	1,672	76	0.5%	339	153	0.3%
Hospitals, medical, labs	42,735	14,081	11.6%	12,043	4,955	9.7%
Metal working and industrial equipment	13,133	2,834	3.6%	2,717	(189)	2.2%
Plastics and composite materials	4,357	(547)	1.2%	877	249	0.7%
Printing and publishing	2,084	568	0.6%	534	(73)	0.4%
Communications software and	318	117	0.1%	96	66	0.1%
Textiles and apparel	12,978	(10,918)	3.5%	5,843	(5,088)	4.7%
Tobacco products	2,957	16	0.8%	-	-	0.0%
Total Employment			369,879			123,518