Exports, Competitiveness, and Synergy In Appalachian Industry Clusters

A Report to the Appalachian Regional Commission

February 1997

Submitted by

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With assistance from

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Prepared for the Appalachian Regional Commission under contract CO-11806C-96

Executive Summary

This report analyzes seven industry sectors pre-selected by the Appalachian Regional Commission on the basis of their importance to the region's economy and export potential. The seven clusters are: miscellaneous plastics parts (SIC 308)*, electronic components (SIC 3670); household furniture (SIC 2510); knitting mills (SIC 2250); medical devices (SIC 3840); industrial machinery (SICs 3540, 3550, 3560, and 3590); and environmental technologies (see appendix for sector classifications). The targets of this analysis are small and mid-sized manufacturing enterprises (SMEs), which have been found to be slow to modernize and hesitant to export. These SMEs cluster, dominate many rural economies, and, with the downsizing of so many large corporations, comprise a potential source of growth.

Three basic assumptions about business practice underlie our study.

1. Businesses tend to cluster (i.e., certain types of businesses are more likely to be found in some areas than others), and this ought to affect policy.
2. Companies clustered in a region are interdependent (i.e., formally and informally rely on each other for information, specialized services, parts, supplies, workers, technologies, and sales)
3. Companies that learn about and use the most advanced and appropriate technologies, invest in the skills of their work force, and either possess or can access specialized expert advice and assistance are more competitive than those that do not.

What is a Cluster?

One definition of a business cluster, as defined by a group of experts assembled under a project supported by the Appalachian Regional Commission, 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" (See Figure 1) More specifically, successful (synergy producing) clusters are characterized by:

- a critical mass of similar, or related, economic enterprises;
- specialized services and infrastructure;
- accessible and rapid exchange of information and knowledge;
- a workforce skilled in and well-informed about the industry;
- competition to keep firms on their toes and spur innovation;
- high rates of new businesses formation to imitate and innovate, fill needs, or diversify; and
- social infrastructure with sufficient trust to enable firms to cooperate and learn from each other.

* SIC refers to the Standard Industrial Classification system (SIC) used to classify each industry in the United States economy. This report uses the system detailed in 1987 Standard Industrial Classification Manual by the Executive Office of the President, Office of Management and Budget, National Technical Information Service, Springfield, VA.

Industry clusters were first noted in Western Europe—particularly in northern Italy where the production of such things as chairs, ski boots, ceramic tiles, and packaging equipment is highly concentrated in distinctive regions. In the U.S., carpet manufacturers near Dalton, Georgia, electronics and computer companies in the Silicon Valley, metalworking firms along the Connecticut River valley, and optics and imaging companies around Rochester, New York are examples of recognized industry clusters. Some of the regions selected in this study are similarly well-known and often cited as clusters: hosiery firms n North Carolina's Catawba Valley (see Figure 1) and furniture companies in Northeastern Mississippi. But even where clusters are less obvious and in less concentrated, businesses tend to locate near compatible and similar businesses—their suppliers, customers, partners, and even competitors—to take advantage of specialized services, information, and resources; economies of scale; and strength of numbers.

Research Questions

Our assumptions stimulated a series of research questions about the exporting and export capabilities, competitiveness issues and the intensity and impacts of interdependencies and connections of SMEs. Do small and mid-sized companies—where they are most concentrated in areas of the ARC—interact and take advantage of their complementary strengths and potential economies of scale? Do they in fact think and act for their collective advantage as a cluster and do they produce synergy?

To learn more about the ways in which companies function as a system, the research team defined specific geographic areas where firms were found to be most highly concentrated. These were Greenville-Spartanburg, South Carolina (industrial machinery); Pittsburgh, Pennsylvania (medical devices); Binghamton, New York (electronic components); Erie, Pennsylvania (plastic parts); Chattanooga-Oak Ridge, Tennessee (environmental technologies); Tupelo, Mississippi (household furniture); and Hickory, North Carolina (knitting mills). Many of these "cluster hubs" can trace their beginnings to either (1) a technological innovation or (2) a branch plant location, followed by (3) entrepreneurial energy of employees who see opportunities for new or competing market niches and start their own companies. Researchers interviewed ten exporters, ten non-exporters, and six support services to learn about sources of information and assistance SMEs used, perceptions of competitive advantages, obstacles to exporting, geographic advantages, forms and levels of interaction, and export performance.

The research team also analyzed national and regional (ARC states) export data and trends for recent years. Most of the region's states export at a rate below the national average, and most are experiencing growth in exporting—especially of manufactured products—at a rate above the national average. Thus, most ARC states are making progress toward the region's goal of bringing its export performance up to the national average. Southern ARC states posted the fastest rates of growth in the value of manufactured exports.

Findings

The interview surveys and analyses led to the following findings.

- Exports are considered important to firms' future business performance. Even though many exporters only export a small fraction of their total output, more than half rated foreign markets as "very important" to their business and another 20 percent rated it as "important."
- Exporters relied slightly more on private sector for trade leads than on the public sector. Export consultants and agents were the most frequent source of general leads, but customers themselves were the most frequent source of specific leads, especially for environmental technology companies.
- Among ten potential barriers presented to companies and services, all classes of respondents ranked "lack of information" very high. Exporters ranked "getting paid" as their largest obstacle, while support services ranked it last and non-exporters, well below average. Trade barriers was ranked third among exporters but last among non-exporters, and eighth among support services. Foreign regulations, not explicitly included on the survey instrument, nevertheless was also mentioned frequently by firms.
- The criteria firms selected as their primary competitive advantages varied by cluster, but overall quality ranked highest among both exporters and non-exporters. "Quality" ranked particularly high in the knitwear and plastics clusters, while "reputation" and "customer service" were ranked highest among industrial machinery exporters and non-exporters, both of whom work closely with users to customize products to their needs.
- Working capital was more problematic than investment capital for SMEs. Responses to access to investment capital were split, with a third rating it as a very large problem, a third as no problem, and a third in the middle. It was of most concern to the industrial machinery and electronics components clusters, where all but two firms rated investment capital needs high and two-thirds rated working capital needs high.
- Trust is assumed by many observers of industry relationships to be an important factor in the strength of a cluster. High levels of trust increase opportunities for firms to take advantage of their collective capabilities and knowledge. Firms' ratings of trust were dichotomous, with half rating trust "above average" and half "below average." Support services tended to rate it higher than average.
- Among location advantages of firms in clusters, proximity to suppliers and customers ranked first, industry specific skills of the work force ranked second, and good distribution channels ranked third. Support services placed distribution channels first, skilled work force second, and access to R&D and technical assistance, third (which SMEs ranked next to last).

Opportunities for Improving Export Performance and Competitive Advantages

- **Overcoming SMEs' difficulty in "getting paid"** Community banks are likely to know local industries best but have little expertise in exporting. A number of niche export finance intermediaries are emerging to target small and mid-sized exporters. Cluster would benefit from help in connecting the new-to-export companies with community banks that are familiar with and accessible to SMEs.
- **Reducing unit costs of international marketing and sales:** Expense was cited as a major barrier to entering export markets. A suggested action is to develop a cadre of skilled brokers and offer incentives for export cooperatives or networks.
- **Increasing participation in trade shows**: Overseas trade shows, though costly, are important sources of sales leads. A suggested action is to organize groups of small and mid-

sized companies to attend trade shows together, sharing costs of booths, or simply gathering information and making contacts that would be shared with others in cluster. Reverse trade missions could bring delegations from other countries to visit the cluster allowing it to become more familiar with its products and capabilities and develop personal relationships.

- **Emphasize design**: Although design ranked high among competitive factors, it is given little emphasis and short shrift by educational programs and services. Colleges ought to play a key role in integrating design into technical curricula and support services ought to include specialized design firms.
- **Improving education and information about export procedures and foreign market requirements**. These services exist in most states but are not easily accessed by rural or remote companies. One suggestion is assistance to SMEs in making greater use of telecommunications, both for education and information.
- **Identifying and targeting gaps in cluster**. View the cluster as a system and look for disruptions in or impediments to the flow of information and business transactions or between firms, weak elements such as lack of important suppliers or industry specific training. Then look for strategies that improve the entire systems.
- **Improving flow of expert information to SMEs**: One of the major weaknesses in most of the systems analyzed is use of public sector services. Responses from businesses suggest a dearth of specific, niche-market oriented information companies need to export—best obtained from experts in the industry. Regional brokers could help SMEs locate the information or, if unavailable, contract for and partially subsidize the studies, and put together companies with similar needs to share the information costs.
- **Merging export/marketing programs with technology diffusion/business assistance programs that target clusters**. SMEs have considerable trouble sorting out and evaluating the multitude of technical assistance programs at their disposal. A "one stop" agency—a long sought ideal of many public agencies—might be more effective if organized around industry rather than function. Community colleges may be well positioned to serve in this capacity and broker specialized services for a cluster.
- **Encouraging networking.** Although there is no long-standing and well-patterned "habits of cooperation" among firms in most regions, many see a potential for creating new mechanisms to allow firms to explore opportunities for joint export development. While many of these firms do compete with each other in regional markets to supply larger customers, a large number have differentiated themselves with their special capabilities over the past few years, thus increasing the likelihood of cooperating on mutually beneficial issues.

Highlights of Clusters

A. Environmental Technologies in Eastern Tennessee

- The environmental technologies (ET) cluster in East Tennessee is concentrated in Oak Ridge, where firms have located to be near Department of Energy (DOE) clean-up sites and the Oak Ridge National Laboratories, but with smaller concentrations in Knoxville and Chattanooga.

- The world market for environmental technologies is estimated to be $400 billion in 1994, and is projected to grow by some $100 billion by 2000. The U.S. accounts for about 40 percent of the total.
- The best market opportunities for remediation technologies in the next five years are Germany, Mexico, South Korea, and the most promising new markets over the next ten years are China, India, and Brazil. Exporting firms surveyed, mentioned mainly sales in Russia, Central Europe, and Southeast Asia.
- Export sales provided about six percent of 1994 revenues for U.S. environmental technologies firms, with about five percent of ET industry revenues in ARC states. In both the U.S. and ARC states, exports contributed about one percent of total export revenues. The most active ET exporting countries, Germany and Japan, earned 30 and 24 percent, respectively, of revenues from exports.
- The Oak Ridge ET cluster has capacity to manage and remediate radioactive and mixed hazardous wastes and decontaminate and decommission nuclear facilities that is unmatched in the world. Chattanooga has unique expertise in electric vehicles.
- In Oak Ridge, a government-dominated market has shaped the development of a cluster where firms cooperate with each other and partner on most projects. Yet there are few local sources of business services and capital.
- Branch offices of larger ET firms have shown limited interest in exporting from East Tennessee sites. The relative isolation of the East Tennessee location is a disadvantage for exporting as is the high cost of marketing abroad. Smaller firms look to export sales to help mitigate cutbacks in DOE contract work. The cutting edge technology and highly skilled work force in East Tennessee are advantages for exporting.
- Industry associations lead efforts to increase non-local marketing, including reverse trade missions to reduce the cost of international marketing. But these efforts are new, and the associations have limited resources.

B. Plastics Parts in Northwestern Pennsylvania and Ohio

- The global market for U.S. plastic products has grown substantially in the past three years. Yet exported products remain a relatively small percentage of overall industry shipments because most plastics parts companies make sub-assembly parts and sell to large original equipment manufacturers. Most firms that do export tend to be large, international and vertically integrated companies but percentage of their products exported is quite low. Many other plastic parts are exported indirectly as a part of another product.
- The most promising market for U.S. plastics are Canada and Mexico due to the close proximity and interrelated markets of those two countries. The implementation of trade agreements will further increase shipments to these markets. The U.S. enjoys a trade surplus of approximately $1.5 billion in plastic parts. Canada, Taiwan, China and Japan are the biggest exporters of plastics to the U.S.
- The plastics part cluster is centered in Erie, Pennsylvania and includes eight counties in Pennsylvania and four in Ohio. Overall, the ARC region is not as strong in plastic as the Northeast and the Midwest. In Erie, however, it has one of the nation's leading centers of plastics production. Erie is the birthplace of the plastics processing technique "injection molding" and most plastics parts firms specialize in this type of operation. This process is

primarily used to produce sub-assembly parts for large original equipment manufacturers (OEMs).

- The major impediment to exporting is both lack of unique, completed products and general lack of interest in foreign markets among company owners, especially those who operate SMEs. Most firms are able to stay competitive within a 300-mile radius and have little interest in expanding beyond that region.
- The area possesses several resources aimed specifically at helping plastics firms become more competitive, including a federally funded manufacturing extension center, but very few concentrate on export promotion.
- If this cluster of plastics firms continues to produce mainly sub-assemblies and parts, there may be little potential for exports. The best hope for those that do want to export is in NAFTA members Mexico and Canada. There also may be potential for some larger plastics firms to export, as large, multi-national corporations seek one global supplier for various products.
- The only way to increase the export potential of small and medium sized plastics firms may be to offer assistance in developing unique products that could be sold directly overseas and to encourage firms to tap directly into the Mexican and Canadian markets, where sub-assembly plastics parts might be needed.

C. Medical Equipment and Supplies in Southwestern Pennsylvania

- The U.S. medical equipment and supplies industry constitutes one of the United States' strongest exporting industries, with 23 percent of all products manufactured in the U.S. heading to foreign markets. The U.S. has 59 percent of the world market. Three reasons for this success are the U.S.' reputation for high quality, its cutting edge technologies and new discoveries, and its service.
- The most promising markets for U.S. medical products are Latin America, Japan, the rest of Asia, and the European Union. The U.S. possesses 21 percent of Japan's total market share, 62 percent of Canada's, 25 percent of France's and 20 percent of Brazil's.
- The ARC region is not particularly strong in medical devices. Most clusters within the industry are near large medical centers and research universities, which are not prevalent in the Appalachian region. Pittsburgh, with two strong research universities and large hospitals, had the highest concentrations. Medical devices firms also are found in the eight surrounding counties.
- Although this area has the strongest medical device firm presence in the ARC region, it is home to a below-average concentration of firms and employees compared to the U.S. Further, local companies make a wide range of products and have no special market niche. Thus, it does not meet criteria for a "cluster" based on either concentration or interdependencies. Because of the small size of the cluster, there are few services in the area that specifically cater to the unique needs of medical device firms.
- The few large companies in the area already export heavily, but because so many of the smaller firms provide local hospitals with fitting devices for specific patients, they are not good candidates for exporting.
- In general, most firms that want to export are already be doing so. Most of the steps that could be taken to increase the level of exporting among these firms would be regulatory

reforms by the U.S. Food and Drug Administration or by foreign nations. Firms cited stringent foreign requirements as a major impediment to increased exports.

- If Pittsburgh wants to build a true medical device cluster, it will have to successfully recruit a number of large firms to add to the few that already operate in the area might be an appropriate strategy and look for ways to develop a supplier base, a long-term strategy. Given that smaller companies often spin out from larger ones, the location of a few industry giants could also spawn new and vibrant SMEs.

D. Knitting Mills in North Carolina and Virginia

- The knitting mill cluster in North Carolina/southwest Virginia/northeast Tennessee produces hosiery, knit outerwear, knit underwear, and knit fabric. More than 130 companies employ almost 20,000 people in a 20-county area.
- Global markets are significant for niche knit products, including branded items, specific use products (such as athletic or medical goods), and products with a strong design component. "American Casual" style apparel and textiles are increasingly popular in Japanese and European (particularly the United Kingdom) markets.
- The U.S. faces stiff foreign competition from low-wage countries in high labor content knit products that must be cut and sewn, such as sweaters and shirts. The U.S. has a stronger competitive position for low labor content goods, such as hosiery and knit fabric. The quality of U.S. yarns and fibers used in high end products represent a competitive advantage. ARC knit producers are, on the whole, as competitive as the average U.S. firm. Within the textile and apparel industries, knit goods is one of the most competitive sectors in export markets. Firms are fairly technologically advanced.
- The cluster is comprised mostly of hosiery companies (55 percent of employment), followed by knit outerwear (26 percent), and knit underwear (9 percent). Since the South produces most of the nation's textiles and apparel, the cluster is located within an even larger concentration such firms.
- Most hosiery firms produce basic "commodity" goods that are not export appropriate. Strong foreign competition exists for "cut and sewn" knit products. As a result, most firms are small and have little marketing capabilities and are unaware of how to find and sustain exporting relationships. Companies must currently self-finance export activities.
- Export potential exists for some, but not the majority, of firms in the cluster. Realizing this potential will take more tailored and more easily accessible information about export markets and better economies of scale to pay for costs associated with exporting. Many firms are now receptive to the idea of entering export markets due to consolidation of U.S. retail markets and overcapacity within the sector.
- The cluster is a mature production system with strong support services, and cooperation among companies is fairly common. Good distribution and transportation infrastructure support exporting efforts.

E. Electronic Components in New York

- The ARC is relatively weak in terms of electronics, with export growth well below the national average. Among ARC states, New York has the highest level of employment in electronics components and a major cluster is in the Southern Tier of New York and the

cities of Binghamton, Johnson City, Endwell, Endicott, and Vestal. York's electronics cluster is fairly diverse with one of its unique features being linkages with ceramics firms in the western part of the region.

- The global market is highly competitive, price sensitive and mainly for commodities. Competition in the electronics industry is fierce, and to be successful a company must have superior technology and/or be highly price competitive.
- The greatest export potential for U.S. electronics components is in markets that are sophisticated and require high levels of technology, such as semi-conductors. The primary customers for electronic components are large, multinational firms that have facilities in countries with few regulations and relatively inexpensive labor costs. Primary markets for U.S. electronics include Canada, Mexico, Singapore, Japan, and Taiwan.
- The cluster has is a strong base of technological support for firms, including particularly strong programs of basic and applied research and development in electronics "packaging" (the physical environment in which chips are contained and operate). Firms view the region's labor force as a significant competitive advantage.
- Larger firms have a great deal of expertise in export sales. A few small electronics firms in the Southern Tier have become adept exporting, but most do not. Most supply components and sub-assemblies to larger firms who may export them as fully assembled products.
- A major barrier to exporting among non-exports is that they are assembly "job shops" or contract manufacturing facilities who view themselves as too small and locally linked to have export capability. Other firms, such as coils and transformers businesses, do not compete because of the enormous price competition from firms in low-wage rate areas.
- There appears to be significant opportunities to expand exports, especially from firms who had been content to service domestic and regional markets. Much of this potential comes from firms beginning to apply their specialized capability in electronics packaging.
- Rather than generic export assistance, it appears that the most rewarding export promotion strategy would be to develop a consortium of exporters and non-exporters who would seek to develop joint marketing and market servicing capabilities in target countries.

F. Household Furniture in Alabama and Mississippi

- This "cluster" is actually two distinct and independent clusters that grew out of the hard work of early entrepreneurs. Northwest Mississippi is home to 318 firms with almost 50,000 people and specializes in upholstered pieces. Northeast Alabama has 205 firms with 15,000 people specializing in solid wood pieces.
- Overseas markets are importing more American furniture, buying $1.3 billion in 1995. The ARC region has contributed a major share of the growth in U.S. furniture exports. Firms believe exporting is very important to the future of their industry. The best sales prospects are Canada and Mexico (NAFTA), Japan, the Middle East (Saudi Arabia), and emerging markets in Latin America
- The niche of both clusters are quality-oriented, promotional (low cost) furniture—solid wood in Alabama and upholstered furniture in Mississippi. The cluster's competitive strengths are in price, design, and access to quality raw materials and suppliers within the local area.
- Promotional furniture is being exported to targeted customer groups abroad, but firms pursue a "passive" approach of order taking from buyers at domestic trade shows. Companies with full-time export staff who travel abroad are most successful.

- Barriers to exporting cited by companies were lack of specific market and customer information. And, lack of skilled labor was cited by a large number of respondent companies as a major impediment to both domestic and export performance.
- The potential to produce and grow via exports is much greater than currently realized. Firms export, on average, less than three to five percent of total sales.
- To realize the clusters' full potential the region must increase worker skills to operate advanced machinery. Firms must commit resources to hire specific staff, seek out foreign markets and export.

G. Industrial Machinery in North and South Carolina

- The industrial machinery cluster is centered in the Greenville/Spartanburg area of South Carolina but extends into Western North Carolina. This highly differentiated cluster produces a wide range of machinery, with the greatest concentrations in automotive and textile machinery. It is composed predominantly of small and mid-size firms and is noteworthy for its high percentage of foreign-owned firms. The cluster is competitive, technologically advanced, and constitutes one of the leading machinery clusters in the U.S.
- Industrial machinery has high export potential, and the majority of final equipment makers are already exporting. However, a significant portion of industrial machinery firms are tool and die or other small job shop operations, performing custom work to order and with less possibility of exporting. Thus, there is more potential to raise exports by helping small and mid-size firms penetrate new markets and expand sales to existing markets than helping current non-exporters to export.
- The U.S. is highly competitive in industrial machinery and exports industrial machinery to all of the world's markets, with the majority going to Canada and Western Europe. But the best mix of prospects varies substantially depending on the specific type of machinery produced. Europe, Japan, and certain former Soviet states provide serious competition for specific kinds of machinery.
- Firms in the Greenville/Spartanburg area and service providers alike reported that exporting is an important and growing part of their strategy. The main barriers cited as impeding more aggressive expansion of exports were lack of market-specific information, lack of export finance and/or concerns regarding international payments, unfavorable policy conditions in target markets and/or subsidies by competing countries, and high costs of international marketing.
- Based on the export orientation of this cluster, its highly competitive position on world markets, and the barriers cited, it appears that this sector offers good potential for further export development. The best prospects for this cluster are: (1) programs to help firms gain better product-specific and country-specific marketing information at lower costs, such as cost-sharing of specialized consulting or trade show attendance by a group of firms and (2) measures to develop better export finance access for these firms, such as collaboration with local banks to improve their linkage to international financing sources.

Findings

This study focused on places in Appalachia where sectors are clustered. Does clustering matter and how does it affect businesses' ability to learn, modernize, and export? It is difficult to make meaningful generalizations that can be applied to other locations because each cluster selected and studied is unique and the way it functions is a product of the type of goods it produces, the customers it targets, and the level of interdependencies among its companies and services (See Table 1).

In fact, the clusters as defined by products and the places with the highest concentrations of companies making those products did not all turn out to be clusters as defined by interdependencies and system characteristics. The medical devices cluster, for example, comprised too few firms with too diverse products and customers and is imbedded in too large an industrial base to be considered a cluster in any sense of the word. Industrial machinery producers are more tightly linked to their customers' clusters than each other, although the smaller supplier firms may constitute a truer and more interconnected cluster. Too little information was gathered about the latter firms to judge their degree of interconnections. Plastic parts and electronics components are clusters of suppliers that achieve external economies as a result of their numbers and are dependent on their customers.

An analysis of two other clusters, household furniture and environmental technologies, revealed that they were each actually two distinct clusters. This illustrates the danger of using only low-level (two- or three-digit) SIC codes to define clusters. Household furniture producers operate as a strong cluster producing upholstered furniture in northeastern Mississippi and a slightly weaker cluster producing solid wood pieces in northern Alabama. In Tennessee, the cluster around Oak Ridge concentrates on nuclear energy and waste and the cluster around Chattanooga on conventional manufacturing environmental problems. Knitting mills as an entire sector is not a cluster but its largest component, hosiery, is a very complex cluster, again illustrating the problem in using three-digit or lower SIC codes. Hosiery firms are tightly linked to each other but not nearly as tightly to other types of knitting mills.

In only three of the clusters do concentrations and connections appear to improve firms' interest in and ability to export. Knitting mills (hosiery), furniture, and environmental technologies are favorably affected by collective marketing and/or better access to information. Electronic components has the potential to benefit from such activities but does not yet. Industrial machinery markets are too diverse and customer specific, and are dependent on customer relationships. The medical devices cluster around Pittsburgh, as defined by current members, is tied to local customers, and plastic parts has little potential because its capabilities are too ubiquitous and readily replicable locally.

Despite the individuality of the clusters, the accumulated knowledge does lead to some findings about export potential. Each cluster has some but not all of the strengths necessary for success in exporting, and therefore each has areas in which it can improve its performance—if it so chooses.

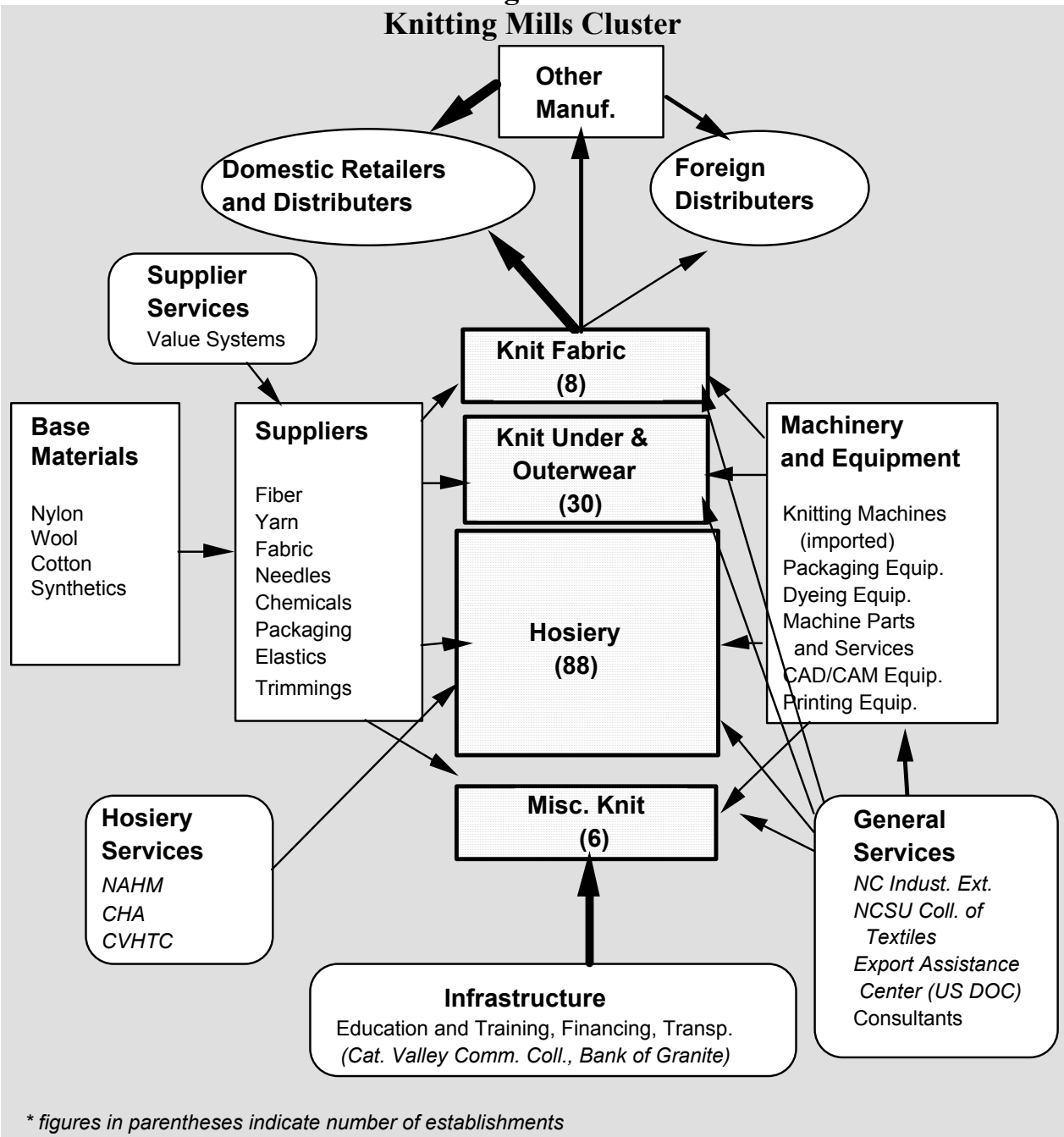
- Clusters that are mainly suppliers of larger firms (e.g., plastics parts and electrical components) are less likely to export than those that sell to final users (e.g., industrial machinery and household furniture).
- Clusters that compete on design or innovation (e.g., environmental technologies and industrial machinery) are more likely to have a future in exporting than those that compete on the basis of lowest price (e.g., plastics parts and knitwear).
- Clusters that are internally networked and can take advantage of external economies of scale (e.g., hosiery and environmental technologies) are more likely to be able to export and adopt new technologies than those that are not (e.g., medical devices).
- Clusters that are composed of larger companies (e.g., industrial machinery and are more likely to export than those comprised of small companies (e.g., knitting mills and .
- Clusters with strong and specialized support services—especially those with marketing expertise, (e.g., hosiery and plastics parts)—are more likely to export than those with fragmented or generic services (e.g., medical devices and industrial machinery).
- Clusters with pro-active companies that seek out markets (e.g., industrial machinery and environmental technologies) are more likely to export than those that are "order takers" (e.g., household furniture)
- Within clusters, firms that are more technologically advanced (often the larger SMEs) are more likely to be exporters than the less advanced firms.

Finally, for the benefit of future cluster analyses, it is important to note that three-digit SIC codes do not adequately classify clusters. Some are too broad (i.e., hosiery is a cluster but other knitting mills in SIC 225 are dissimilar and unconnected); some are too restrictive (i.e., they miss vertically integrated clusters where suppliers are part of cluster); and some are too new and undefined by product (i.e., environmental technologies).

Table 1
Summary of Cluster Characteristics

Cluster	Main Customer Base	Specialized Services & Infrastructure	Export Performance	Export Potential	Synergy	Competitive Advantage	Export Prospects
Electronic Components (NY, PA)	Large final producers	Strong technology services; private support services	Fairly high among high-End and specialized producers	Strong for specialized products	Significant but informal cooperation	Labor skills; "niche" capabilities	Strong base exists to support export expansion efforts
Environmental Technologies (TN)	Government	Two industry associations; federal labs; university expertise; training programs	Minimal but growing recognition of need to export due government cutbacks	Very strong particularly for nuclear cleanup as environmental concerns rise	Firms highly competitive but form partnerships for specific contracts	Highly skilled labor; Specialized facilities; Cutting edge products and services	Strong if firms Broaden horizons and build infrastructure to overcome locational disadvantages.
Household Furniture (AL, MS)	Retailers	Showrooms; technology centers	Minimal	Strong in newly developing economies	Informally networked to share resources, solve problems	Price; access to raw materials	Good if firms overcome passive marketing and network to share costs
Industrial Machinery (SC, NC)	Manufacturers	Technical colleges best source	High among mid-sized firms; low among small suppliers	High	More tightly linked to customers' clusters than each other	Technologically advanced; internationally competitive	Expansion possible with more support services in place
Knitting Mills (NC, VA)	Large retail chains	Technology center; active trade association	Small, individual efforts	Strong for high-end, branded goods with low labor content	Hosiery intensely networked; collective identity	Design, quality; strong suppliers	Good for firms with appropriate products (relatively few firms)
Medical Devices (PA)	Hospitals and physicians	None	Virtually none	Very high for sector overall, but low for firms in cluster	No interdependencies	Firms are too dissimilar to jointly characterize	Insufficient concentrations; Inappropriate products
Plastics (PA, OH)	Manufacturers	R&D at local university; dedicated extension services	Moderate among larger firms; minimal among small firms	Limited because most products are not export appropriate	Substantial linkages among firms; regional cluster identity	Skilled labor; sector expertise; price and quality	General lack of interest in exporting

Figure 1
Knitting Mills Cluster



** figures in parentheses indicate number of establishments*

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Exporting for Mass Consumption (Brian Davis)
Knitting Mills in North Carolina and Virginia
Committed to Cooperation (Cynthia Liston)
Electric Components in New York
A Self Aware Cluster (Brian Bosworth)
Plastic Parts in Northwestern Pennsylvania and Ohio
Successful, Clustered, and Ubiquitous (Dan Broun)
Medical Devices in Pennsylvania
Still Undeveloped Potential (Dan Broun)

Acknowledgments

This project was a team effort, with the Alabama International Trade Center (AITC), the Kenan Institute for Private Enterprise (KIPE), and Creative Strategies, Inc. (CSI) playing key roles. Pat Dusenbury of CSI did the trend analysis for the ARC states and national overviews and analyzed environmental technologies; a team at KIPE led by Jennifer Bremer and including Barbara McMurray and Kathleen McDevitt contributed the cluster specific export analyses in the appendices to the individual case studies and analyzed industrial machinery; and Brian Davis at AITC helped identify exporters in all clusters and analyzed the household furniture clusters. RTS principal Brian Bosworth and RTS staff members Daniel Broun and Cynthia Liston carried out the other four cluster analyses. Each brought a different perspective to the project—particularly with respect to trade issues—that complemented RTS' experience in industrial competitiveness issues and programs. In addition, Pat Dusenbury and Cynthia Liston contributed to and edited the final report.

A number of others also contributed to the study. University of North Carolina graduate student Theodore Noell did most of the data analyses and mapping of employee and establishment concentrations. Richard Bell conducted the interviews for the plastics and medical devices clusters and Robin Alpaugh did the same for the electronic components cluster.

Within the clusters, Paul Fogleman, executive director of the Carolina Hosiery Association was extremely helpful, setting up interviews at his offices and providing a history of the hosiery industry. Tom Trevor of Chattanooga State Technical College assisted in arranging interviews with environmental technology firms in his area.

Finally, Carol Conway of the Southern Growth Policies Board provided us with a great deal of useful background reports and materials plus advice at various stages as the project progressed.

Stuart Rosenfeld
Project Director
February 24, 1997

PART ONE: FRAMING THE SITUATIONS

A. Why Worry About Exports?

Appalachia, like the rest of the United States, looks increasingly to foreign markets for its sources of economic growth. National economic data, backed by mounting research, underscores the importance of exports to the region's industrial Competitiveness. For too long, U.S. firms have taken the country's large and expanding domestic markets for granted and assumed that U.S. customers could absorb all of their production and generate continuing growth. Thus, they assumed, there was little need to aggressively seek customers outside U.S. borders.

As a result, U.S. companies, according to Conway and Nothdurft, have been "the world's biggest export underachievers." Exports as a percent of GNP are less than half of what they are in Germany, Japan, Canada, and the United Kingdom combined. But this situation is rapidly changing. Last year total exports for U.S. firms were 52 percent higher than in 1990.[12] A small number of the nation's largest companies (about fifty) still account for almost half of U.S. exports, but with rapid rises in imports competing for domestic markets, consolidation of retail markets, and growing opportunities abroad, exporting has become an important consideration—if not imperative—for firms of all sizes.

Smaller firms in particular have been slow to exploit export opportunities. Often their management lacks the specialized expertise, resources, access to necessary information, and capital of large companies. In 1995, only 14 percent of firms with between 20 and 100 employees were direct exporters, and in almost half of those firms no more than five percent of sales were exported. Less than nine percent of firms with fewer than 30 employees export. These data have led to government to focus on SMEs, and since the enactment of the Trade and Competitiveness Act of 1988, U.S. federal and state policy has paid greater attention to the capabilities and competencies of small and medium-sized business enterprises (SMES) with respect to both meeting market requirements and levels of modernization. In 1993 the recommendations of the President's Competitiveness Policy Council contained in its "Trade Policy for a More Competitive America" led off by exhorting the government to "stimulate an 'export mentality' by concentrating on the untapped export potential of small and mid-sized businesses."[3]

Exports, we know, create jobs, and companies that do export exhibit significantly more (statistically different) of the characteristics associated with higher performance companies-higher value added per employee, higher wages, salaries and benefits, higher capital expenditures per employee, and higher investments in plant and equipment per employee. High technology industries tend to export more than lower technology industries, but the differences in indicators of performance hold, in general, across all sectors of manufacturing. In transportation equipment, for example, value added per employee for exporters was 48 percent higher than for non-exporters, investment in plant and equipment was 47 percent higher, and salaries and wages were 23 percent higher.[4] Exports also have a large multiplier effect. Every single manufacturing job directly associated with exports creates slightly more than two additional jobs indirectly associated with exports.[5]

It is not at all surprising to find that the vast majority of exporting in the United States is done by large, multi-branch corporations-which could account for the higher average wages in exporting firms since larger companies on average pay higher wages. But since much of the data used to measure exports—such as the *Annual Survey of Manufacturers*— includes large establishments, it is difficult to capture accurately the full export value of the small and mid-sized companies that comprise a large proportion of the industrial base of Appalachia. Data analyses have shown, for example, that most of the value of exported goods comes from lower tier suppliers. These firms are indirect exporters and may have to meet demands of export markets even if they do not transact business directly.

Driving Exporting and Modernization

Government-sponsored technical assistance programs, for the most part, have separated the related goals of and support services for technological development/utilization and market development/exports. Consequently, each set of programs is driven by a different set of assumptions about the competitiveness of SMEs.

- Government programs that promote greater adoption of technologies (popularly called "industrial modernization") are based on an accumulation of survey evidence showing that, on average, SMEs in the U.S. lag behind SMEs in leading foreign competitor nations in technology adoption. Experts contend that American SMEs can and will be more competitive in global markets and better able to export if they increase and expand their uses of advanced technologies. Engineering problems drive the activities of agencies that are formed to assist with modernization and staffed by technicians and engineers more interested in and knowledgeable about improving product than expanding customer bases. Such government-assisted efforts include industrial and manufacturing extension services, quality certification programs, technology transfer programs, university-based technology centers, community colleges' continuing education divisions, technology trade shows, and state technology councils.
- Government programs that promote exporting also justify their activities on surveys—but about markets, not technologies. These data inevitably show low proportions of exporters among SMEs. Programs to encourage exporting, experts assert, may require firms to modernize because new customers are likely to be more demanding. For example, western European nations that have high quality standards and Pacific Rim nations with demanding delivery schedules as well as quality requirements will cause SMEs to invest in new technologies. Market trends and opportunities drive programs that work with marketing—particularly exports—and their staffs are often former marketing and sales managers and economists, many with little knowledge of production issues. These include state-operated foreign trade offices, trade missions, small business development centers, world trade centers, export service directories, trade shows, and trade lead services.[6]

Unfortunately, the value of technology in opening new markets has been difficult for many companies to accept because equipment manufacturers have promoted their new technologies far more as a labor saving than capacity building device. For decades, machine builders advertised the labor reductions possible with their equipment as justification for investments. In the 1980s,

however, when quality and flexibility emerged as the new foci of modernization, companies began to invest in new technology not just for cost savings but to also meet rising quality standards and produce smaller runs of more specialized goods. In the 1990s, time is emerging as yet another new competitive advantage, and modernization is also being pursued to reduce time to market or order.

This policy dichotomy between modernization and marketing divides the delivery of services and creates unnecessary confusion for the smaller firms because the two strategies of modernization and market development are not separated in the decision-making processes of small businesses managers and often handled by the same people. In fact, programs that promote modernization ultimately will expand market opportunities, and policies that promote exports ought to eventually require modernization. To adopt new technologies, SMEs have to justify their investment and training costs on a cash flow basis, which generally is related to new markets and sales growth. At the same time, firms considering new markets often find that they need to modernize in order to be "export-ready," and meet the quality, design, and delivery standards of their competition. Most government programs are not organized to address these issues holistically.

Fusing Modernization and Exporting

Where programs are becoming more demand driven, the barriers between modernization and export assistance programs are fading, and distinctions between production and marketing capabilities are diminishing. For example, members of the new Manufacturing Extension Partnership (MEP), established by the National Institute of Standards and Technology (NIST) in 1988 to enhance technology transfer, increasingly are being asked to provide their clients with assistance in domestic and foreign market development. Each of the Appalachian states has a state program supported by NIST aimed at assisting Appalachian SMEs modernize, e.g., the West Virginia Partnership for Industrial Modernization which includes the Richard C. Byrd Center, Marshall University, and West Virginia University; the Virginia Alliance Competitive Manufacturing, which includes the A.L. Philpott Manufacturing Center, the Manufacturing Technology Center at Wytheville Community College, and the Center for Innovative Technology; the Southeastern Manufacturing Technology Center in South Carolina; the North Carolina Manufacturing Extension Partnership headquartered at North Carolina State University; and the Southwestern Pennsylvania Industrial Resource Center in Pittsburgh.

Further, a new set of programs established by modernization advocates to encourage inter-firm collaboration ("networks") as a means for enhancing the capabilities of SMEs found much greater interest in marketing and exporting than in technological advancements. Accordingly, these centers recognize that exporting is a leading driver for competitiveness, and therefore technical assistance is now a priority of many of the Manufacturing Extension Partnership centers. The more effective programs are those able to address the multi-dimensional needs of SMES, which include not only technology and training, but the skills, finances, and contacts to be able to export.

Most programs that target SMEs, however, operate on very small budgets, have little long-term security, and are asked to very quickly move toward self-sufficiency. This drives them toward

more urban areas, larger companies that are better able to pay for services, and shorter-term, less strategic, projects that can yield quicker returns. Modernization programs, in particular, continually struggle to maintain a presence in rural areas and there are few provisions for the diseconomies of scale associated with more rural areas and very small companies.

Exporters, Sectors, and Industry Clusters

At the heart of this project is the knowledge (based on existing research) that virtually all small and mid-sized businesses do business in the context of complex production and social systems that include other firms with similar or complementary products, materials, supplies, services, resources, capital, and distribution channels. To take advantage of external economies of scale and access to information and innovation, firms with common needs or interests tend to cluster together in spatially bounded regions.[7] Although clusters are most often designated by standard industrial classifications (SICs) of their products, firms also cluster around other commonalities. The element binding firms together may be a marketing strategy, exemplified by the crafts cooperative Watermark, in North Carolina whose products include ceramics, wood, and fabrics. he element could be a common core technology, illustrated by the optics and imaging technologies in Rochester, New York, or biotechnology in central Kentucky. It may be a similar set of labor market skills, such as the metals industries in the multi-county Region 2000 of central Virginia.

Clusters Count, But Clusters are More Than "Counts"
Defining and understanding clusters is much more difficult than spotting concentrations. It involves a set of intangible factors, e.g., social infrastructure; access to information, services, and capital; and linkages to other markets. An industry duster has a critical mass of companies with like interests, a set of specialized services, an experienced labor market, suppliers, and relevant R&D. Every agglomeration of companies with a common interest does not function effectively as a duster and produce synergy. Synergy depends on relationships within the cluster and the ability and willingness to recognize and act on complementarities and common interests by forming various kinds of alliances, sharing non-proprietary information, and challenging each other to improve and innovate. It depends on the entrepreneurial energy and the rate of new business spin-offs. And it depends on the presence of leadership and a collective vision for the cluster. These process-oriented attributes depend in turn on the region's social infrastructure—the associations and organizations that bring business people together where they can get to know and trust each other.

The factors that affect the flow of information and foster alliances, we believe, also influence success in export readiness and activity. Research on clusters demonstrates that high concentrations of companies making similar products, complemented by their suppliers generate sufficient demand to attract specialized services and labor markets, stimulate flow of information about market opportunities and emerging trends, and facilitate inter-firm cooperation. Clustering of like or related businesses also leads to the obvious conclusion that specialized factors are more important to a region's economy than generic factors.

Although ARC specifies sector-based clusters, in investigating clusters, the research team looked for firms with products complementary to those of the targeted sectors, which also might be able

to take advantage of similar export services and markets. For example, the firms that comprise the industrial machinery sector are not simply an independent cluster but inputs in other clusters. The industrial machinery cluster in South Carolina emerged from the needs of the textile and knitting industries in the 1950s, electronic components is an input to the industrial machinery industry, and plastic parts are required to produce many electronic components.

B. Choosing Appalachia's Key Industry Clusters

Despite the steady march of jobs from the production sector to the service sector, Appalachia remains a manufacturing intensive region. It accounted for about 1.9 million jobs in 1993. The northern part of the region (Pennsylvania, New York, and Ohio) and a southern wedge from South Carolina running through Alabama and Tennessee have the largest concentrations of manufacturing employment. As shown in Table 1, non-durable goods industries are more concentrated in Appalachia than in the rest of the U.S.

The selection of industries for analysis is based in part on a prior study by the Kenan Institute of Private Enterprise at the University of North Carolina[8] of the structure of manufacturing within the ARC region, as defined by maps of concentrations of industries within ARC's local development districts (LDDs) according to their three-digit Standard Industrial Classifications[*] (SICs). The study compares ARC to national profiles and differentiates between small (less than 100 employees) and mid-sized firms (100 to 500 employees). It then estimates the "export potential" for each sector by applying national data on export value per job at the two-digit SIC level to the ARC industrial profiles and calculates a hypothetical surplus or deficit based by comparing the export value per job for the ARC states' economies to the national economy. For example, food processing shows a deficit of about 25 percent in exported goods per job compared to the national figure because the industry is underrepresented in Appalachia. In contrast, furniture shows a surplus of nearly 50 percent in exported goods per job because it is has proportionately more employment in the region. The investigators' assumption was that some industries are more inclined to export than others and therefore the region should direct its efforts to industries with the most export potential.

[*] SIC refers to the Standard Industrial Classification system (SIC) used to classify each industry in the United States economy. This report uses the system detailed in 1987 *Standard Industrial Classification Manual* by the Executive Office of the President, Office of Management and Budget, National Technical Information Service, Springfield, VA.

Table 1
Concentrations of Industries in Appalachia, 1993

SIC	Industry	Ratio of % or ARC mfg employment to % of National mfg employment
20	Food processing	0.79
21	Tobacco	1.50
22	Textiles	3.40
23	Apparel	1.81
24	Wood products	1.34
25	Furniture	1.96
26	Paper	0.94
27	Printing & publishing	0.56
28	Chemical	1.02
29	Petroleum	0.67
30	Plastics	1.06
31	Leather	1.00
32	Glass	1.46
33	Foundries	1.68
34	Fabricated metals	0.87
35	Industrial Machinery	0.85
36	Electronics	0.85
37	Transportation	0.47
38	Instruments	0.52
39	Miscellaneous	0.63

To make an initial selection of clusters for this analysis, defined by three-digit SICs, the Appalachian Regional Commission used the following factors:

- Kenan's Local Development District (LDD) maps of sector employment and firm concentrations of small and mid-sized companies;
- presence of sector concentrations in multiple areas (and states) within the region;
- a mix of traditional and mature sectors with more rapidly changing sectors; and
- potential value to region.

Export intensity was not a major consideration in the selection, and some of the clusters selected had low rates of exports. The process resulted in two traditional sectors (household furniture and knitting mills); four more technologically advanced sectors (plastic parts, electronic components, industrial machinery not elsewhere classified, and medical devices); and one emerging industry believed to have high growth potential but not identified by a single set of SICs (environmental technologies).

Household furniture (SIC 2510) The household furniture manufacturing industry is made up of producers of wood, upholstered, metal and other furniture, and mattresses and bedsprings. In the second half of the 1990s, household furniture shipments in constant dollars are expected to

increase three to five percent annually. Total U.S. employment in household furniture manufacturers was 250,000 in 1992 with the ARC region home to approximately 75,000 of these jobs. North Carolina, Mississippi and Alabama had the highest concentrations-approximately 24,000, 19,000 and 5,000 jobs, respectively.

Industrial machinery (SICs 3540, 3550, 3560, & 3590) This category includes four SIC codes: machine tools, special industry machinery, general industrial machinery, and industrial machinery not elsewhere classified. The companies with these SICs produce a wide range of specialized machinery for a variety of industrial processes—e.g., textile, woodworking, paper and printing, and food processing. They also produce machinery common to many manufacturers such as furnaces, pumps and pumping equipment, pistons, ball and roller bearings, compressors, and blowers and fans. This cluster, combined with the closely related 3550 and General Industrial Machinery (3560), employs 721,000 in the United States in 1992 and almost 70,000 in the ARC region. Pennsylvania (20,000), Tennessee (9,000), South Carolina (9,000), and New York (7,000) have a significant portion of these jobs.

Electronic Components (SIC 3670) Components are fundamental building blocks for the electronics industry. A wide variety of products make up the electronics components category, including electron tubes, printed circuit boards, semiconductors and diodes, capacitors, resistors, coils and transformers and connectors. Demand for electronic components comes primarily from the computer, telecommunications, instrumentation, medical equipment, and transportation industries. These components accounted for about 507,000 U.S. jobs in 1992. The ARC region has 38,000 electronics components manufacturing jobs, with heavy concentration in western New York (17,000) and Pennsylvania (9,000).

Environmental Technologies and Services (SICs N/A) The environmental technologies and services industry includes industrial air pollution control equipment, water and wastewater systems, solid waste recycling, hazardous and toxic waste technologies, and the emerging pollution prevention industry. This relatively young industry has evolved in response to enactment and enforcement of pollution control legislation in the United States and growing concerns about the risks and costs of pollution. Because the environmental equipment industry includes many diverse products, services, and technologies, it is extremely difficult to estimate market size or employment levels in environmental goods and services using SIC code-based data. Industry analysts estimate the national environmental technologies employment reached 1,263,000 in 1994. Employment estimates for the ARC region are not available.

Medical Instruments and Supplies (SIC 3840) The U.S. medical and dental instruments and supplies industry is a diverse and technologically dynamic sector consisting of surgical and medical instruments, surgical appliances and supplies, dental equipment and supplies, X-ray apparatus and tubes, electromedical equipment, ophthalmic goods, and used and refurbished medical equipment. Nationwide, industry employment was 253,000 in 1992, with 16,000 in the ARC region. Tennessee, Georgia and Pennsylvania have the strongest presence, with a combined total of about 10,300 (2,700, 2,200 and 5,400, respectively).

Plastics Products (SIC 3080) Companies within this duster produce plastic parts for use by the electronics, health care, construction, transportation, automotive and food packaging industries. Production processes involve the transformation of primary plastic inputs into plastic shapes

with specific characteristics. There were 637,000 plastics products jobs in the U.S. in 1992. In the ARC, employment in companies producing plastics products was about 60,000. Pennsylvania, with 18,000 jobs, and eastern Ohio, with 6,000, together make up a significant portion of this employment.

Knitting mills (SIC 2250) Knitting mills are part of the textile industry but face pressures more similar to the apparel industry. The category consists of producers of hosiery, socks, knit underwear and outerwear, and knit fabrics. Total U.S. employment in knitting mills was almost 190,000 in 1992. About 51,000 of the jobs were in the ARC region, with North Carolina (20,000), Alabama (12,000) and Tennessee (7,000) having the highest concentrations.

Given these as starting points for the study, the research team set out to refine the sector selection in order to apply a cluster approach and search for interdependencies among firms that affected competitiveness and export readiness. This process resulted in two modifications to the original selection. First, plastic parts was separated from plastics commodities to focus on a single type of process. Second, the classification for industrial machinery was expanded to include three closely related three digit sectors: metalworking, general, and special industrial machinery.

C. Posing the Questions

This report is based on a number of assumptions about what makes Appalachian businesses and economies competitive. The first is **clustering**: although the region as a whole is diversified, certain types of businesses are more likely to be found in some areas than others, and related businesses tend to cluster in particular sub-regions. This proximity to one another gives them certain advantages over firms that are more dispersed and isolated.

The second is **connections**: when companies in a region are interdependent, i.e., formally and informally rely on each other for information, specialized services, parts, supplies, workers, technologies, and sales, they are more competitive collectively than companies in regions that are not well connected to each other. Further, clustered companies that are linked to external sources of information, innovations, and customers—throughout the world—are more competitive than companies that are provincial and unconnected.

The third is competencies: companies that learn about and use the most advanced and appropriate technologies, that invest in the skills of their work force, and that either possess or can access expert advice and assistance are more competitive than those that do not.

These three assumptions—clustering, connections, and competencies—led to a series of questions about the export readiness, competitiveness, and interdependencies of Appalachian businesses.

Export issues and capabilities

- Who exports what and where? What are the major exported products and what countries are their major destinations?

- What entities help SMEs export and how do SMEs rate their services? Is the propensity for an SME to export related to the strength and accessibility of export assistance and support services?
- How important is exporting to Appalachian SMEs?
- What conditions impede exporting and what are SMEs' needs?

Competitiveness issues and conditions

- What must SMEs do to prepare for exporting? Are SMEs that export more likely to be modernizers because of the standards imposed by foreign markets and competition?
- What organizations help SMEs improve their operations and become export ready?
- What advantages or disadvantages do SMEs ascribe to their location? Are rural SMEs less likely to be exporters than urban SMEs due, for example, to distance from distribution hubs, access to fewer specialized services and information, and increased transaction costs?

Interdependencies and connections

- What special advantages accrue from proximity to and relationships with other SMEs?
- Are firms that are embedded in tight production and social systems better able and more apt to export?

D. Industry Clustering within the Appalachian Region

While the preliminary data analyses used to help select sectors showed absolute concentrations of firms by SIC code, they did not indicate relative importance to local economies and thus generally favor large urban population concentrations. An alternative measure called a "location quotient" indicates relative concentrations. The location quotient is a ratio of the fraction of a region's employment (or number of establishments) in a specific industry compared to that same fraction of the national employment (or establishments) in that same sector compared to total national industrial employment (or establishments).

$$L.C. = \frac{\text{Number of employees (establishments) in sector, in region}}{\text{Total number of employees (establishments) in region}} \Big/ \frac{\text{Number of employees (establishments) in sector, in nation}}{\text{Total number of employees (establishments) in nation}}$$

Thus, a location quotient of 1.0 indicates that a region is at the national average while a location quotient greater than 1.0 indicates a higher than average concentration of that sector in a region. It is important to note that a high employment location quotient for employment may be due to a dominant branch plant rather than a cluster of firms. Further, these measures were based on the U.S. Department of Commerce's 1993 County Business Patterns, which Generally undercount employment and establishments.

Location quotients for the six clusters that could be defined by SIC codes were calculated for each county in the ARC region and then combined with the quantity of jobs and establishments to identify potential clusters of firms in groups of contiguous counties. The analyses, described in detail in individual case studies in the appendices, pointed to the locations most likely to

benefit from interdependencies and produce synergy. A small number of counties had high employment locations quotients but small numbers of companies and were eliminated from cluster analysis.

Gathering information

After selecting the sites, the field research teams set out to learn about the components of the clusters—the exporting and non-exporting firms; the services, institutions, and agencies that support them; and the infrastructures that undergird them. The goal was to identify factors that influence exporting, export readiness, and competitiveness, find out how proximity influences outcomes, i.e., whether clustering of the industry produces synergy, and whether a collective identity exists and does enhance performance.

The main source of information was a survey of small and mid-sized exporters, non-exporters, and support services conducted over the telephone and followed up by fax. The survey also included technology extension services, banks, trade associations, marketing services, freight forwarders, trade centers, and community colleges. In each cluster, the target was at least ten exporters, ten non-exporters, and six support services. Names and addresses for companies in the relevant SICs in each cluster were obtained from Dunn & Bradstreet, state catalogues, and other technical assistance providers.

Each research teams tried to connect with a local organizations known and respected by the potential respondents to identify exporters (general business data bases do not identify exporters), send letters of introduction and support and, in a few instances, to help collect information, provide an entr?, and secure cooperation. For example, the hosiery trade association and community college in North Carolina, industrial resource center in Pittsburgh, Plastics Technology Center in Erie, and the manufacturing extension office in Binghamton, New York all lent their names and assistance. One consequence of asking local agencies to assist in gaining access to firms, however, is that the sample of respondents is biased in favor of members or customers of these organizations, and therefore they are not statistically representative of the universe of manufacturers in the cluster. The major impact of that bias is toward greater use of agency provide information and services.

E. National and Regional Trends in Exports

Increasing the value of goods and services exported from the United States in order to reduce the U.S. international trade deficit is a national goal. But equally important, export sales represent revenues for U.S. industry and jobs for U.S. workers, and individual states and regional organizations have adopted the goal of increased export sales to provide income and support employment. Consequently, they want to know just how successful they are. But good information by sector at the state level is poor and county level non-existent.

The Massachusetts Institute of Social and Economic Research (MISER) refines data compiled from Shippers Export Declarations to produce a data series that is published in the National Trade Data Base. These data show the value and destination of exports from each state by two-

digit SIC industry. For the six target industries that are defined by SIC codes, export statistics in the analysis are based upon the MISER data in the National Trade Data Base. For the target industry environmental technologies, which cannot be defined by SIC codes, data produced by Environmental Business International Inc. is used for the analysis. Data sources are described in more detail in Appendix G, Data Sources and Methodology.

The MISER data has two limitations. First, only the state of West Virginia is wholly within the Appalachian Region; the other twelve states are parts of states. Since no sub-state data exist, for the national and regional trends analysis, statewide data serves as a surrogate for the ARC regions of each state. Second, MISER data describes two-digit SIC industries, but ARC defined six of its target industries at the three-digit SIC level or lower.

The export performance analysis uses national and state gross product data provided by the U.S. Department of Commerce Bureau of Economic Analysis (BEA), but the most recent gross state product (GSP) statistics available from BEA are for 1992. The 1993-1995 GSP for the ARC member states was estimated using recent growth in BEA state personal income data and trends in the relationships between personal income and GSP (methodology described in Appendix A).

Products of the trade flow analysis include an evaluation of overall export performance indicated by the contribution to that income that exports of goods make to the economy—for the Appalachian Region and individual member states. Comparisons between export performance of ARC states and national averages assess progress toward the ARC strategic plan objective, "Appalachian export performance will increase u to the national average." The analysis begins with an overview of the last three years' national exporting trends and then moves to more detailed analysis of the Appalachian States' export performance in the target industries selected by ARC.

Recent Export Trends

Between 1993 and 1995, the total value of goods exported from the United States increased by just over 25 percent—from $432 billion to $529 billion. Exported goods include manufactured products (the output of SIC industries 20 through 39), commodities such as coal or wheat, and miscellaneous materials, which include scrap and waste. The value of manufactured exports for those categories increased at the slowest rate, an even 25 percent, while the value of commodity exports increased by just over 31 percent. Table 2 reports growth in U.S. exports of goods for three categories.

Table 2
Total Value of Goods Exported, USA, 1993-1995 (Billions of Dollars)

TYPE OF GOODS	1993	1994	1995	1993-95 Change
Manufactured Goods	$423.2	$468.9	$529.0	$105.8
Commodities	$31.7	$32.6	$41.6	$9.9
Misc., Including Scrap & Waste	$9.9	$10.9	$12.4	$2.5
Total Exports	$464.9	$512.4	$583.0	$118.1

During the same 1993-95 interval, the total value of goods exported from the ARC states increased by just under 24 percent—from $127 billion to $157 billion, a rate of increase slightly below the national average. Clearly, ARC states participated in the nation's expanded export activity but have not led that growth. In contrast to national trends, the ARC states' combined totals showed little variation among the rates of growth for manufactured goods and for commodities, while the percentage increase in miscellaneous goods exports was less than half that for the other categories. Table 3 shows recent trade data for the combined ARC states.

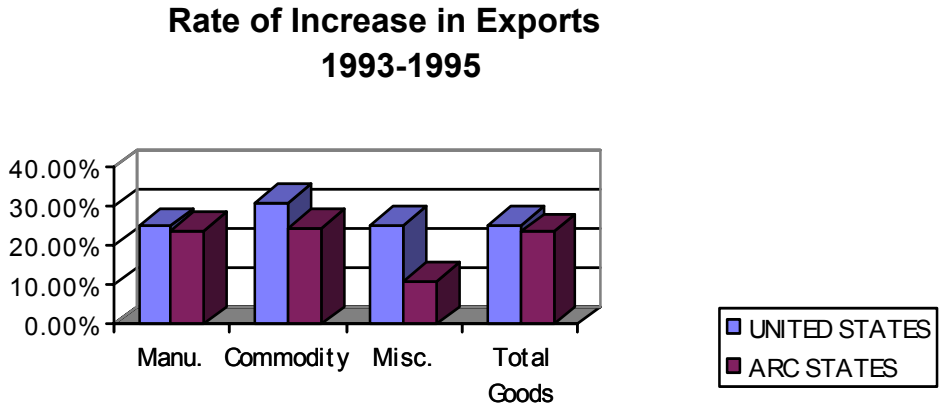
Table 3
Total Value of Goods Exported, ARC States, 1993-1995 (Billion of dollars)

TYPE OF GOODS	1993	1994	1995	'93-'95 Change
Manufactured Goods	$116.7	$127.7	$144.7	$28.0
Commodities	$6.6	$6.7	$8.2	$1.6
Misc. w/Scrap & Waste	$3.6	$3.7	$4.0	$0.4
Total Exports Of Goods	$126.9	$138.1	$156.9	$30.0

The slower growth rate for 1993-1995 goods exports from ARC member states suggests that the region is not making progress toward its target, the national average. However, this data describes trends in entire states, and except for West Virginia, only portions of these states lie within the ARC region. More detailed analysis is needed to assess with greater certainty whether of not the ARC is indeed losing ground rather than gaining on the national average.

Figure 1 illustrates in more detail differences between recent export trends in the three major categories of exported goods among ARC states and for the national as a whole. The ARC states' rate of increase in the value of goods exported was lower than the national average in every category. The deficit is smallest for manufactured goods.

Figure 1

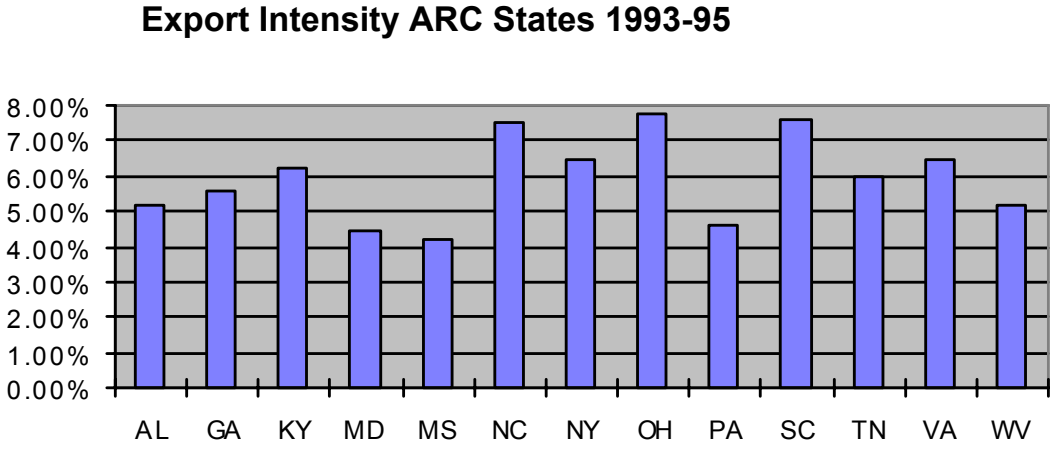


Export Intensity

Because the size of economies vary among ARC states, it is difficult to compare state exporting performance. One means for adjusting for size differences is to calculate the value of exports from a state as a percentage of its gross product (i.e., the total value of goods and services produced by the state). The resulting percentage describes the contribution of income from exports to the total economy. It also provides a basis for comparing ARC states to one other and to a national average. Figure 2 shows the export intensity for the ARC states for 1993-1995.

It shows, for example, that North Carolina, South Carolina, and Ohio were the only ARC states with an export intensity near or above the national average of 7.5 percent. The export intensity for the combined ARC states was 6.2 percent, well below the national average. Thus, most ARC state economies have received less benefit from export sales than average. The region-wide deficit in export intensity shows that the ARC states stand to benefit economically from increasing their export performance to the national level.

Figure 2



To facilitate comparisons of the ARC states' export performance with the national average over time, export intensity can be portrayed as an index relative to the national export intensity. A state with an export intensity greater than the U.S. average will have an export intensity index (EII) greater than 1.0, while a state where exports contribute a below average share of gross state product has an EII below 1.0. Changes over time in a state or regional EII reflect a change in the contribution of goods sold abroad to the state or regional economy that is greater (an increasing EII) or less (a decreasing EII) than the national average. Table 4 lists the EII for each ARC member state for 1993 through 1995.

Table 4
Export Intensity Index 1993-1995

STATE	1993	1994	1995
Alabama	0.65	0.69	0.71
Georgia	0.67	0.75	0.80
Kentucky	0.81	0.84	0.82
Maryland	0.62	0.60	0.56
Mississippi	0.52	0.52	0.62
North Carolina	0.91	1.02	1.06
New York	0.97	0.83	0.81
Ohio	1.04	1.05	1.01
Pennsylvania	0.61	0.61	0.61
South Carolina	0.95	1.00	1.07
Tennessee	0.74	0.81	0.81
Virginia	0.86	0.87	0.87
West Virginia	0.64	0.66	0.74
All ARC States	0.83	0.82	0.82

Ohio was the only ARC state with a 1993 EII greater than one, but by 1995, both Carolinas had joined Ohio in exceeding the national average. Nine of the 13 ARC states posted increases in their EIIs between 1993 and 1995, which means that their export intensity increased more rapidly than the national average. One of the states with a declining EII was Ohio, but it remained just above one.

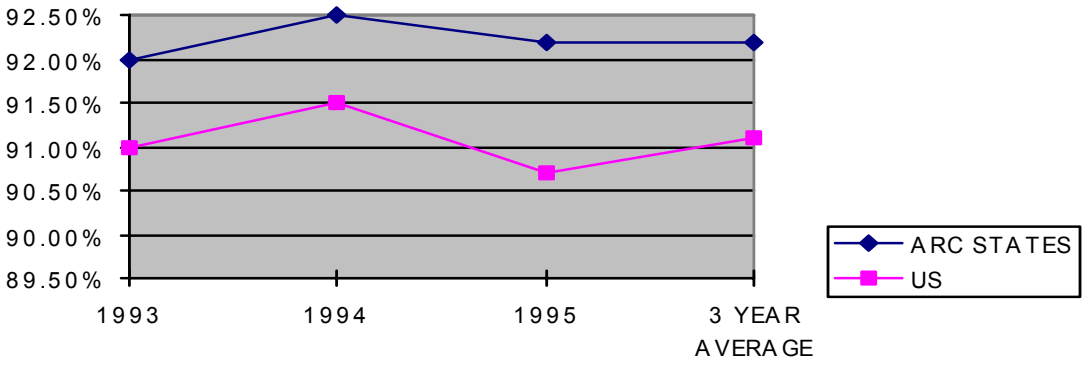
The strong increases that several states recorded in their export performance as measured by the EII suggests that these states are taking advantage of the opportunities offered by the growth in international trade. The fact that the majority of ARC states still have an EII below one indicates that there is a significant opportunity to improve the state economy by increasing export activity among the states' goods producing industries.

Manufactured Exports

For both the United States and the states in the ARC region, manufactured goods are the largest part of exported goods, accounting for over ninety cents of every dollar received by selling goods abroad. Clearly, manufacturing industries are both the key to the U.S. export activity and in a position to benefit from increased export sales. Manufactured goods comprise a slightly higher proportion by value of goods exported from the ARC states than from the U.S. as a whole. The proportions vary slightly from year to year, but the relationship was constant from 1993 to 1995. Figure 3 compares the proportion of manufactured products among goods exported.

Figure 3

Manufactured Products as a Percent of Goods Exported, 1993-1995



The predominance of manufactured products among goods exported improves the export prognosis for ARC states. If recent growth trends in manufactured exports rather than total exports are considered, ARC states as a group are experiencing a growth rate only one percentage point below the national average.

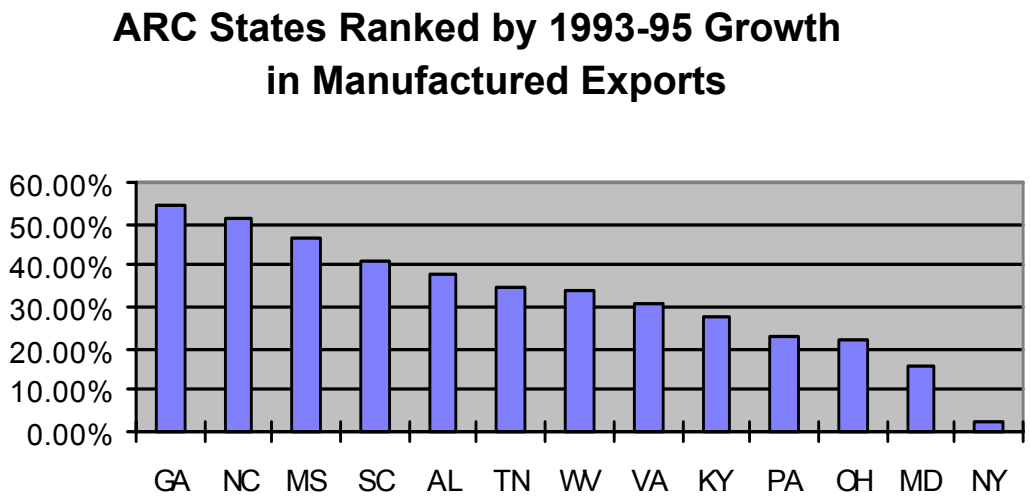
Table 5
Manufactured (SIC 20-39) Exports from ARC States (millions of dollars)

State	1993	1994	1995	1993-95 Increase
Alabama	$3,526	$4,252	$4,869	$1,343
Georgia	$7,391	$9,212	$11,397	$4,006
Kentucky	$4,393	$5,091	$5,603	$1,210
Maryland	$5,152	$5,708	$5,974	$822
Mississippi	$1,764	$1,956	$2,581	$817
North Carolina	$10,288	$12,880	$15,576	$5,288
New York	$33,416	$30,998	$34,077	$661
Ohio	$18,558	$20,770	$22,629	$4,071
Pennsylvania	$11,778	$12,946	$14,468	$2,690
South Carolina	$4,996	$5,829	$7,060	$2,064
Tennessee	$5,982	$7,134	$8,045	$2,063
Virginia	$8,438	$9,706	$11,012	$2,574
West Virginia	$1,030	$1,226	$1,376	$346
All ARC states	$116,712	$127,711	$144,666	$27,955

There is great variation in the value of manufactured exports among the states that comprise the ARC region. Much can be attributed to large differences in the scale of state economies and manufacturing bases. Not surprisingly, New York is the largest exporter—because it is the largest economy. Recent growth trends in the value of goods exported also vary widely among ARC member states. North Carolina experienced growth of over $5 billion in the value of manufactured exports, while several states experienced increases of less than one billion. Table 5 lists recent trends by state and reveals the large differences in exporting scale and experience among the states' manufacturing economies.

Comparing rates rather than absolute values of increases in the value of manufactured exports allows comparisons among, states despite different sized economies. It also allows comparisons with national performance, which was 25 percent in the value of manufactured exports. Figure 4 shows how ARC states rank on this measure.

Figure 4



Most ARC states experienced faster than (national) average growth in export sales of manufactured goods. The regional growth rate for manufactured exports was 24 percent, only one percent below the national average. Slow growth (less than one-tenth of the regional average) in New York, the largest state economy, depressed the region's overall rate of growth. However there is no consistent relationship between size and rates of export growth. Rather, differences in 1993-95 export growth rates follow geographic divides. Southern states posted the fastest rates of growth in value of manufactured exports. Each gained above the regional average, as did the "border" states of West Virginia and Kentucky. Conversely northern states plus the border state of Maryland all experienced relatively slow growth. In summary, there is no consistent exporting experience within the ARC states. Most perform below the national average. Most are exporting at a rate above the national average. In other words, most ARC states are making progress toward the regional goal of "increasing export performance up to the national average."

The ARC selected seven industries to be the targets of regional export promotion. Six of the target industries identified by the Appalachian Regional Commission are manufacturing industries, while the seventh, environmental technologies, includes both manufacturing and service components. Table 6 lists the six industries targeted by ARC for further study that are defined by SIC codes.

Table 6
ARC Target Industries by SIC Code

TARGET INDUSTRY	SIC CODE
Knitting mills	SIC 225
Household furniture	SIC 251
Misc. plastics products	SIC 308
Industrial machinery	SIC 354, 355, 356, 359
Electronic components	SIC 367
Medical instruments	SIC 384
Environmental technologies	See Appendix A

Our analysis is restricted by the fact that the MISER data reports the value and destination of exports from each state only by two-digit SIC industry. For the six target industries that are defined bv three-digit SIC codes, the two-digit SIC industry that includes the target industry must be used to approximate broad trends for the three-digit clusters. For environmental technologies, which cannot be approximated by a two-digit SIC, the analysis relies on data commissioned by the International Trade Administration and supplied by Environmental Business International, Inc. Specific data sources are described in more detail in Appendix G.

F. Who Exports What and Where?

Nationally, about 37 percent of all exporting is done by SMEs (companies with fewer than 500 employees), and 80 percent of all exporting is by manufacturing sectors. Arthur Anderson, Inc. estimates than one fourth of all firms with fewer than 100 employees export. Further, some types of products are more prone to be exported than others. A recent study for the ARC found that Chemicals and Machinery and Computer Equipment account for about a fifth of the region's exports.[9] These two sectors, plus electronics and transportation equipment, exhibited high growth between 1983 and 1991 as well.

The Kenan Institute report concludes that four in ten SME export dollars in the ARC region are in three sectors—industrial machinery, electronic equipment, and chemicals. At the three-digit SIC level, the top six exporting sectors are plastics materials and synthetic resins (2820); motor vehicles, equipment, and parts (3710); industrial organic chemicals (2860); electronic components and accessories (3670); computer and office equipment (3570); and construction and related machinery (3530). These six clusters account for more than 30 percent of the region's exports. Lower value sectors such as household furniture (ranked lst) and men's and boy's clothing (ranked 2nd) employ many more people in Appalachia but export much less.

Despite efforts to promote exports ubiquitously, all companies do not have the same potential or predilection to export. In general, the farther down the supply chain a company is situated, the lower its value added, the more closely it works with its customers, and the less likely it is to be an exporter. Knitting mills that produce gray goods for the finishers, for example, and toot and die companies that serve fabricators are not likely to be exporters.

Further, the size of a company is directly related to the probability it exports, although not necessarily its success in exporting. Larger companies that have greater internal specialization and production capacity, and more resources are more apt to export. Globally, mid-sized, family owned firms are well represented among the most entrepreneurial and dynamic companies. In Germany, these mittlestand firms are the most successful segment of the economy, and in Italy the *media industria* are quickly gaining the same reputation.[10] In Appalachia, too, such mid-sized firms have been found to be regional leaders, and on average, the firms surveyed and identified as exporters as part of this research are larger than the non-exporters.

Management is also a key factor in export performance. A study of the wood products industry in the northwest United States found that the greater managers' innovativeness and knowledge, the greater the export performance.[11] Another recent study based on environmental technology industries found that learning-oriented firms and managers who are optimistic about the future are more likely to be exporters.[12] Although we were unable to formally test this hypothesis, the interviews with exporters appear to confirm this. They tended to be much more enthusiastic about the future and more open to new ideas.

Where are the Emerging Markets?

Companies are able to draw on a wealth of information from both the public and private sectors about current and emerging foreign markets for their general types of products. These reports provide current dollar amounts, rates of exports, and patterns over time for particular countries or groups of countries such as the European Union or Asian "newly industrialized countries" (NICs). Although this general information alone does not produce customers, it suggests where to direct marketing resources. Following are summaries of ARC's key clusters.

Industrial machinery is an active exporting sector with roughly a quarter of its production sent out of the country. Half of its exports in 1995 were to five countries—Canada, Mexico, Japan, Germany, and Korea. These five, along with Italy and Japan, are also major competitors of U.S. firms. The largest increases in exports from 1994 to 1995 were to competitor nations Korea, Germany, and Japan—mainly in special market niches. Japan, for example, imports special semi-conductor and filtering equipment from the U.S. and Korea is a customer for non-metalworking machine tools, gas turbines, and thermal processing equipment.

Environmental technologies have growing global markets driven by increasing desires for pollution prevention and cleanup. They is already estimated at $408 billion. The most promising markets for remediation technologies over the next five years are expected to be Germany, Mexico, and Korea. Mexico now imports about 28 percent of all its pollution prevention equipment from the U.S., Canada imports 30 percent, and Korea imports nine percent of its environmental technologies. The Canadian market tends to be smaller firms, and its government is encouraging alliances or networks with U.S. companies to address environmental needs holistically. Five to ten years from now, Brazil, China and India are expected to be prime markets because of their investments in nuclear power.

Plastic parts exported $6.7 billion worth of goods in 1995, which was more than 50 percent higher than its total exports for 1992. This sector had a net trade surplus of $1.5 billion. Most

plastics parts are inputs to other industries—particularly electronics, health care, construction, transportation, automotive, and food packaging firms. The leading exporters are large, international, and vertically integrated companies. Much of the industry's growth is due to increased replacement of other materials by plastics to improve design and reduce weight and costs. Major threats to growth are environmental awareness and regulations, especially in the European Union countries. The fastest growing markets are expected to be in NAFTA members Mexico and Canada; Mexico is projected to increase annually by 10 percent and Canada by 12 percent.

Electronic components firms annually export about a quarter of their output, which was $45.5 billion in 1995. Japan, Singapore, Canada, Mexico, and Taiwan are major markets. Yet the U.S. overall is a net importer of electronic equipment. Including computers, computer peripherals, and parts, the U.S. had a trade deficit of $11.1 billion in 1995, exporting approximately $129.5 billion and importing $177.1 billion. The electronic component industry has grown significantly over the last four years and, with increasing demand for electronic equipment such as HDTV and computers, the market is expected to continue to grow.

Household furniture's major markets are in the NAFTA countries, Europe (especially Germany), the Middle-East, and Japan. The U.S. furniture export market is quite highly developed in Canada and Mexico, and moderately developed in Europe and the Middle East but underdeveloped in Latin America and Asia. South America is also emerging as an importer of furniture as trade barriers are lowered and disposable income grows. The best prospects for overseas markets are generally believed to be high-end branded furniture, although this analysis suggests that there is a large, growing potential market for well-made promotional furniture among the middle classes in newly developed economics.

Combining several **knit sub-sectors** (hosiery, fabric, and shirts), U.S. exports were $1.35 billion in 1995. While exports are growing to some countries, the industry is not generally considered a significant exporter. In 1993, for example, the U.S. exported only about five percent of U.S. hosiery production. Several strong markets are Canada, Mexico, Japan, and the United Kingdom where "American casual" styles are popular among middle and upper income classes. (The U.S. Department of Commerce's trade data does not directly coincide with SIC codes. Also, these data are distorted by "maquiladora production," where workers partially produce goods in the United States which are then finished in Mexico or Caribbean nations, then re-imported for sale in the United States.)

Table 7
Total Value of Export, in Millions of Dollars, and Emerging Foreign Markets

Cluster	Exports 1993	Exports 1995	Promising Markets
Industrial Machinery	n/a	30,692	Canada, Mexico, Japan, Germany, and Korea
Plastics Parts	$4,471	$6,774	Canada, Mexico, Japan, Netherlands
Environmental Technologies	n/a	$10,800 (1994, est.)	Canada, Mexico, Japan, France, Korea
Electronic Components	$62,343	$92,203	Japan, Taiwan, Singapore, Canada, and Mexico
Household Furniture	$1,183	$1,320	Canada, Mexico, Germany, Japan, Brazil, Saudi Arabia
Knitting Mills	$324	$441	United Kingdom, Canada, Mexico, Japan
Medical Devices	$7,632 (1992)	$10,281	Japan, Canada, France, Korea, Brazil

PART TWO: OBSERVATIONS, ANALYSES, AND LESSONS FROM EXPERIENCE

This second part of the report draws on all of the information from the seven targeted industry clusters acquired from surveys, interviews, reports, and extant data to (1) assess export performance, competitive advantages, and potential for improved performance; (2) estimate small and mid-sized companies' potential for exports and competitiveness; and consider the strength of the systems in which they operate. Although the information was gathered from within the Geographically constrained clusters, the lessons are not limited to those sub-regions. Much the what has been learned from firms and services applies to the industry throughout the ARC region.

Most of the new information was obtained from personal and telephone interviews. In each cluster the team interviewed ten exporters, ten non-exporters, and at least six service providers. The analysis also includes a small number of interviews with firms outside of the cluster in areas of the ARC region without significant concentrations of companies ("clusterless") in order to learn more about the effects of distance from a specialized infrastructure. Because we chose to gather in-depth information from a small number of companies rather than cursory information from a large number, there was no attempt to select random samples. In fact, the process of using local industry experts to gain access to small and mid-sized firms and convince them to give us the time that was required to complete the detailed survey most likely resulted in biasing some part of the information collected; many of our contacts suggested firms with which they had worked, and some of these firms are probably somewhat atypical just by the fact that they had used external services.

In considering the data, there were striking differences between exporters and non-exporters responding to the surveys. Exporting firms, for example, were on average larger than non-exporters. Of the exporters interviewed, 48 percent had fewer than 100 and 28 percent had more than 250 employees. Of the non-exporters, 70 percent had fewer than 100 employees and 17 percent had more than 250 employees. Exporters purchased a larger share of their inputs locally; 86 percent purchased more than 10 percent and 52 percent purchased more than half of their inputs from suppliers within 100 miles of their plant. Among non-exporters, 66 percent purchased more than 10 percent locally and 34 percent purchased more than half locally. This is somewhat surprising, since larger, exporting firms might be expected to have more contacts and options among potential suppliers and to draw from a larger area.

Each cluster is assessed on its own merits but, where appropriate, information is pooled across clusters to make some assessments of particular strengths and weaknesses in the region.

A. Setting Cluster Boundaries

On the assumption that space and distance affect relationships and thus some of the competitive advantages of clusters, the project team estimated geographic boundaries for each of the sectors studied. This was accomplished by mapping concentrations of companies and employees and

calculating location quotients for establishments and employment (i.e., the ratio of the fraction of total establishments or employment in the sector in the county divided by the same fraction in the nation as a whole) by ARC county. The raw numbers and relative concentrations were mapped to search for groups of counties that fit both criteria. When these data were mapped, natural "breaks," where concentrations and location quotients dropped dramatically became obvious. The resulting cluster geographies are described in the following paragraphs. Many of the clusters, of course, overlap into non-ARC counties. Thus, border areas may actually be home to some of the specialized service used by ARC-based companies, and some of the services interviewed were just outside of the ARC boundaries. But firm-specific data was collected only from firms within the region. The geographies of the seven clusters are described below.

Household furniture companies are heavily concentrated in seven ARC counties in Mississippi that are home to 139 furniture companies employing almost 16,000, and in three ARC counties in Alabama which have 49 companies employing almost 3,000. Although published data establishes the boundaries of this "cluster," a careful analysis reveals that the concentration of companies is not really a single cluster but divided between two distinct clusters in adjoining regions that are separated by not only a state boundary but also by history and types of product. Alabama companies make an assortment of wood pieces while Mississippi's niche is upholstered furniture, and there is little sharing between the two.

The **knitting mill** cluster, which is dominated by hosiery manufacturers, extends through western North Carolina, adjacent counties in Virginia, and slightly into Tennessee. It also includes a smaller number of knitwear manufacturers producing among other things sweaters and blankets. Nine North Carolina counties contain 251 knitting industry firms employing over 25,000 workers and three Virginia counties have eight companies employing 2,500. The location quotients for employment in the cluster are greater than "20" in eleven counties in this cluster, i.e. the industry is at least twenty times as concentrated in those counties as in the nation as a whole. Much of the support for hosiery resides in Hickory in Catawba County, adjacent to the ARC region's boundary.

The **plastic parts** cluster is centered in the city of Erie and includes eight counties in Pennsylvania and four in Ohio. These plastics manufacturers are primarily sub-assemblers of products for large original equipment manufacturers. The Pennsylvania counties are home to 151 companies with 10,000 employees and the Ohio counties have 36 firms with 2,600 employees. Location quotients are higher than 3.0 in eight of the counties, which is quite striking in an industry so ubiquitous in the U.S.

The **environmental technologies** cluster is the one cluster not defined by counties because the firms comprising the cluster include a wide range of types of businesses that are not easily aggregated. Instead this cluster follows a "technology corridor" in Tennessee that runs along a 100 mile stretch of interstate connecting Oak Ridge with the city of Chattanooga. The two poles of the cluster, however, represent different types of interest and expertise in environmental technology. Oak Ridge is characterized by nuclear-based environmental technologies and services and R&D while Chattanooga is an older industrial city committed to both a clean environment and to developing a local environmental technology industry base.

Industrial machinery manufacturers are highly concentrated in the South Carolina ARC counties, and is one of the nation's premier clusters according to DRI/McGraw-Hill.[13] in terms of scale and importance to the region's manufacturing base. The six South Carolina counties have 301 companies employing 12,800 people. This cluster also extends into the more urban counties of western North Carolina, where 83 industrial machinery companies employ 1,900 workers. The cluster comprises about five percent of all employment but—in South Carolina—about a sixth of all manufacturing employment.

The **electronic component** industry is concentrated in the nine ARC counties that comprise the southern tier of New York (16,500 jobs) and spills over into the northern adjacent counties of Pennsylvania (8,700 jobs). Like industrial machinery, this cluster was recognized by DRI/McGraw Hill as one of the nations' premier clusters. The location quotients in four of the New York counties are greater than 1110,11, meaning that the proportion of employment in this sector is ten times the national ratio of employment. Two of the Pennsylvania counties have location quotients of four or greater.

The **medical devices** industry is concentrated in seven counties surrounding and including Pittsburgh, although compared to the other six clusters in terms of scale and concentration, it is quite weak. There are 45 companies with SIC 3840 in the eight counties employing 3,400 workers. The one county that also has a high employment location quotient is the site of a single large manufacturer.

B. The Birth of Clusters: Innovations and Branch Plants

Each of the geographic areas selected for the analyses have some of the characteristics of effective or working clusters, most of which have developed over many decades. The roots of these clusters, as of most dusters, are imbedded in some serendipitous historical event. Many of these clusters can trace their origins to either (1) a technological innovation or (2) a branch plant location, followed by (3) entrepreneurial energy of employees who see opportunities for new or competing market niches and start their own companies.

- **Mississippi's furniture cluster** grew out of the region's successful recruitment of Futorian Furniture Company to the state in 1948, which first introduced mass production technologies to the furniture industry, previously operated as a craft. Many of the largest companies are part of the progeny of that single innovative company and the owners proudly call themselves "graduates of Futorian University."

- **Alabama's furniture cluster** developed opportunistically, to take advantage of the region's growing mobile home industry. Workers trained in that industry saw opportunities to design and build promotional furniture for the customers of that low-cost housing industry.

- **Pennsylvania's plastics parts cluster** developed to support Erie Resistor, a plastics manufacturer that, in 1935, became the first company in the nation to use injection molding. Many of its employees took that new technology outside and started their own companies, and that entrepreneurial spin-off mentality persist today. Two companies interviewed, for example, were started by employees of a third. The area's large and successful tool and die

industry was able to support the industry with the precision molds it needed and helped spark growth. By 1953, 14 million pounds of plastic were shipped into the region to leave as products ranging from buttons to auto parts.

- **Tennessee's environmental technologies cluster** was a response to environmental problems, i.e., high rates of pollution from nuclear products at Oak Ridge and heavy industry in Chattanooga. The need to clean up these two areas gave rise to the birth of a new industry. The Oak Ridge National Laboratories was became a source of expertise and entrepreneurs, and many of its former professional employees are the entrepreneurs behind recent startups.

- **South Carolina's industrial machinery cluster** began in the 1950s when textile magnates attracted foreign machine tool builders to support and enhance their industry. Leaders in that traditional industry were able to connect the importance of access to the latest advances in technology to their own success, and to bring that technology closer to home, they successfully recruited Swiss and German machine tool builders.

- **New York's electronic components cluster** evolved in the 1960s from employees of the large IBM facility there. In this relatively young cluster, enough company employees took the skills and knowledge honed at IBM to develop their own independent market niches or to become suppliers of IBM.

- **North Carolina's hosiery cluster** owes its scale to the large branch plants such as Sara Lee and Kaiser-Roth that located there much earlier and then gradually discontinued lines or moved operations to lower cost regions. Many of the employees took their skills and borrowed capital to purchase used equipment and set up shop themselves.

These diverse histories illustrate that clusters cannot be formed out of whole cloth even with strong public policies accompanied by sufficient resources. Certain conditions must exist. But clusters can be made more effective and stronger when their interconnections and collective needs are recognized by government and taken into account policy implementation.

Specialized Services and Skilled Workers

One of the main advantages of clusters is their tendency to create and attract highly specialized services and knowledge and to develop skilled labor markets to meet their employment needs. Specialized assistance is more useful and valuable to firms than general knowledge. Engineers who know the language of the industry and know about special advanced technologies in use and in development, bankers who understand the trends and patterns of the industry, and market specialists who know where and who the customers are more likely to solve problems, make loans, and find new markets than their counterparts who know their respective discipline but not the specifics of the industry. Similarly, workers who are familiar with the industry are more highly valued than those who are not. Even though corporate leaders proclaim their desire for employees with general abilities, who know how to learn, problem solve, and communicate, owners of small companies without human resource directors or training programs (and even the line managers of large corporations) prefer new hires who know the business.

What sort of specialized services and skilled labor forces have the seven clusters been able to attract or develop?

- **North Carolina's knitting mill cluster (hosiery subset)**, as a result of its regional trade association, acquired state support for a hosiery technology center located at the local community college and, in 1996, was able to add a satellite center at another community college located on the periphery of the cluster. The local bank president attends association meetings and, according to industry spokespersons, is the only banker in the state with intimate knowledge of the hosiery business. North Carolina State University and 21 cluster members formed a network to attempt to develop an advanced boarding technology, and the university's technology extension service will soon assign an engineer to work with the cluster. Although marketing and exporting expertise are still concentrated in New York, this cluster, with assistance from the North Carolina Alliance for Competitive Technologies, is attempting to build capacity locally. The skilled labor market in the area is also considered a major advantage by firms, although there is concern about the shrinking labor market as youth turn away from manufacturing.

- **New York's electronic components cluster** relies on a number of strong federal and state funded research and development facilities, one at Cornell University, one at Alfred University, and another at State University at Binghamton. A manufacturing extension service center staffed by people with electronics industry experience provides technical and managerial assistance. Further, the region has a number of banks, advertising agencies, and legal services with staff with knowledge of the industry. There is little industry expertise within the cluster, however, in marketing and exports.

- **Pennsylvania's plastics parts cluster**, as it developed fostered the accumulation of technical expertise, including the Penn State-Erie plastics center and Plastics Technology Deployment Center (PTDC), and there is a considerable pool of skilled workers due to the large number of family businesses and local plastics training programs. But no export programs in the area yet target the cluster.

- **South Carolina's industrial machinery cluster** is supported by a number of organizations, such as the Southeast Manufacturing Technology Center and the area's three technical colleges, with expertise in their specific process technologies. But none of the support services and associations interviewed engaged in exports professed any expertise in the cluster.

- The scale of **Mississippi/Alabama's household furniture cluster** has led to a number of targeted support services, including an automated upholstered furniture technology center at the community college, a furniture mart, a furniture research center at the University in Mississippi, and an export/technology forestry team and trade experts at the University of Alabama and in Mississippi. There is a sizable labor pool familiar with and experienced in the industry, but business is concerned that it is both diminishing and not able to adapt to the new technologies. Government services do not appear to be targeted to or expert in the needs of the furniture industry.

- **Tennessee's environmental technologies cluster** is supported by the very services and institutions that gave birth to it—the federal labs and agencies, state universities, and the Tennessee Valley Authority. The university and two technical colleges have special advanced and associate degree and shorter certificate programs in environmental technologies. Further, the state's department of economic and community development has an environmental technologies sector team. An environmental technologies specialist will be assigned to the U.S. Department of Commerce's International Trade Export Assistance Office in Chattanooga.

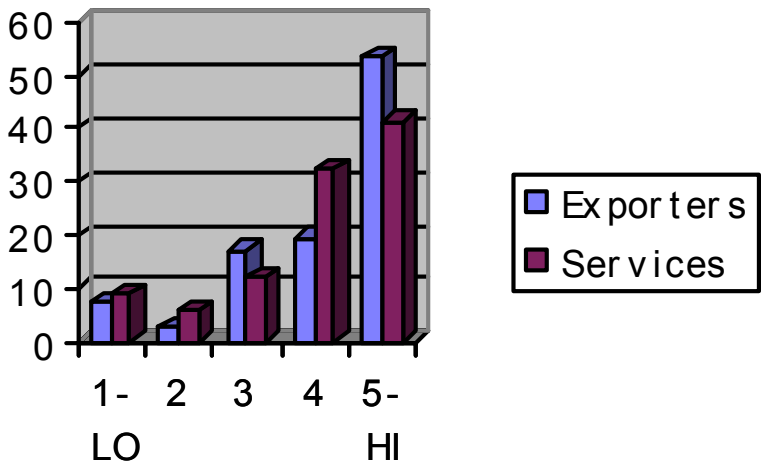
C. Becoming Global: Export assistance and performance

The seven clusters selected for analysis each exhibit somewhat different export market characteristics and structures, which have implications for the types of services they need. Two clusters—knitting mills and household furniture—sell to retail markets and therefore depend heavily on distributors, trade shows, and field agents to find customers. Most firms are simply order takers, and only the more aggressive companies actively pursue new foreign markets. Their most important capabilities are delivery and design so that they can adapt to changing consumer tastes. Two clusters—industrial machinery and environmental technologies—sell their products to other industries and depend on trade journals, shows, and sales offices, and reputation. Their most important capabilities are quality and service, which generally requires on-site attention after the sale. Two other clusters—plastics parts and electronic components—are integrated into more complex industrial or consumer products that may eventually be sold overseas. These companies are less likely to be direct exporters unless they have some special patent or unique product feature or competency needed by foreign companies, in which case the product sells itself. Their most important capabilities are reliability and design, and they may have to meet special foreign product design requirements. Finally, medical devices are sold to professionals, and the firms interviewed in the area selected exhibit little export potential.

For the most part, firms interviewed believed that exports are important to their future business performance. Even though many exporters only export a small fraction of their total output, more than half rated foreign markets as "very important" to their business and another 20 percent rated it as "important" (see Figure 5). Almost 70 percent of support services rated foreign markets as "important."

Exporters in the seven clusters relied slightly more on private sources for trade leads the public sources. Export consultants and agents were the most frequent source of general leads, but customers themselves were the most frequent source of specific leads, especially in environmental technologies. Universities were used only by the furniture cluster, which probably can be attributed to the source of contacts being the university. Knitting mills used federal agencies for general but not specific leads, and the industrial machinery cluster used state agencies for general leads but not specific leads.

Figure 5
Ratings of Importance of Foreign Markets by Exports and Support Services, Percent



Highlighting Clusters' Export Activity

In the **household furniture** cluster, exporting is a passive activity. Companies show their products and respond to orders-which may or may not originate in other countries. The companies interviewed rate exporting as "important" and, in principal, are more than willing to export. But few make any concerted efforts to find new export markets. In each furniture sub-cluster (solid wood in Alabama and upholstered furniture in Mississippi), the larger companies are both the major exporters and more advanced companies most likely to invest in new equipment and training. The strongest specialized services of both regions are for technology and training, with little support for export, with the exception of the University of Alabama. Both states will provide limited assistance when asked, but neither has any significant expertise in or support for exporting household furniture on staff.

Knitting mills in western North Carolina, like furniture, have been relatively passive exporters, relying on trade shows and marketing brokers to find outlets for their goods. A few small firms aggressively pursue new foreign markets, but these are exceptions and their exports generally are only a small percent of their total sales. Exporting is not commonplace. In fact, it was difficult to find active exporters in this industry cluster. Sock producers are split between greige, finishers, and integrated firms, and the companies producing greige (an input to the final product) would be unlikely to export. The women's sheer hosiery and knit underwear producers are mainly larger multi-national corporations, not SMEs, and, therefore, more likely to export. Most companies make low- or mid-price range products for sale in discount and department store chains, but those making high-end and specialized niche products for domestic outlets can also succeed in Japanese and European markets where "Made in the USA" labels on knit goods carry a certain cache and are valued for their design and quality. Some companies export under

their own brand name while others profit from licensing agreements to make products under brand names such as "Keds" or "Wrangler."

In the **industrial machinery** cluster, virtually all mid-size and large firms that can export are already doing so—mainly with overseas shipments directly from the plant. Nation-wide, 92 percent of plants with more than 500 employees and 72 percent of plants with 100-500 employees export. For this group, growth will come from increasing export sales not from introducing new-to-export firms to the benefits of international marketing. There is still substantial opportunity for growth in exports per firm, given that direct exports average only 23 percent of sales for the largest plants and 18 percent for the mid-size plants. Non-direct exporters are the job shops and suppliers of common parts and components. Most of the exporters polled had been exporting for over 20 years, and exports exceeded 20 percent of sales for 7 of the 10 exporting firms.

The **environmental technology** cluster, despite huge projected global market for the industry, are not major exporters. That may be because so much of the Oak Ridge cluster views government, not the private sector, as its primary client, and foreign governments may resist hiring a U.S. firm, preferring to purchase the technology and do it themselves. Given the specialized nature of their products or services, they market directly to the customer. Exporting does not require product changes; most projects are tailored to a specific client and situation in the U.S. and elsewhere. However, exporting does require adjustments to accommodate differences in culture and in business practices—and usually requires an off-site partner, which adds to the difficulties and costs. Despite the obstacles, U.S. environmental technologies firms are becoming increasingly interested in export opportunities. And because of their dependence on government for contracts, they look to the federal agencies for export information and assistance more than other clusters.

The **medical devices** cluster in the Pittsburgh area is not yet a significant exporter, and exhibits little promise for future exports. Many of the firms manufacture surgical supplies, which tend to be unsuited to export. Most are low-tech and some such as orthopedic appliances, which account for 20 percent of the employment in this sub-sector-serve local customers who request products designed to fit particular patients. Further, employment in this sub-sector is made up almost entirely of two large companies, one a manufacturer of personal safety devices for the mining industry, and the other a manufacturer of respiratory and patient ventilation products. Most interviewed believe that exports are "very important" to their industry's future. Yet, clearly, any significant future export development is contingent on building on the region's technical expertise to expand the cluster's product lines or by recruiting new companies.

The firms in the **plastics parts** cluster in the Erie area, like the plastics sector nationally, do not heavily export because so many of the skills and technologies used in the industry are common to so many localities. Many of the inputs customers require are injected molded parts, which can be manufactured nearly anywhere. Therefore few niche markets exist for this miscellaneous products cluster. Most companies receive large orders and produce them to a customer's design, competing more on quality, delivery, and price than on innovative or unique design. The cluster's major strength is its proximity to industries in the larger, heavily industrialized Great Lakes region and its technology infrastructure.

Barriers to Exporting

What are some of the obstacles to exporting? During interviews, executives from both exporting and non-exporting firms were asked to rank factors that made exporting difficult or not an option for their firm. Service providers also were asked to rank factors inhibiting export activity in the target industry. Aggregating the weighted averages of the responses produced a ranking of export barriers as perceived by exporters, non-exporters, and support services (see Table 8).

While there was some agreement among the three classes of respondents—for example, all three ranked lack of information very high—there were also striking disparities. The largest difference in opinion was in "getting paid." Exporters, who obviously had experienced the problem frequently, ranked it as their largest obstacle. The support services, however, rated it last and non-exporters, well below average. Another disparity occurred in trade barriers, which exporters ranked third, non-exporters, last, and support services, eighth of ten. Lack of time was ranked the second biggest obstacle by support services, fifth by non-exporters, but only seventh by exporters. Unfamiliarity with the exporting process was scored high by services (third) and non-exporters (fourth) but low by exporters. Foreign regulations, not explicitly included on the survey instrument nevertheless also was mentioned frequently by firms.

Clearly, doing business abroad imposes additional costs on small firms. Transportation costs were a distant second biggest obstacle for non-exporters, followed closely by high exporting costs, and lack of familiarity with the exporting process. Non-exporters do not know enough about foreign markets, are wary about the added costs, and not willing to invest time and money to see if exporting would be profitable.

There were also significant differences among clusters. Each had a slightly different perspective that reflects the natures of their products and markets. *Household furniture* producers, for example, were concerned about foreign exchange rate fluctuations and high tariffs. The *industrial machinery* companies viewed' financing their high cost products as a primary obstacle facing local firms. *Environmental technology* firms noted the high cost of establishing and maintaining an overseas presence, which is exacerbated by the lag between starting to market abroad and realizing revenues from the typical project. They also noted difficulties in finding dependable foreign on-site partners and then maintaining communications between the home base and projects multiple time zones away. *Plastics* firms added concerns about foreign regulations of imports and taxes. Medical devices had the same concern. Other nations have stringent requirements about products entering their markets and require all imports to meet product design standards.

Technology-based clusters encounter difficulties from U.S. government regulations related to technology secrecy and, for the *medical devices* firms, difficulty on both ends of the sale in getting necessary government approvals of their product. A representative of one medical devices firm suggested worldwide standards for medical devices. The *environmental technologies* cluster specializes in nuclear issues and works with top secret facilities, and consequently frequently faces a web of red tape. Similar complaints were voiced by *electronic components* firms, and some work through congressional offices to speed trade approvals.

Table 8
Rankings of Barriers to Exporting by Exporters, Non Exporters, and Support Services

Barrier	Exporter	Non-Exporter	Support Service
Getting paid	1	7	10
Lack of information	2	1	1
Tariffs/trade barriers	3	10	8
High marketing/sales costs	4	3	7
Transportation costs	5	2	6
Lack of capital	6	6	4.5
Too little time	7	5	2
Unfamiliar with process	8	4	3
Design specifications	9	9	4.5
Language	10	8	9

Rating Export Capabilities

Based on the results of the interviews and the lead researchers' best judgment, Table 9 represents an attempt to assign a preliminary relative rating to each element of infrastructure that supports exports within each of the seven clusters. The scale is only an exploratory attempt to formulate a quantitative profile of a cluster's export infrastructure and a rough indicator of export capabilities. It will require considerable additional work to further refine it and assess its validity. Where possible—such as interest in exporting and assigned importance to exporting—the interview results are applied. Elements not obtained from data are based on researchers' educated best guesses. Each element is ranked on a scale from 1 (low) to 5 (high). Although comparisons must be taken with a great deal of caution since the ratings were made on an individual basis without standards, they suggest, for example, that household furniture and industrial machinery (end use machines) products are most universally appropriate for export and that furniture has the best access to generic information about foreign markets.

Table 9
Comparative Ratings of Export Infrastructure

FACTOR	Hous. Furn.	Indust. Mach.	Knit. Mills	Elec. Com.	Med. Dev.	Env. Tech.	Plas. Parts
Transportation and distribution	5	5	5	3	4	1	4
Generic information and services	5	4	3	3	4	2	4
Specialized information and services	4	3	3	3	1	1	4
Importance of exports	3	4	4	4	3	4	2
Appropriateness of products	5	5	3	4	3	4	2
Interest in exporting	5	5	3	4	3	4	2
Capital availability	n/a	n/a	2	3	3	1	3

D. Making Things Better: Competitiveness and Modernization Assistance

One of the most important assumptions driving current industrial modernization policy is that U.S. manufacturers no longer can compete on the basis of price alone. Quality, reliability, design, and delivery times are equally, if not, more important to increasingly discriminating and demanding customers. Therefore, the project team asked companies and support services surveyed to select the two factors most important to their competitiveness from among those in Table 10 asked them to add their own. Among exporters, product quality and customer service garnered the most votes.

- Quality ranked particularly high in the knitwear and plastics clusters.

- Reputation and customer service were highest among industrial machinery exporters and non-exporters, who tend to work closely with users to customize their machines to their needs.

Non-exporters' choices were distributed more evenly, with all but timely delivery selected about the same number of times. Support services strongly emphasized product quality, and also product design.

Despite the number of national initiatives to organize programs to help SMEs modernize, few have reached the firms in these clusters. Few companies are customers and many remain unaware of them as sources of information for exporters, with the exception of universities for

the furniture industry. By and large they rely heavily on other companies for information, e.g., suppliers, customers, equipment producers, and even competitors. Most industrial machinery firms surveyed had never received export assistance from trade promotion organizations, did not seek out information about exporting or export services from public sources, and were in fact unfamiliar with the availability of such services. When public sector agencies were named by companies, it may be simply because these same services were used as contacts to identify respondents (in order to gain cooperation). Thus, on this particular question, the responses may be biased.

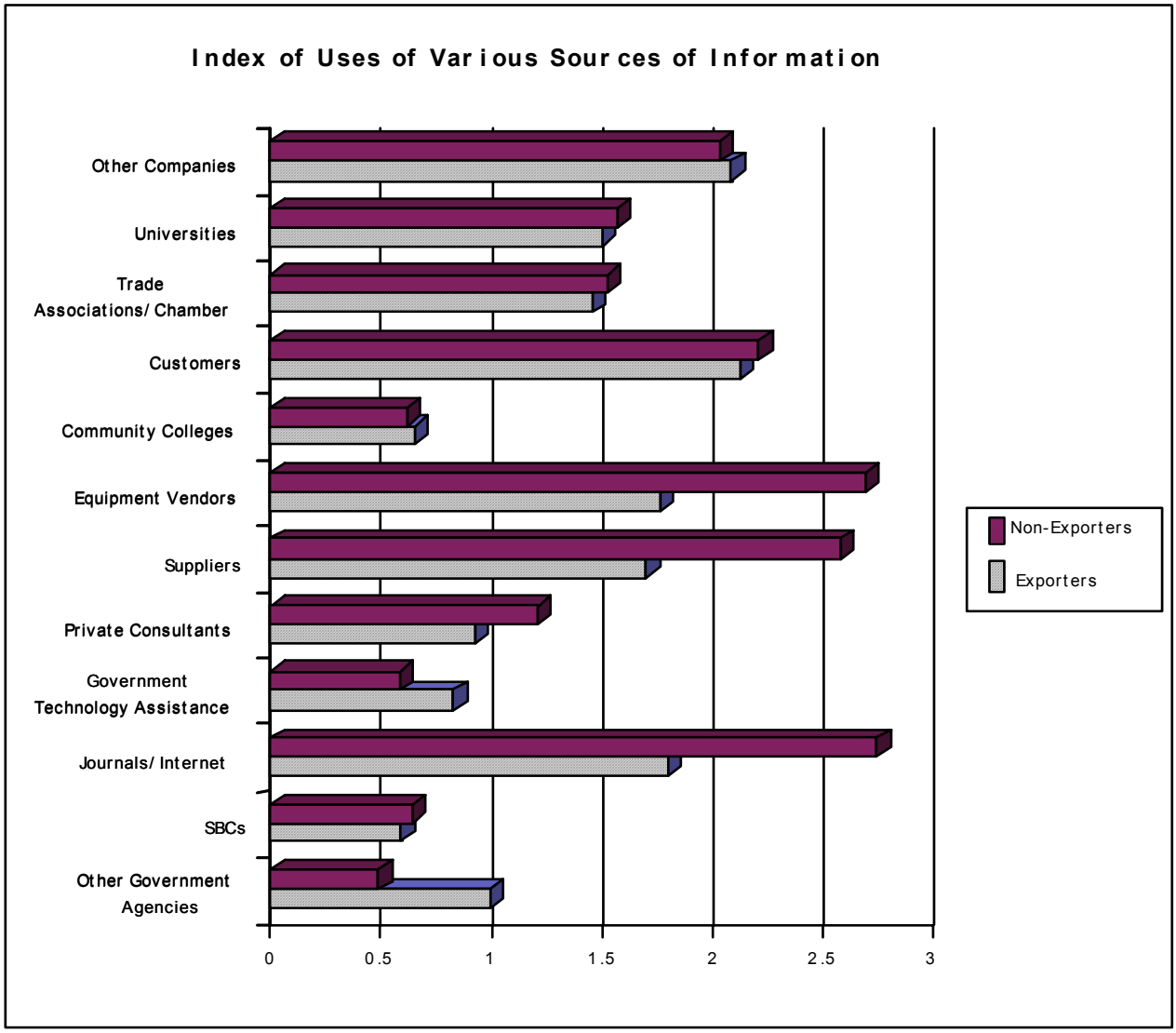
Table 10
Number of Times Factor Was Selected As One of Two Most Important Competitive Advantages and Rank Order (in parentheses)

Advantage	Non-Exporters	Exporters	Services	Not Inside**
Product design	14 (3)	15 (2/3)	16 (2)	3 (3/4)
Customer service	20 (2)	12 (5)	8 (5)	3 (3/4)
Price	12 (4/5)	14 (4)	9 (3/4)	2 (5)
On time delivery	7 (6)	3 (6/7)	7 (6/7)	1 (6)
Product quality	24 (1)	15 (2/3)	18 (1)	5 (1)
Reputation	12 (4/5)	16 (1)	9 (3/4)	4 (2)
Other*	1 (7)	3 (6/7)	7 (6/7)	0 (7)

* Support services and one exporter added location (1)and labor force skills (4) as leading advantages.
** Companies, both exporters and non exporters, located in areas distant from the cluster.

Figure 6 displays an index of the degree of use of a variety of sources of technical information for the combined clusters. Among exporters, which were generally slightly larger companies, the largest source of information was other companies. Therefore, despite the mistrust and competitiveness, these companies look to other firms most frequently for information. A close second source was customers and third was trade journals/internet and universities. Environmental technologies was the single cluster that did make considerable use of government sources, in part because government is so readily accessible in the Oak Ridge area and in part because it is a leading customer.

Figure 6

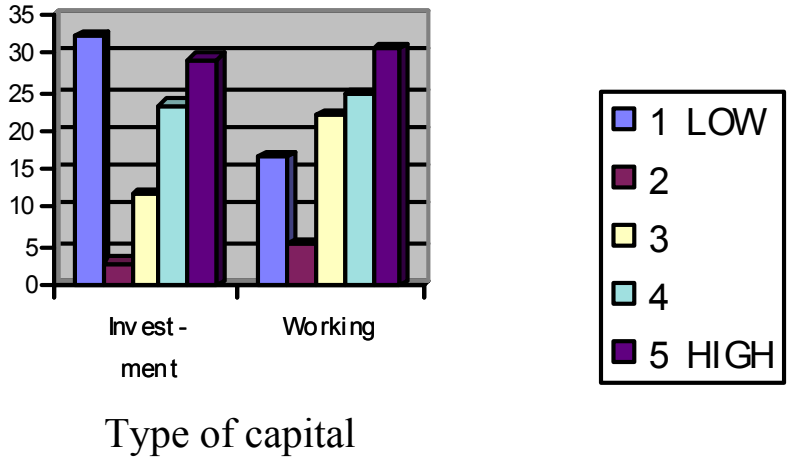


Note: The score is weighted according to the reported frequency of use and divided by the number of respondents.

Access to Capital

Policy-makers often view capital as a potential barrier for companies outside of major metropolitan financial centers—particularly for SMEs. The project team asked non-exporters to rate the degree to which both lack of investment and working capital impeded their efforts. Across all clusters, working capital was more problematic than investment capital (see Figure 7). Sixty percent of the firms cited it as a problem. Responses to investment capital were split with a third of the firms rating it as a very big problem, a third as no problem, and a third somewhere in the middle. Breaking the issue down by cluster, it was of greatest concern in South Carolina's industrial machinery cluster and New York's electronics components cluster, where all but two firms rated investment capital needs high and two-thirds rated working capital needs high.

Figure 7
Percent Distribution of Ratings of Capital Availability Among Non-Exporters



E. Cluster Power: Impacts of proximity, association, and interdependence

The project team selected regional boundaries for clusters on the basis of concentrations of employers and employees and importance to local economics. The factors that make these groups of firms "clusters" and influence their ability to generate synergy, however, are more than mere counts of businesses. Rather, successful clusters arise from dynamic activities and resources, such as access to specialized information and assistance, means and tendencies to associate and learn from one another, reliance on local suppliers, availability of skilled and experienced labor, tough competition, entrepreneurial energy, and shared vision.

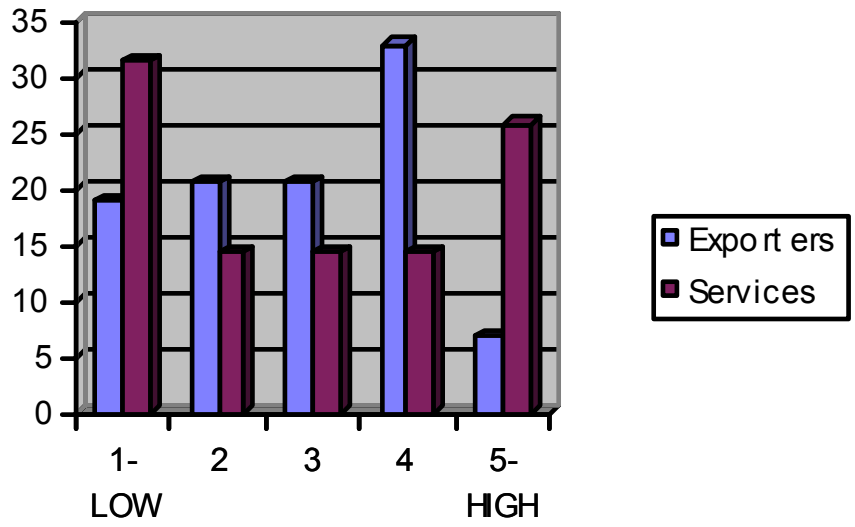
Each of the seven clusters has some of these elements, but in some they are much stronger than in others. For example, knitting mills, household furniture, environmental technologies, and

plastics are the most self-aware clusters. Their members recognize their importance to the regional economy, take advantage of their strength of numbers, collectively address common needs and problems, and rely heavily on other local companies. Medical devices is a weaker cluster with its members overshadowed by other sectors in the heavily industrialized metropolitan area. Although it has been targeted by the state because of the industry's growth potential, there is little unity or interaction among member firms and minimal export activity.

The industrial machinery cluster is imbedded in a diverse web of manufacturing companies and its members relate as much to the industry they serve as other firms in their industries. (As comedian Steve Wright once said, "Anywhere is walking distance—if you have the time.") Therefore, although they have many common needs and specialized services, these companies' most valued relationships are with the member firms of the clusters that their customers represent as much as each other. Textile machine builders, for example, are part of the region's textile cluster, metal-bending or cutting machines may be linked to the auto industry, and extrusion machines to the plastics industry.

Trust is a major factor in the strength of a cluster, increasing the opportunities for firms to take advantage of their collective capabilities and knowledge. Increasingly respected experts, borrowing heavily from the writings of Alexis de Tocqueville, are relating economic growth to high levels of trust.[14] Considering the clusters as a whole, ratings of trust were dichotomous. Exactly half of the respondents rated trust above average and half rated it below average (see Figure 8). Support services, which had a more global view of the cluster, tended to rate it higher. Within clusters, industrial machinery exporters and household furniture exporters rated themselves lowest and electronics components, environmental technologies, and knitting mills the highest.

Figure 8
Distribution of Ratings of Trust Among Exporters and Support Services, Percent



Highlighting the Clusters' Inner Workings

Household furniture cluster is bifurcated between the two states. Each has elements of an autonomous cluster with Mississippi, where concentrations and numbers are greater, exhibiting a stronger cluster structure. Synergy is fostered in part by common resources and in part through an informal social infrastructure and labor market than allows information and innovations to travel freely as employees and managers move from firm to firm. With respect to marketing, there are common elements that provide opportunity to connect the two: they both produce promotional, low-to mid-price range household furniture and both sell to similar markets. Moreover, their products are complimentary, not competitive. Therefore, cooperative export development seems feasible.

The hosiery firms that make up the largest segment of the **knitting mill** cluster is tightly bound by an active regional trade association and a regional industry-led technology and training hub at the community college, both of which provide the social glue that builds trust. The strength of this trade organization and the cohesiveness it has imbued in its members have brought to the cluster new specialized services and resources and resulted in a regional plan for the cluster that highlights collective marketing and exporting goals. Many members freely associate and take pride in their high levels of cooperation. They in fact view collaboration as their best chance to adjust to changing technologies and a consolidating customer base and to survive in highly competitive markets.

Plastic parts service providers indicated that the clusters' atmosphere is fairly conducive to trust because many companies—especially those exporting—are not in direct competition with each other. Firms are quite aware of the strength and scale of their sector. Collectively, the larger

companies have helped establish the Penn State-Erie plastics center which, along with the Plastics Technology Deployment Center, sponsors "consortia" geared to particular elements of the plastics industry. For example, the "blow molding consortium" supplies specific training and technical assistance to firms specializing in that method of plastics processing. The Society of Plastics Engineers is also quite active and provides networking opportunities. For the smaller companies, most collaboration revolves around meeting orders too large to fill alone. Many of the firms indicated a willingness to explore other formal forms of collaboration.

Environmental technologies companies in Oak Ridge have several characteristics of a successful cluster. A highly skilled labor force follows government contracts from firm to firm. Although competitive firms, they draw on a network of technical expertise that strengthens all participants, and it is common for firms to form partnerships on a project-by-project basis to compile the strongest array of skills. Vertical partnerships include mentoring relationships with small firms, especially firms that are classified as disadvantaged or certified by the Small Business Administration 8(a) program. On their own, small and medium sized firms partner horizontally and vertically, acting as sub-contractors on some contracts and prime contractors on others. Most Oak Ridge firms belong to and participate in local business associations, such as the East Tennessee Environmental Business Association and the East Tennessee Economic Council, both of which foster exchange among members. Further, the labor market is very fluid and, similar to Silicon Valley, people move freely from firm to firm taking knowledge with them. The industry concentrations act as an information resource for firms, but it is also apparent that information technology is moving free of geographic bounds. Those asked how often they used various sources of information most frequently cited other companies and the internet.

Industrial machinery is highly concentrated in the South Carolina ARC counties—one of the nation's premier clusters according to quantitative analyses by DRI/McGraw-Hill. It is a cluster in terms of scale and importance to the region's manufacturing base. Yet this research suggests that industrial machinery companies in this region do not have a strong tradition of working together. The mid-sized machine builders in the cluster are not highly competitive with each other since these high exporting firms generally have narrow market niches. Instead, these companies are oriented toward their customers and the clusters in which their equipment is used. They are, in fact, often a source of innovation within their customer clusters. Inter-firm relationships tend to be vertical, with their suppliers. Yet the concentration has led to a number of specialized services, especially in the technical colleges. The smaller and less direct export-prone supplier companies in the cluster, such as tool and die makers, are more likely to network and take advantage of interdependencies, both with their peers and their machine builder customers.

The **medical devices** companies examined in this research do not meet the requirements generally associated with a cluster. The concentration of firms is low compared to other sectors, there is no self awareness of any concentration of firms or of the competencies and/or products of others in the cluster. In addition, there are no specialized trade associations to facilitate interaction (except for those that serve all high tech firms), and, as a result, little cooperation among firms. The main positive attributes of the area are the local sources of technology development and expertise, and the markets created by a large medical sector—both of which create possibilities for future growth. And, indeed, Pennsylvania would like to develop this

cluster, building upon the research and development resources in place, because of its national growth potential.

Electronic components firms are cognizant of the importance of their industry to the entire region. Specialized technology, marketing and work force training institutions exist that probably are not matched anywhere else in Appalachia. A number of larger customer firms in the region—many of them Original Equipment Manufacturers (OEMs)—drive and shape demand, and smaller, specialized supplier firms both cooperate and compete to meet those needs. The cluster has a history technological capability in sophisticated packaging processes, several entrepreneurial firms, a strong research and development base supported by higher education institutions, and a large and well skilled work force.

F. Locational Advantage

If firms do in fact cluster—which data on plant location by SIC confirm—one might ask what conditions or local factors cause that to happen? What are locational advantages that companies and services view as most important to the clusters' competitiveness? The industry specific skills of the work force ranked first (Table 11). Even in areas where there are labor shortages, a density of companies creates an experienced labor pool from which new and growing companies can draw. Despite some poaching from one another, as Mississippi's furniture companies noted, the advantages of a large number of workers knowledgeable in the industry outweighs such disadvantages. This is important to the industrial machinery cluster in South Carolina, which is supported by specialized training programs at the region's three technical colleges, and knitting mills, which are not well served by most community colleges and therefore rely heavily on the specialized training developed within the region. Human resources are crucial to knowledge-base industries. For example, the environmental technologies industry also depends upon a skilled labor force.

The second most important factor was proximity to suppliers and customers and good distribution channels. Even though in today's global world of manufacturers suppliers can be anywhere, most companies would choose to have suppliers nearby if at all possible. Proximity to suppliers is important to the furniture cluster, which uses inputs having a high shipping cost to value ratio. Similarly, proximity to customers is important to greige manufacturers in the knitting products cluster. Proximity to customers is also important for specialized products produced to individual situations, a situation common to segments of the medical devices and industrial machinery industries. Proximity to suppliers is less important for inputs with low shipping cost to value ratios such as specialized instruments used by environmental technology firms. Overall, more than half of the exporters interviewed buy more than half of their inputs from companies within a 100 mile radius of their plant.

The next most important factor cited in interviews was the intangible "quality of life." Most people like where they live and work or they would not be there. Most of the companies are not recruited but started as spin-offs from larger companies that may have been recruited years earlier and long time residents of the area. This was especially common in the industrial machinery cluster. Quality of life is a key factor predicting that the environmental technologies cluster in East Tennessee will survive the closure of its primary local customer. Fewer

companies rated factors relating to opportunities to interact, such as proximity of other firms or good industry associations, among the most important locational factors.

Table 11
Rankings of Weighted Ratings of Geographic Advantages

Advantage	Rank/SMEs	Rank/Services
Proximity to customers	4	8
Distribution channels	3	1
Quality of Life	6	4.5
Skilled labor force	2	2
Government support	9	7
Close to other like firms	7	6
Access to R&D, Technical services	8	3
Proximity to suppliers	1	4.5
Industry associations	5	9

Outside of the cluster

The team appended interviews with nine companies in industry sectors selected but located in regions outside of the cluster boundaries (Kentucky, West Virginia, and Virginia) to gain any insights into differences in responses that might indicate a disadvantage. Based on limited responses from this very small sample, there were no discernible differences in the distribution of responses (one example shown in Table 7). Combining responses from exporters and non-exporters, the relative rankings of competitive advantages, barriers, and sources of information were quite similar among firms in and outside of the cluster. The scale of the effort and design of the research, unfortunately, did not allow for an actual comparison of the elements that would be expected to vary between clustered and non-clustered firms, such as level of access to information, technical assistance, strength of capital and labor markets.

G. Building a Profile of Cluster Power

Clusters are generally described in literature and in research studies in terms of quantitative measures of industry concentration and scale. System attributes are generally limited to supplier linkages. Our analysis moves beyond these quantitative factors and attempts to look at clusters as interdependent systems. The central element is, in each case, the firms in the cluster. Supporting elements are the (a) sources of innovation, technology, research and development (b) suppliers of parts, materials, and equipment, (c) specialized services, (d) distribution infrastructure, and (e) customers. The connecting arrows represent dominant flows of capital, products, and information.

Because clusters are complex systems and not simple agglomerations, however, they cannot be simply represented by indices or even graphics. Therefore, as with export power, we have

developed a preliminary profile for rating the "power" of the cluster using a set of elements that characterize strong clusters throughout the world. This is not a scientific profile based on hard data; it is simply an attempt to develop a potential model that can look beyond the counts of companies and bodies and offer an alternative view of a cluster effectiveness and ability to produce synergy.

The first element represents concentration and scale, the common measures of cluster power. The second element estimates innovation within the cluster, and whether members firms are on the cutting edge of adopting new technologies. The third, fourth, and fifth elements estimate the presence of and level of specialization of support services, suppliers, and the cluster's labor pool. The sixth and seventh elements are indicators of the flow of information and innovation within the cluster, and opportunities for interaction and association that represents. The eighth and ninth are estimates of the strengths of leadership and self-awareness. The final two elements represent entrepreneurial energy and competition.

Unlike the export capacity cluster (Table 9), the competitiveness profile for each of the seven clusters was rated by multiple team members, but with lead researchers' judgment given greater weight. Like the earlier profile, it uses a scale of 1 (lowest) to 5 (highest).

Table 12
Estimated Comparative Competitive Profile of Cluster Power:
A Preliminary Model

FACTOR	Hous. Furn.	ndust Mach	Knit. Mills	Elec. Com.	Med. Dev.	Env. Tech.	Plas. Parts
Concentration/scale (critical mass of companies in region, loc. quotients.)	4.8	4.2	5.0	4.2	1.4	4.2	4.2
Adoption of advanced techniques and technology (rates of investment)	3.4	4.0	3.5	4.0	3.3	5.0	3.6
Specialized support services (knowledge of and value to services)	2.4	3.0	3.8	3.0	2.0	1.8	4.6
Local subs/supply relationships (links between regional businesses)	4.6	4.0	4.5	3.8	2.8	3.0	4.3
Skilled work force (size of labor pool w/experience in industry)	2.0	4.8	3.8	3.0	3.2	4.5	4.3
Social Infrastructure: associations (membership and activity)	3.0	2.6	4.3	3.6	1.4	3.8	3.6
Networking (sharing, pooling resources, alliances)	1.6	2.2	4.0	3.8	1.0	3.5	3.4
Export infrastructure (average ratings from Table 7)	4.5	4.3	3.3	3.4	3.0	2.4	3.0
Cluster awareness (recognition of interdependencies)	4.2	2.2	4.8	3.4	1.0	4.0	4.8
Leadership (numbers of lead and innovative firms)	4.8	2.3	3.8	3.5	1.8	3.5	4.0
Entrepreneurial energy (rate of new business spin-offs)	4.5	4.0	2.3	3.5	1.6	3.8	3.7
Competition (strengths of other local companies)	4.6	3.6	4.0	4.0	2.0	4.2	3.5

Table 12 shows the team's best estimate of the relative strengths and weaknesses of each cluster. The ratings in the table suggest, for example, that household furniture and knitting mills are the most concentrated clusters; that knitting mills and plastics the most self-aware clusters, furniture the most entrepreneurial (perhaps because the initial investment is lowest); industrial machinery and environmental technologies have the most highly skilled and specialized work forces; and environmental technologies the quickest to adopt new technologies. With additional effort, more rigorous measures for each dimensions could be developed and benchmark established.

Perhaps more important, the profiles point out shortcomings and gaps that suggest attention. For example, skilled work force rates low for household furniture and electronic components. This

could reflect a gap in specialized training or simply a shortage in labor market supply. Environmental technologies, medical devices, and furniture all rate low in specialized support services. And there was little evidence of industry leadership in the industrial machinery cluster. Social infrastructure was lowest in medical devices and industrial machinery. Environmental technology, plastics, and medical devices were rated relatively weak in export infrastructure. Shoring up these weaknesses ought to improve the cluster as a whole.

H. Opportunities for Improving Export Performance and Competitive Advantage

Increasing Exports

Economic development theory tells you to exploit competitive advantages and counter the disadvantages and for export promotion, suggests a focus on industries with products most likely to find a market overseas. Research and site visits revealed that the seven ARC target clusters include four very different categories of firms based upon the export outlook for their product. The following discussion refers to the target cluster, not to a national industry. Firms in a single cluster often are divided between these categories.

The first two categories offer the most promising targets for export promotion, those firms with products appropriate for exporting. Some of these firms already are exporting, looking to increased exports as a business opportunity, and seeking larger foreign orders. The first category is firms that sell final products for consumption through retailers. These companies are generally, but by no means all, larger firms. Selling to retailers requires knowledge of consumer tastes and preferences and quick response. Numerous firms in the household furniture cluster and the finished hosiery segment of the knitting cluster fall into this category.

The second category is firms that usually sell to other companies and have unique products or occupy special niches. Certain producers of industrial equipment and electronic components as well as many environmental technology firms fall into this category. Selling to industry or government requires an intimate knowledge of the customer's facilities and needs and often, the ability to provide continuing service and training. Any follow-up requirements add complexity to the export process, but numerous firms in these industries have demonstrated that export sales can be profitable. In this arena, the technological expertise of US firms is a distinct competitive advantage.

The third category is also firms that usually sell to other companies, but their products tend to be standardized commodities on the market. These firms face difficulties in foreign markets, because their products are low value and easily replicated in localities with lower wage rates than the US. Shipping costs add to the exporting disadvantage when the products have a high shipping cost to value ratio. This third category includes portions of the knitting and plastics clusters, the firms that manufacture greige (unfinished) hosiery or simple extruded plastic parts. It also includes portions of the electronics components industry, manufacturers of less sophisticated coils, transformers, and printed circuit boards. Some of these suppliers, such as the plastics parts and electronic components manufacturers, may export indirectly, by making parts used in goods that are sold to foreign markets. While these companies often have to meet

foreign quality standards, they do not have to process exports or have internal expertise; their customer is the exporter.

The final category is the firms that have little or extremely limited export potential. this may be because their customers are local, or because their product is tailored to the individual customer. This category includes that portion of the medical devices industry most often found in the target area, firms manufacturing prosthetics for local physicians. It also includes the tool and die companies that support industrial machinery or plastics companies. For these firms, proximity to customers is crucial to competitive advantage, and by definition, exporting involves distance from customers.

Firms in categories one and two offer the most likely targets for increased export sales, but they still face barriers to exporting. Reducing those barriers offers a strategy for increasing exports, and the cluster structure includes strategic avenues for interventions. The interviews found that lack of information kept firms out of export markets. Information on export markets and information about exporting procedures is available from public and private sources. Apparently, the target audience is not aware of the available information or else that information is too difficult to access and use. Improved services to SMEs would address these barriers. An industry or trade association is an excellent conduit for enhanced services.

Other frequently mentioned barriers relate to the additional marketing and transportation costs associated with doing business overseas. These costs can be reduced through group services and collective exporting, which is an option if firms in a cluster have built the trust and networks so that they can work together. Again, industry or trade associations provide a structure for this activity. The following recommendations describe specific options to address export barriers that were mentioned in discussions with firms and service providers.

- **Overcoming SMEs' difficulty in "getting paid":** Community banks are likely to know clusters the best but have little expertise in exporting. Large banks that know exporting have little expertise in clusters or want to deal with SMEs. A number of niche export finance intermediaries are emerging that are targeting small and mid-sized exporters. One suggestion is to help connect these new companies with the community banks that are more familiar with and accessible to SMEs.

- **Reducing unit costs of international marketing and sales**: Expense was cited as a major barrier to entering export markets. National programs in British Columbia, New Zealand, and Australia have proven quite effective in establishing exporting networks that allow forms with complementary products to target foreign markets and share the costs of doing business there. A suggested action is to develop a cadre of skilled brokers and offer incentives for export cooperatives.

- **Increasing participation in trade shows**: Overseas trade shows, although costly, are important sources of sales leads. A suggested action is to organize groups of small and mid-sized companies to attend trade shows together, sharing costs of booths, or simply gathering information and making contacts that would be shared with others in cluster. Another possible intervention is support for reverse trade missions, bringing delegations from other countries to visit the cluster, become familiar with its products and capabilities, and build

personal relationships. Such reverse trade shows are especially suited to high tech clusters, giving firms a chance to showcase their capabilities.

- **Improving education and information about export procedures and foreign market requirements**: These services exist in most states but are not easily accessed by rural or remote companies. One suggestion is to help SMEs make greater use of telecommunications, both for education and information. For example, Trident Technical College in South Carolina and West Virginia University at Parkersburg are developing a export certification program that will be able to be accessed and delivered via the internet anywhere in the ARC region.

Improving Competitiveness

Exports and competitiveness are intrinsically interconnected. Exporters must be globally competitive, and therefore actions that improve the performance of a company with respect, for example, to quality delivery, design or costs, improve its export capacity. Government agencies have recently come to the realization that SMEs are important to regional economies and that they have distinctive needs and that scarce resources can be best optimized by addressing collective and common needs of clustered SMEs.

The assumption behind sector or cluster analysis is that specialized services and infrastructures, tailored to the specific needs of an industry, are more useful to companies than generic services and infrastructures. Companies prefer to deal with—and receive better service from—others who understand their business. That leads to policies for industry-specific services with their hubs in the general vicinity of the largest concentrations of companies. Other competitive advantages accrue from closer access to suppliers and equipment manufacturers, particularly in situations where suppliers' expertise and knowledge is vital to the final product and interaction enhances the design, where transportation costs are high, and where technologies are changing rapidly. The last is particularly important now that leading economists have discovered that "proximity of others users of advanced technologies is associated with higher rates of adoption."[15] They accrue from labor markets able to meet changing employment needs with minimal retraining.

All of these factors are part of what economists call "external economies of scale." They are optimized in regions where leadership, vision, social infrastructure, and levels of trust allow technology and knowledge transfer to flourish and companies to take advantage of their mutual complementarities and interdependencies.

- **Identify and target gaps in cluster**. View the cluster as a system and look for disruptions in or impediments to the flow of information and business transactions between firms, or weak elements such as a lack of important suppliers or industry specific training. Then look for strategies that improve the entire systems.

- **Improve flow of expert information to SMEs**: One of the major weaknesses in most of the systems analyzed was the use of public sector services. While support services believed they were serving the companies well, the companies claimed it is too general. Therefore, they look most often to the private sector for specific information. Yet the responses from

businesses suggest a dearth of the very specific, niche-market oriented information companies need to export, which can best be obtained from experts in the industry. Regional brokers could help SMEs locate the information or, if unavailable, contract for and partially subsidize the studies, and put together companies with similar needs to share the information costs.

- **Emphasize design**: Although design ranked high among competitive factors, it is given little emphasis and short shrift by educational programs and services. Those that do may emphasize design for manufacturability but not the creative and aesthetic qualities of final products that are increasingly important when competing in global markets with nations noted for their design, such as Denmark or Italy. Colleges ought to play a key role in integrating design into technical curricula and support services ought to include specialized design firms.

- **Merge export/marketing programs with technology diffusion/business assistance programs that target clusters:** SMEs have considerable trouble sorting out and evaluating the multitude of technical assistance programs at their disposal. A "one stop" agency-a long sought ideal of many public agencies-might be more effective of organized around industries rather than functions. Some Manufacturing Extension Program agencies are moving in this direction, enlarging their scopes to address a fuller range of needs of SMEs, yet they are, at the core of their mission, still engineering oriented. Community colleges may be better positioned to serve in this capacity, brokering specialized services for the cluster. Itawamba Community College in Mississippi, for example, specializes in upholstered furniture production and Catawba Valley Community College in North Carolina specializes in hosiery production. The latter is also becoming involved in marketing and exporting issues.

- **Encourage networking**: Although there is no long-standing and well-patterned "habits of cooperation" among firms in most regions, many see a potential for creating new mechanisms to allow firms to explore opportunities for joint export development. While many of these firms do compete with each other in regional markets to supply larger customers, a large number have differentiated themselves with their special capabilities over the past few years, thus increasing the likelihood of cooperating on mutually beneficial issues. Thus, they may find there is now less direct competition and more opportunities for cooperation. In fact, virtually all of the firms surveyed for this project expressed interest in at least exploring new and closer forms of cooperation. The knitting mills in North Carolina have carried this the farthest among the seven clusters, creating informal production networks and formal marketing and R&D networks.

I. Conclusions

This study focused on places in Appalachia where sectors are clustered. Does clustering matter and how does it affect businesses' ability to learn, modernize, and export? It is difficult to make meaningful generalizations that can be applied to other locations because each cluster selected and studied is unique and the way it functions is a product of the type of goods it produces, the customers it targets, and the level of interdependencies among its companies and services (See Table 13).

In fact, the clusters as defined by products and the places with the highest concentrations of companies making those products did not all turn out to be clusters as defined by interdependencies and system characteristics. The medical devices cluster, for example, comprised too few firms with too diverse products and customers and is imbedded in too large an industrial base to be considered a cluster in any sense of the word. Industrial machinery producers are more tightly linked to their customers' clusters than each other, although the smaller supplier firms may constitute a truer and more interconnected cluster. Too little information was gathered about the latter firms to judge their degree of interconnections. Plastic parts and electronics components are clusters of suppliers that achieve external economies as a result of their numbers and are dependent on their customers.

An analysis of two other clusters, household furniture and environmental technologies, revealed that they were each actually two distinct clusters. This illustrates the danger of using only low-level (two- or three-digit) SIC codes to define clusters. Household furniture producers operate as a strong cluster producing upholstered furniture in northeastern Mississippi and a slightly weaker cluster producing solid wood pieces in northern Alabama. In Tennessee, the cluster around Oak Ridge concentrates on nuclear energy and waste and the cluster around Chattanooga on conventional manufacturing environmental problems. Knitting mills as an entire sector is not a cluster but its largest component, hosiery, is a very complex cluster, again illustrating the problem in using three-digit or lower SIC codes. Hosiery firms are tightly linked to each other but not to other types of knitting mills.

In only three of the clusters do concentrations and connections appear to improve firms' interest in and ability to export. Knitting mills (hosiery), furniture, and environmental technologies are favorably affected by collective marketing and/or better access to information. Electronic components has the potential to benefit from such activities but does not yet. Industrial machinery markets are too diverse and customer specific, and are dependent on customer relationships. The medical devices cluster around Pittsburgh, as defined by current members, is tied to local customers, and plastic parts has little potential because its capabilities are too ubiquitous and readily replicable locally.

Despite the individuality of the clusters, the accumulated knowledge does lead to some findings about export potential. Each cluster has some but not all of the strengths necessary for success in exporting, and therefore each has areas in which it can improve its performance—if it so chooses.

- Clusters that are mainly suppliers of larger firms (e.g., plastics parts and electrical components) are less likely to export than those that sell to final users (e.g., industrial machinery and household furniture).
- Clusters that compete on design or innovation (e.g., environmental technologies and industrial machinery) are more likely to have a future in exporting than those that compete on the basis of lowest price (e.g., plastics parts and knitwear).
- Clusters that are internally networked and can take advantage of external economies of scale (e.g., hosiery and environmental technologies) are more likely to be able to export and adopt new technologies than those that are not (e.g., medical devices).
- Clusters that are composed of larger companies (e.g., industrial machinery and are more likely to export than those comprised of small companies (e.g., knitting mills and .
- Clusters with strong and specialized support services—especially those with marketing expertise, (e.g., hosiery and plastics parts)—are more likely to export than those with fragmented or generic services (e.g., medical devices and industrial machinery).
- Clusters with pro-active companies that seek out markets (e.g., industrial machinery and environmental technologies) are more likely to export than those that are "order takers" (e.g., household furniture).
- Within clusters, firms that are more technologically advanced (often the larger SMEs) are more likely to be exporters than the less advanced firms.

Finally, for the benefit of future cluster analyses, it is important to note that three-digit SIC codes do not adequately classify clusters. Some are too broad (i.e., hosiery is a cluster but other knitting mills in SIC 225 are dissimilar and unconnected); some are too restrictive (i.e., they miss vertically integrated clusters where suppliers are part of cluster); and some are too new and undefined by product (i.e., environmental technologies).

Endnotes

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[1] Jeffrey C. Fuher and Jane Sneddon Little, "Technology and Growth: An Overview," in *New England Economic Review* (November/December 1996) pp. 3-25.
[1] Because the lines differentiating these categories and other SIC 35 industries are difficult to draw at the firm, or even regional level, the scope of the inquiry was broadened to include other industrial machinery, such as farm equipment (352) and construction equipment (353). Industries excluded from the analysis include 351 (engines and turbines), 357 (computers and office equipment), and 358 (refrigeration and heating equipment). Despite this exclusion, SIC 35 data are used in the analysis of recent export trends (unless otherwise noted), because neither industrial outlook nor state-level data are generally available at the three-digit level.

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[1] The statistics in this section are drawn from *Selected Characteristics of Manufacturing and Wholesale Establishments that Export: 1992,* published by the Census Department.
[1] *America's Clusters: Building Industry Clusters*, DRI/McGraw-Hill, San Francisco: June 1996 (available from the National Technical Information Service as PB96-212253).
[1] See *The Report Card on Trade*, Kenan Institute, March 1995.
[1] Percentages are based on surveys that include about two-thirds of all exporters.
[1] Exports exceed output
[1] Much of this information was collected and reported by Mississippi State University graduate student Albert Nylander. It is supplemented by this author's interviews with business leaders in Tupelo.
[1] Numbers in this section are for all Furniture and Fixtures (SIC 25), the only level at which state export statistics are available. Household furniture is a subset of this group.
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Appendix
Data Sources and Methodology

Export Data

The data used for the analysis of export performance in the six target industries that can be defined with contemporary SIC codes is taken from US *Exports by State of Origin of* Movement, Foreign Trade Division, the US Bureau of the Census (MISER revision), which is published on CD ROM as part of the *National Trade Data Base.* This statistical series is based upon data collected by the US Customs Service through the Shipper's Export Declaration (SED), which must be completed by the exporter when the goods are shipped.

Among the information gathered by the SED *are* the point of origin, commodity classification, country of destination and dollar value of the shipment. The commodity classification is translated by Census to the appropriate product-based SIC code. The point of origin is defined as the place from which the merchandise starts its export journey, the place of the commodity of the greatest value, or the place of consolidation. The intent is to identify the location where the goods were sold to a foreign purchaser and became an export. This location does not always coincide with the location at which the exported good product was grown, mined, or manufactured.

The Foreign Trade Division (FTD) began collecting this information by state in 1985, when the state of origin question was added to the SED. Since then, it has worked to improve the accuracy of the data. Because some 10 to 15 percent of SEDs are incomplete, FTD began contracting with the Massachusetts Institute for Social and Economic Research (MISER) in 1987 to assign states and SIC codes to export shipments with incomplete SEDs. MISER continues to refine this data, and it is available in a timely manner. However, there remain distortions caused by ambiguity about when a product becomes an export. A second shortcoming in the context of this report is that the MISER data is available only for two-digit SIC industries, and the target industries selected by the ARC are defined at the three-digit level.

The Industry Division of the Census has published annual export data by three-digit SIC industry in a publication entitled *Exports from Manufacturing Establishments,* which used information From the Census and Survey of Manufactures. Although there was a substantial time lag in the release of this data, it was the best available information on the state level describing the export of manufactured products. However, in spring of 1996, Census ceased publication of that data series. The last year of data published was for calendar year 1992 and did not go below the two-digit level.

As noted in the text, environmental technologies (ET) is not susceptible to definition by the contemporary SIC code system. Moreover, its products include services as well as goods, and the MISER data reports only on the export of goods. The International Trade Administration has selected ET as a target industry and is working with the Environmental Protection Agency and Census to develop a data series that will measure environmental technologies revenues, employment, and exports. To enable some initial analysis of ET exports, ITA contracted wiffl the Environmental Business International Inc. to produce estimates of ET exports. Those estimates were mode for the calendar year 1994 and are the source of the state and notional ET export statistics used in this report.

EBI segments the environmental industry into services, products and equipment, and resources.

Those segments can be translated into the context of the SIC system. Service activities fall under major SIC groups 73 .(business services), 87 (engineering, research, management, and related services), and 16 (heavy construction other than buildings). Equipment producers include manufacturing firms plus special trade contractors from SIC 17. Resource conservation firms include portions of utilities, SIC group 49, plus resource recovery firms, which are considered SIC manufacturers or business services, depending upon their customers and contractual arrangements. The following lists potential SIC codes for environmental technology firms.

SIC Codes for Environmental Technology Firms

1389 oil and gas field services NEC
1623 water main line construction
1629 waste disposal, water, wastewater, and water power plant construction,
1711 water system balancing and testing
1799 asbestos and lead paint removal
2299 processing of textile mill waste and recovering fibers
2493 reconstituted wood products
2499 reqround sawdust, pressed logs of sawdust
2679 converted paper and paperboard products NEC
2899 water treatment compounds
3089 plastic products NEC, inc. recyclables and underground storage tanks
3272 incinerators, concrete
3341 recovery and refining of non-ferrous metals
3399 recovery of iron ore from open hearth slag
3443 heating equipment, inc. wood waste burning and biomass systems
3564 air purification and dust collection equipment
3567 incinerators, metal: domestic and commercial
3569 air separators
3589 water treatment equipment, industrial scrubbers and sweepers
3634 air purifiers, portable
3823 water quality monitoring systems, industrial process control instruments
3826 analytical instruments
3829 measuring and controlling instruments
4941 water supply systems, except irrigation
4952 sewerage systems
4953 waste materials disposal, including hazardous incinerator operation
4959 sanitary services NEC
5075 air pollution control equipment and supplies - wholesale
5093 waste rags, rubber, wholesale
737 computer programming, data processing, other related services
7389 business services NEC,. including solvent recovery, aluminum processing scrap metal, plastic, fiber, paper recycling
8711 engineering services, except architectural and surveying
8731 engineering laboratories, commercial physical research; ex testing
8734 testing laboratories, pollution testing, except automotive emissions

EBl data include public sector operation of water and sewer facilities and of waste management, including resource recovery. However, they do not include government regulatory activities, which would fall under SIC code 9511, government environmental protection, quality and control agencies.

Estimating the Gross Product

Domestic Product data quarterly with only a few months lag. However, the most recent Gross State Product data available from the Bureau of Economic Analysis was for calendar year 1992. The 1993 through 1995 Gross State Product for the ARC states was estimated by using a model which was developed by Creative Strategies, Inc. and is described below.

1. Individual ARC state shares of the 50-state Total Personal Income were calculated using BEA data for each year 1990 through 1995.

$$\frac{\text{1990-92 (Gross State Product/Gross Domestic Product)}}{\textbf{State Personal Income/SO-State Total Personal Income}}$$

2. Individual ARC state shores of the Gross Domestic Product was calculated using BEA data for each year 1990 through 1992.

Gross State Product/Gross Domestic Product

3. The ratio between individual ARC state shares of the Gross Domestic Product and individual ARC state shares of the 50-state total personal income was calculated for the

$$\frac{\text{1990- 1992 (Gross State Product/Gross Domestic Product)}}{\text{1990-92 (State Personal Income/50-State Total Personal Income)}}$$

This produced a projection factor for each state. The project factors reflect the varying composition of state personal income and ranged from a high of 1.039 for Tennessee and Georgia to a low of 0.8666 for Maryland.

4. The projection factor was applied to the individual ARC state shares of the 50-state Total Personal Income for each year 1993 through 1995. This produced a projected state share of Gross Domestic Product for each year.

$$\text{projection factor} \times \frac{\text{1993 State Personal Income}}{\text{1993 50-State Total Personal Income}}$$

$$\text{projection factor} \times \frac{\text{1994 State Personal Income}}{\text{1994 50-State Total Personal Income}}$$

$$\text{projection factor} \times \frac{\text{1995 State Personal Income}}{\text{1995 50-State Total Personal Income}}$$

1. The Gross Domestic Product was multiplied by the appropriate projected state share to produce and estimated Gross State Product for each year 1993 through 1995.

1993 projected state share of GDP	X	estimated 1993 GDP
1994 projected state share of GDP	X	estimated 1994 GDP
1995 projected state share of GDP	X	estimated 1995 GDP

Volume II: Case Studies

INDUSTRIAL MACHINERY IN SOUTH AND NORTH CAROLINA *CLUSTERED WITH ITS CUSTOMERS*

by Jennifer Bremer
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Preface

Few regions in the United States can boast of the industrial success of the Greeneville-Spartanburg area and the surrounding counties comprising Appalachian South Carolina, particularly with foreign industry. Nearly two in five workers are employed in manufacturing in the region and the local Chamber claims that the I-85 business corridor has the nation's highest number of engineers per capita. The state is home to international firms from 18 countries, including 50 foreign U.S. headquarters. The city of Spartanburg alone has 83 international companies from 14 countries. The region includes a foreign trade zone, one of the few high schools in the nation that offer an international baccalaureate diploma, and dozens of special associations, programs and schools that make foreign workers and managers feel welcome and comfortable.

The roots of the region's industrial base lie in its textile industry, which once dominated South Carolina's economy. In the late 1950s, local business leaders recognizing the importance of innovation, traveled to Europe—mainly Germany, Switzerland, and Austria—to entice the industry's machine tool builders to locate facilities closer to its manufacturers. Those first few successes formed the core of the region's industrial machinery cluster, which subsequently grew and diversified attracting many other closely and loosely related businesses.

Summary of Key Findings

Industrial machinery is an important element of the ARC region's manufacturing sector. An important concentration of companies in this industry is found in the region of the Carolinas surrounding South Carolina's Greenville-Spartanburg metropolitan area. This section discusses the cluster—based in part on the results of a survey of 20 industrial machinery firms and seven support services in the region—and draws implications for public policies that would expand the cluster's export activity and accelerate its modernization.

The overall findings are:

- The industrial machinery is highly clustered but also highly diversified internally. Although textile machinery was important in its development, it does not dominate the cluster; it also includes other sectors such as automotive parts and diversified metal products.
- The industry is further divided between (a) manufacturers who produce a final product, nearly all of whom export, and (b) job shops, which have fewer opportunities to export because they manufacture to special order and generally supply other members if the cluster.

- Nearly all of the firms with high export potential are already exporters—many of them at a high level. About a third of all exporters in the region are foreign owned firms or foreign transplants.
- Industrial machinery companies in the area do not have a strong tradition of cooperation. In general, these companies have specialized products and are more oriented toward their respective customers than each other. Yet they do have many common interest and concerns, such as skill development and process technologies.
- Industrial machinery firms in the cluster rely primarily on private sector sources for assistance with marketing and technology issues. Only a minority use government agencies or other public sector sources, such as technical colleges for training.
- Companies cite worker skills and transportation infrastructure, and quality of life as the primary advantages of their location. The local presence of companies in the same industry—whether competitors, suppliers, or customers—does not given as a major factor by respondents.

General Industry Description

The target industry "industrial machinery" includes establishments in all segments of SIC 35, which is highly diversified. Special emphasis was placed on four related three-digit industries: 354, 355, 356, and 359.[16] These industries are:[17]

- SIC 354, machine tools, includes machinery for forming, cutting, and shaping metal, power tools, molders' patterns, tools and dies, rolling mill machinery, welding apparatus, and related parts and equipment.

- SIC 355, special industry machinery: manufacturers of equipment for establishments for specific industries, including textiles, woodworking, paper, printing, food products, and a miscellaneous category that covers everything from ammunition loading to zipper-making machinery.

- SIC 356, general industry machinery: manufacturers of equipment used across a broad range of industrial plants, including pumps, roller bearings, compressors, fans, gears, power transmissions for industrial machines, furnaces, and ovens.

- SIC 359, miscellaneous industrial machinery: carburetors, pistons, rings and valves, fluid power cylinders, pumps and motors, non-laboratory scales, and industrial and commercial machinery not elsewhere classified—including establishments that produce or repair industrial machinery parts for others.

The industrial machinery sector, in contrast to some of the consumer product clusters, is more diversified and, within firms, more specialized in its products. This has several important implications for our analysis, and for efforts to work with the sector.

First, industrial machinery markets are diverse and respond to trends in the specific industries of which they are a part, not to any general markets for machinery. These markets are closely linked to the industry they serve. Trends within each subsector are dictated by technological change and the fortunes of the industry that will use the equipment, as well as broad economic

and market conditions. The market for machine tools responds to events in the metal forming industries, for example, and is generally unrelated to the market for textile equipment or pumps and compressors.

Second, even though the products are highly diverse, the production processes used to make industrial machinery are broadly similar. Technological change occurs both through the process with which the machine is produced and in the ways in which the machine will be used in the production process for which it is designed. This, while process technologies are more common, product related technological change is industry- and company-specific.

Third, companies tend to have strong relationships with their customers, their suppliers (some of which are other job shop industrial machinery companies), and other companies in their subsector, rather than with other final industrial machinery companies located nearby with unrelated industries.

Fourth, the industrial machinery industry is dominated by small and mid-size firms. With the exception of the construction machinery sector and computer equipment (included in SIC 35 but not discussed here), most firms have fewer than 100 employees. The only exceptions are in areas where a product has sufficiently broad use to create a large, reasonably homogenous market, such as that for industrial pumps. The diversity and specialization of the industrial machinery sector tends to impede the formation of large, market dominating firms.

Structural and Market Patterns

The major customers for industrial machinery companies are, by definition, other manufacturers. Firms in this sector fall into two major categories: job shops and batch producers. This distinction has important implications for the firms' relationships with customers, marketing strategies, and manufacturing activities.

The job shop category is comprised of small shops producing custom products to order. They do not produce a "product line" but perform work to customer's orders. Job shops are typified by tool and die operations, common to any major industrial region, which provide highly specialized inputs with which the equipment produces the intended part. A close working relationship with the customer is fundamental to this business, and these companies tend to serve customers in a concentrated geographic area, or cluster.

Batch producers, on the other hand, use a more standardized manufacturing process to produce in larger quantities. Although improving communication and transportation systems are encouraging batch producers to behave more and more like job shoppers, with shorter runs and/or customized products, they nonetheless produce an identifiable product line that can be described in a catalog and exhibited at a trade show.

Among job shops, the primary marketing task is maintaining customer relationships. Some job shops serve a single large customer and many do not have a dedicated marketing staff. New business in this category generally is through word of mouth, as plants seek a particular expertise that the jobber offers. Quality and reputation are therefore of primary importance to the success of the firm. Job shops are often in keen competition with each other.

Batch producers tend to be more specialized than job shops, producing a specific kind of equipment for specific industries. The level of competition varies greatly from subsector to subsector, with many small and mid-size firms essentially monopoly producers of a specific type of equipment, such as circular knitting machines or pad-batch dying equipment. As a result of a trend among their large customers towards outsourcing, more and more batch producers are first tier suppliers, supplying components or sub-assemblies to major manufacturers. It is not uncommon for such a supplier to serve a single customer exclusively. For example, one of the firms surveyed manufactures sub-assemblies for Volvo. This firm's managers do not consider themselves exporters even though all of their product eventually ends up in foreign markets because direct sales are to another U.S.-based manufacturer that completes the product for Volvo. Batch producers tend to differentiate themselves by price and customer service.

Exporting Patterns

In 1995, industrial machinery accounted for approximately 20 percent of the value of manufactured products exported from the United States and 18 percent of the value of manufactured exports from the ARC states. Although the Appalachian region is not selling quite as much industrial machinery abroad proportionally, it is a leading industrial sector in terms of the value of goods exported. Between 1993 and 1995 U.S. exports of industrial machinery grew by over $25 billion, from $80.1 billion to $105.9 billion, a 32.2 percent increase. Industrial machinery is exported to all of the major markets served by the U.S. Emerging market countries, such as Taiwan and Brazil, are growing markets for these products, while Canada, Europe, and Japan are established customers.

The distinction drawn between job shops and batch producers has important implications for exports. As a rule, job shops do not export because they rely on close, continual communications with their customers. Exporting is not currently an option, although as use of the information highways increase, opportunities could arise. In contrast, the vast majority of batch producers are already exporting. If they are not, it may be because they are pursuing a business strategy that precludes exporting, such as producing sub-components for a U.S. firm under license or to a customers' design. Since they cannot export the product they currently produce, such firms would clearly have to undertake a substantial marketing and product development effort in order to be able to export, an option that may not be financially feasible or attractive.

Foreign-owned firms are quite important to the exporting performance in the Greenville/Spartanburg cluster. Although hard data are not available, discussions with informed observers indicate that about one-third of the industrial machinery firms in the area are foreign transplants or foreign-owned. These include both foreign firms that invested to establish plants in the area and local firms that were acquired by an offshore investor. Foreign ownership can be an advantage for exporting, particularly if the parent firm has a strong international marketing presence and a sales network from which the U.S. subsidiary can benefit.

In some cases, however, foreign ownership effectively blocks exports. This may happen when the parent firm already serves export markets from its existing plants or has chosen to establish a plant in the United States precisely to tap into the U.S. market. In either case, exporting may not be part of its strategy for the subsidiary. In such cases, lack of information about export opportunities, lack of export services, etc., are clearly not the constraint to exporting.

Overall, however, the presence of foreign firms is a positive factor. It can support the growth of export expertise in the region as a whole by increasing awareness of international markets or supporting the development of international shipping expertise. Though difficult to document, this could give a substantial boost to the export capabilities of local firms. Table 13 shows exports of SIC 35 products from the ARC states and Carolinas.

Table 13
Value of Industrial Machinery and Computer Equipment Exports
(1993-1995, millions of dollars)

AREA	1993	1994	1995	1993-95 Change	% Change
U.S.	80,141.5	91,074.9	105,947.6	25,806.1	32.2
ARC States	19,211.1	22,051.8	26,020.4	6,809.3	35.4
ARC as % U.S.	24.0	24.21	24.6	26.4	109.9
Carolinas	2,906.6	3,607.1	4,759.1	1,852.5	63.7
Carolinas as % U.S.	3.6	4.0	4.5	7.2	197.8

The ARC member states experienced a slightly higher export sales growth rate than the United States but did not close the gap in exports as a percent of shipments in between the ARC region and in the nation. Nonetheless, in the 1993-95 period, the 13 ARC states accounted for almost one of every four dollars in export sales of U.S. industrial machinery. These statistics demonstrate the growing importance of the Carolinas in industrial machinery (although, again, the inclusion of computer equipment requires caution in drawing conclusions from these figures alone). Industrial machinery in the Carolinas displayed an even higher level of export growth than the ARC region as a whole, nearly double the national average.

Defining the Cluster

The ARC target industry industrial machinery includes establishments from three SIC codes, 355, 356, and 359. SIC 355, special industry machinery, includes establishments primarily engaged in manufacturing machinery—and parts, attachments and accessories for that machinery—for specific industries. These specific industries include textiles, woodworking, paper, printing, food products, plus a miscellaneous category, special industry machinery not elsewhere classified, which ranges from ammunition loading to zipper making machinery.

SIC 356, general industry machinery, includes establishments primarily engaged in manufacturing machinery—and parts, attachments and accessories for that machinery—that has broad applicability in industrial processes. This encompasses as pumps, roller bearings, compressors, fans, gears, power transmissions for industrial machines, furnaces and ovens. SIC 359, miscellaneous industry machinery includes carburetors, pistons, rings, and valves; fluid power cylinders, pumps, and motors; non-laboratory scales; and industrial and commercial machinery not elsewhere classified. It also includes establishments that produce or repair industrial machinery parts for others. (*Standard Industrial Classification Manual*; Executive Office of the President, Office of Management and Budget, 1987.) The target industry comprises a large part of SIC major industry 35, industrial and commercial machinery and

computer equipment. SIC 35 data is used in this analysis of recent export trends. Unless otherwise noted, the industrial machinery sector analysis, like the export analysis in Chapter 1, uses the MISER export data, as provided in the National Trade Data Base, for the years 1993 through 1995.

Recent Export Trends

Between 1993 and 1995 US exports of industrial machinery grew by over $25 billion, from $80.1 billion to $105.9 billion. At the same time, exports from ARC member states rose from $19.2 billion to $26.0 billion, an increase of almost $5 billion. The value of recent industrial machinery exports is presented in Table 14. The increased sales represent a 32.2 percent increase for the United States, and a 35.4 percent increase for the combined ARC member states. The higher growth rate for the ARC states indicates that as a group, the ARC states are moving closer to the national average.

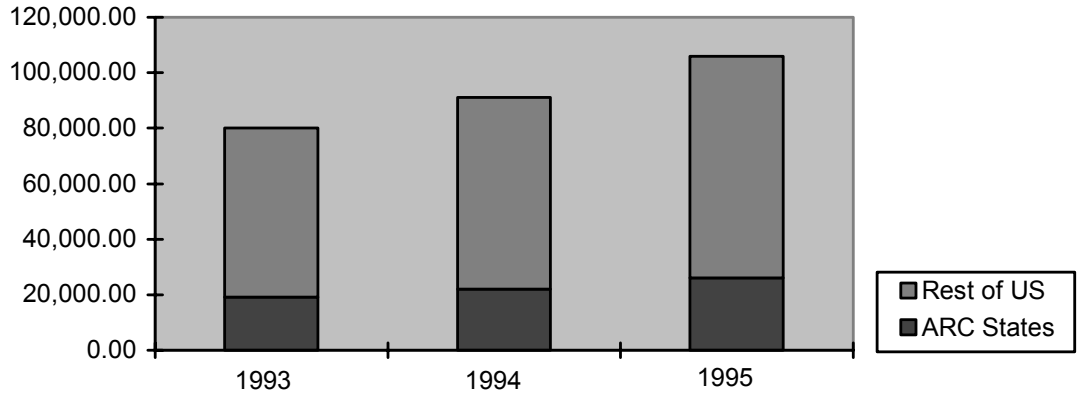
Table 14
Value of Industrial Machinery, Computer Equipment Exports
1993-1995 (millions of $)

AREA	1993	1994	1995	1993-95 CHANGE
ARC States	$19,211	$22,051	$26,020	$6,809
United States	$80,141	$91,074	$105,947	$25,806

In 1993-95, the 13 ARC states accounted for almost one of every four dollars in export sales of US industrial machinery. Because of the faster growth rate for the ARC states, that ratio increased from 24.0 percent in 1993 to 24.6 percent in 1995. Figure 9 depicts the region's contribution to national export sales of industrial machinery, including computers.

Figure 9

ARC Share of US Industrial Machinery Exports (millions of dollars)



The largest amount of industrial machinery exporting is in the northern Appalachian states. New York, with 1995 export sales exceeding $6 billion, is by far the largest exporting state for industrial machinery, and Ohio is second with $4.6 billion. A second tier of states, North Carolina and Pennsylvania, exported approximately $3 billion each, while Virginia firms had $2 billion in 1995 export sales.

Between 1993 and 1995, the dollar value of industrial machinery exports increased for every ARC member state. New York and North Carolina experienced the largest increase in the dollar value of industrial machinery exports, some $1.4 billion each, while Ohio firms added $ 1 billion. No other state experienced growth near that magnitude. The smallest sales increases were for the states of West Virginia and Mississippi. Table 15 lists the 1993 through 1995 value of textile exports attributed to each ARC member state, and the changes that occurred during that interval.

Table 15
Value of Industrial Machinery, Computer Equipment Exports by State, 1993-1995
(millions of $)

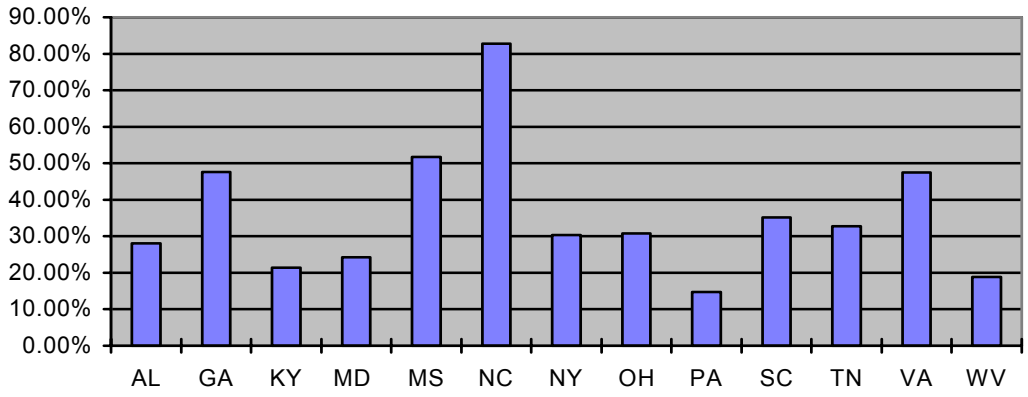
AREA	1993	1994	1995	'93-'95 Change
Alabama	$404.6	$468.9	$518.2	$113.7
Georgia	$1,177.8	$1,421.7	$1,738.8	$561.0
Kentucky	$766.8	$852.3	$931.1	$164.3
Maryland	$617.8	$623.4	$767.4	$149.5
Mississippi	$155.0	$164.8	$235.2	$80.2
North Carolina	$1,741.0	$2,342.1	$3,182.7	$1,441.8
New York	$4,826.8	$5,556.4	$6,291.7	$1,464.9
Ohio	$3,556.0	$4,064.0	$4,646.2	$1,090.2

Pennsylvania	$2,486.6	$2,560.4	$2,855.4	$368.8
South Carolina	$1,165.6	$1,265.0	$1,576.4	$410.8
Tennessee	$832.7	$901.0	$1,105.7	$273.0
Virginia	$1,437.7	$1,792.8	$2,120.8	$683.1
West Virginia	$42.8	$38.9	$50.9	$8.1

Absolute numbers tell part of the story, but the impact of a given increase or decrease in export sales depends in part upon the amount of export activity. Calculating the rate of change helps put the movement in perspective. The rate of change in industrial machinery exports for the ARC states, depicted in Figure 10, confirms the wide variations in export growth suggested by the absolute numbers. It also demonstrates the importance of looking at rates as well as absolute numbers. A$1.4 billion increase in sales produced a growth rate of over 80 percent in North Carolina and a growth rate of 30 percent in New York. Mississippi, Georgia, and Virginia also show relatively high rates of growth.

Figure 10

Percent Growth in Industrial Machinery Exports 1993-1995

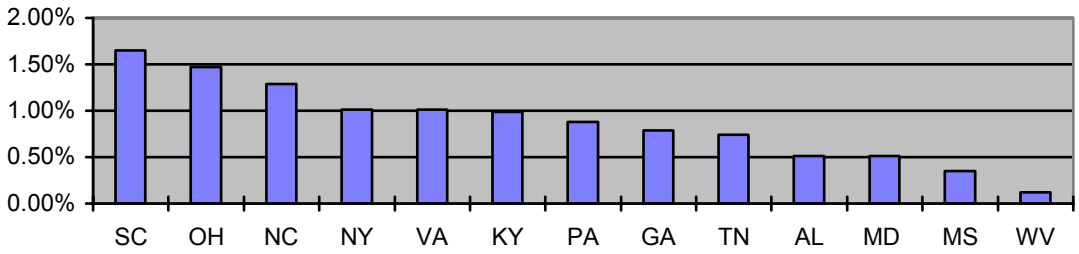


Export Intensity

Another way to accommodate size differences among states so that comparisons can be made is to calculate the value of textile exports as a percentage of the gross state product (GSP). That ratio measures the contribution that industrial machinery exports make to the state economy. It is the target industry counterpart of the state export intensity calculated in Figure 1. The US export intensity for industrial machinery for the 1993-95 period was 1.34 percent. For the ARC states, it was 0.98 percent. The difference describes the gap between the contribution that export sales of instruments and related products are making to the regional economy and the contribution they would make if export performance was at the national average. It reveals that as a group, the ARC states are receiving less than average benefit from the export of industrial machinery. The experience varies among individual states. Figure 11 ranks the ARC states by their 1993-95 textile export intensity.

Figure 11

ARC States Ranked by Industrial Machinery Export Intensity



Calculating the export intensity brings a new state, South Carolina, to the forefront. The state-by-state variation in industrial machinery export intensity shows a clear geographic concentration in three states, North and South Carolina and Ohio, which have export intensities above the national average. A second tier of states—New York, Virginia, and Kentucky—have export intensities above the regional average of 0.98 percent. The other seven of the thirteen ARC states have export intensities below both national and regional averages.

To facilitate comparisons over time of ARC states' industrial machinery export performance with that of the nation, export intensity can be calculated as an index relative to the national average. The resulting number is the export intensity index (EII) for the target industry. The national export intensity changes over time, but the national EII is always one. States where industrial machinery exports make a contribution to the economy that is greater than the national average have an industrial machinery EII above 1.00. Conversely if industrial machinery exports make a relatively small contribution to the state economy, the EII is less than 1.00. Changes over time in the target industry EII reflect changes in the contribution of target industry exports to the state economy that are more positive (an increasing EII) or less positive (a decreasing EII) than the national trend.

The industrial machinery EII confirms that South Carolina leads the ARC states in exporting performance for industrial machinery. Only North Carolina and Ohio join South Carolina in having an EII over one. Both Carolinas are experiencing a rising EII, while Ohio remains essentially stable. Georgia, Virginia, and Mississippi have EIIs that are below average but rising. The remaining seven ARC states also have relatively low industrial machinery EIIs, but they are not closing the gap. Table 16 lists the textile EII for each ARC state.

Table 16
Industrial Machinery & Computer Equipment Export Intensity Index, 1993-1995

AREA	1993	1994	1995
Alabama	0.39	0.39	0.37
Georgia	0.56	0.60	0.62
Kentucky	0.77	0.75	0.71
Maryland	0.40	0.36	0.38
Mississippi	0.25	0.24	0.29
North Carolina	0.80	0.95	1.10
New York	0.75	0.76	0.75
Ohio	1.10	1.11	1.09
Pennsylvania	0.71	0.65	0.63
South Carolina	1.24	1.19	1.27
Tennessee	0.56	0.53	0.56
Virginia	0.70	0.77	0.78
West Virginia	0.10	0.08	0.09

Despite the predominance of below average and falling EIIs, the combined industrial machinery EII for the ARC states rose slightly, from 0.73 in 1993 to 0.75 in 1995. The increase is due to the very strong performance of a few states. The low but rising regional EII indicates that there is opportunity for economic growth by increasing export sales of industrial machinery produced in the ARC states.

Exports by Firm Category

The latest export data by firm size (1992) demonstrates the breadth of exporting activity in the industrial machinery sector. Virtually all midsize and large firms in this industry that can export are already doing so. Nationwide, 92 percent of plants with more than 500 employees and 72 percent of plants with 100-500 employees export directly, that is, with the overseas shipment made directly from the plant. Given that the direct export figure excludes exports through another unit of the same firm (e.g., a central warehouse at another location) as well as exports through a wholesaler or distributor, and given that some firms are unable to export (e.g., their sole product is produced under license for a domestic customer), it is evident that the vast majority of firms that can export, do export. This opinion is confirmed in discussions with knowledgeable practitioners in the industry, both in the cluster and nationally.

For this group, growth will come from increasing export sales, not from introducing wholly new-to-export firms to the benefits of international marketing. There is still plenty of room for growth in exports per firm, given that direct exports average only 23% of sales for the largest plants and 18% for the midsize plants.

What is generally not recognized is that a large share of small industrial machinery firms are already exporting. Nationwide, only 23% of SIC 35 manufacturing plants with fewer than 100

employees export directly, but this figure is heavily skewed by the presence of small job shops and other micro-firms in this category. Non-exporters among small firms average only 10 employees, compared to average employment of 24 among small industrial machinery firms that export. When one factors in the important role that wholesalers play in machinery exports by small firms, activity not captured in these statistics, it is evident that even in the small plant category, a large share of firms with the potential to export are already exporting.

This pattern is even stronger in the SIC 35 category in the Carolinas. In South Carolina, for example, 83% of midsize plants and 93% of large plants export directly. Non-exporters among the small plants tend to be the tiny firms, averaging only 10 employees compared to 28 for the small firms that export (among those with under 100 employees).

Another important measure of export penetration is the proportion of the labor force currently working in a plant that exports. The bottom line here is that most workers in the sector in South Carolina are employed by a plant that exports: 45 percent of the employees in small plants and an impressive 79% of all industrial machinery employees work in an exporting plant.

Locational Patterns

The industrial machinery sector has two main focal points within the ARC region, the heavy industrial Pittsburgh area, and the "Threeville" area (the triangle formed by Greenville, Knoxville, and Huntsville). Table 17 shows the distribution of plants and jobs for the sectors of the industrial machinery sector chosen in the ARC region.

Table 17
Industrial Machinery Plants and Jobs in SIC 354, 355, 356, and 359

	Plants by State	% of total ARC	Jobs by State	% of ARC
Alabama	398	12.74	7616	8.7
Georgia	267	8.55	6222	7.1
Kentucky	96	3.07	2193	2.5
Maryland	19	0.61	536	0.6
Mississippi	81	2.59	1869	2.1
New York	137	4.39	8844	10.1
North Carolina	174	5.57	4601	5.3
Ohio	209	6.69	5138	5.9
Pennsylvania	896	28.69	25791	29.6
South Carolina	245	7.85	9096	10.4
Tennessee	313	10.02	7977	9.1
Virginia	89	2.85	11735	13.4
West Virginia	231	7.40	15384	17.6
Total	3155		107002	

The industry is broken down as shown in Table 18 for North and South Carolina.

Table 18
Industrial Machinery Cluster: Establishments and Employment by State

Industry	North Carolina		South Carolina		Total			
	plants	jobs ('000)	plants	jobs ('000)	plants	% of ARC	jobs ('000)	% of ARC
Construction machinery (353)	8	803	11	490	19	5	1293	7
Metal forming (354)	52	919	61	3850	113	13	4769	19
Special industrial machinery (355)	29	696	82	3829	111	27	4625	29
General industrial machinery (356)	22	1907	26	2782	48	16	4689	18
Industrial machinery NEC (359)	115	1195	126	1895	241	11	3090	11
Total	226	5520	306	12846	532	54	18466	58

Appalachian Region Data

Key elements of the machinery industry cluster include, in addition to the firms themselves, the suppliers and distributors that serve the industry.

Suppliers. The basic building materials for industrial machinery include metal components; plastic fittings, parts, and hoses; industrial fluids, computer and other controls, and mechanical and electrical assemblies. Many of the secondary materials, tools, and machines serving the industry are made by the industrial machinery sector itself, so many of the suppliers of companies in these industries are also in the industry, and may be machinery exporters themselves.

The most important supplier relationships within the industry are among industrial machinery firms, e.g., between machine tool builders and customers who use machine tools to produce textile machinery. Because both customer and supplier tend to be small firms and to have longstanding relationships, interfirm relationships are often personalized, based on mutual knowledge and loyalty rather than the volume of the sales. At the same time, the equipment industry is highly globalized, and special purpose machinery used even by small firms may be sourced in Europe or Japan (generally through a local distributor). Because of the high value of this equipment, however, and the importance of the buyer-supplier linkage to both parties, these relationships can be quite close despite the distances involved. In-plant visits by manufacturers' representatives help to maintain these ties and identify new technologies for the customer, as well as new market needs for the manufacturer. The survey findings discussed below demonstrate that these supplier contacts are the primary source for new machinery and production techniques.

Other supply relationships are less critical, both to the supplier and the customer. Many of the supplies used by the industry (industrial fluids, plastics) are also used by a wide range of firms, including the industrial machinery firm's own customers, often in much larger quantities.

Coupled with the small scale of most machinery manufacturers, this factor reduces the importance of any single customer to this group of suppliers and leads to a less personal relationship. This generalization does not apply to such subsectors as construction machinery or industrial pumps, where large firms are dominant (Deere, Komatsu-Dresser, etc.) and therefore the importance of the customer to the supplier is much greater.

Distributors. Industrial machinery is sold through a number of distinct channels, including contractual relationships, direct sales, and agency relationships, as indicated in the cluster diagram presented later in this section. In many cases, the equipment produced by smaller plants, in particular, is produced to order from a longstanding customer. Such relationships may continue for several years at a stretch. Both batch producers and small job shops rely on this approach, the latter to a much greater degree than the former. In this situation, it is common for firms to seek new customers entirely by word of mouth, an approach that is common to small tool-and-die operations and other jobbers. As a result, many companies do not have a sales staff, much less formal relationships with distributors.

More formal sales structures include direct sales to customers through an in-house sales force, independent agents, and distributors, often used in combination. Depending on the number of customers served, the sales volume per customer, and the geographic distribution of the customers, an industrial equipment manufacturer may deal directly with the customer through an in-house sales force (or, for small firms, even through senior management). Smaller customers and those located far from the plant are likely to be served through a distributor, if the manufacturer produces equipment that lends itself to this approach (i.e., equipment that is sufficiently standardized for a distributor to be able to represent the supplier). Depending on the product and the relationships among the supplier, distributor, and customer, the distributor may have a large role in customizing the product for the client, training, and after-sales service.

An additional factor in this equation is the comparative underdevelopment of the distribution network in the Southeast compared to the nation as a whole.[18] In general, the wholesale sector in the southeast is made up of smaller firms than is the wholesale network in the country as a whole. South Carolina, for example, has a total of 966 wholesalers serving the machinery, equipment, and supplies category (SIC 508), with average sales of $2.3 million, or 1.6 wholesalers for every SIC 35 plant. Sales through this channel were equivalent to only 39% of the value of industrial plant shipments; that is, South Carolina wholesalers sold $0.39 for every dollar of shipments by South Carolina manufacturers. (This comparison is offered as a measure of the relative scale of operation of the two marketing segments; it is not suggested that Carolina firms sell wholesale only through Carolina wholesalers, nor that Carolina wholesalers carry only Carolina products.) By comparison, the nation as a whole has 74,000 such wholesalers with an average of $3.1 million in sales, an average of 1.4 per SIC 35 manufacturing plant, and their sales equaled 89% of total national shipments by manufacturers.

The reasons for this phenomenon are not clear. It may be due to the prevalence of branch plants in the southeast, associated with national and, increasingly, international companies that are headquartered outside of the region. Many branch plants are limited to production only, with the central distribution, product design, and marketing functions carried out through their headquarters. As a result, they would be expected to make much less use of local distribution services for both purchasing and sales, which in turn might be expected to lead to the slower

development of these networks seen in the southeast. The relatively lower numbers of senior marketing, design, and management personnel in the region that would also be expected to result from the heavy concentration of branch plants may also lead to reduced development of new businesses, including distributors, as there are fewer senior sales personnel, technicians, and managers "going out on their own" to build a new business. Further research is needed to clarify this issue.

Heavier use of distributors in the industrial machinery sector should encourage export expansion, all else being equal. Overseas sales of commodities requiring substantial training and after-sales service, such as industrial machinery, generally require an in-country presence. Large firms often establish a sales subsidiary or wholly owned distribution system, but most small firms rely on distributors. Because industrial machinery firms are already accustomed to using distributors domestically, they should be relatively well-positioned to establish and use such networks overseas.

The Industrial Machinery Cluster in North and South Carolina

The concentration of industrial machinery firms around Greenville and Spartanburg, South Carolina has long been recognized as an important center for this industry. The cluster is an intriguing blend of established local firms with relatively new local startups and a heavy admixture of foreign firms. It does not appear that transplant firms from within the United States are an important factor in this cluster. The foreign firms that are a particularly noteworthy element in this cluster were attracted beginning in the 1950s and 1960s as the result of an intensive recruitment effort spearheaded by local business leaders, particularly the chamber of commerce and local textile leaders.

The Greenville/Spartanburg industrial machinery cluster is one of the strongest technology-oriented clusters in the Appalachian region. Of the 380 industrial clusters identified in a recent DRI/McGraw-Hill study, only a handful were in the Appalachian region.[19] One of these is the industrial machinery concentration in Greenville/Spartanburg. DRI ranked this cluster as 18th in the industry, with particular strength in textile machinery and steam engines and turbines. Greenville also was included as the nation's 14th-ranked cluster for automotive parts (including tires) and as the top-ranked cluster for textiles and apparel.

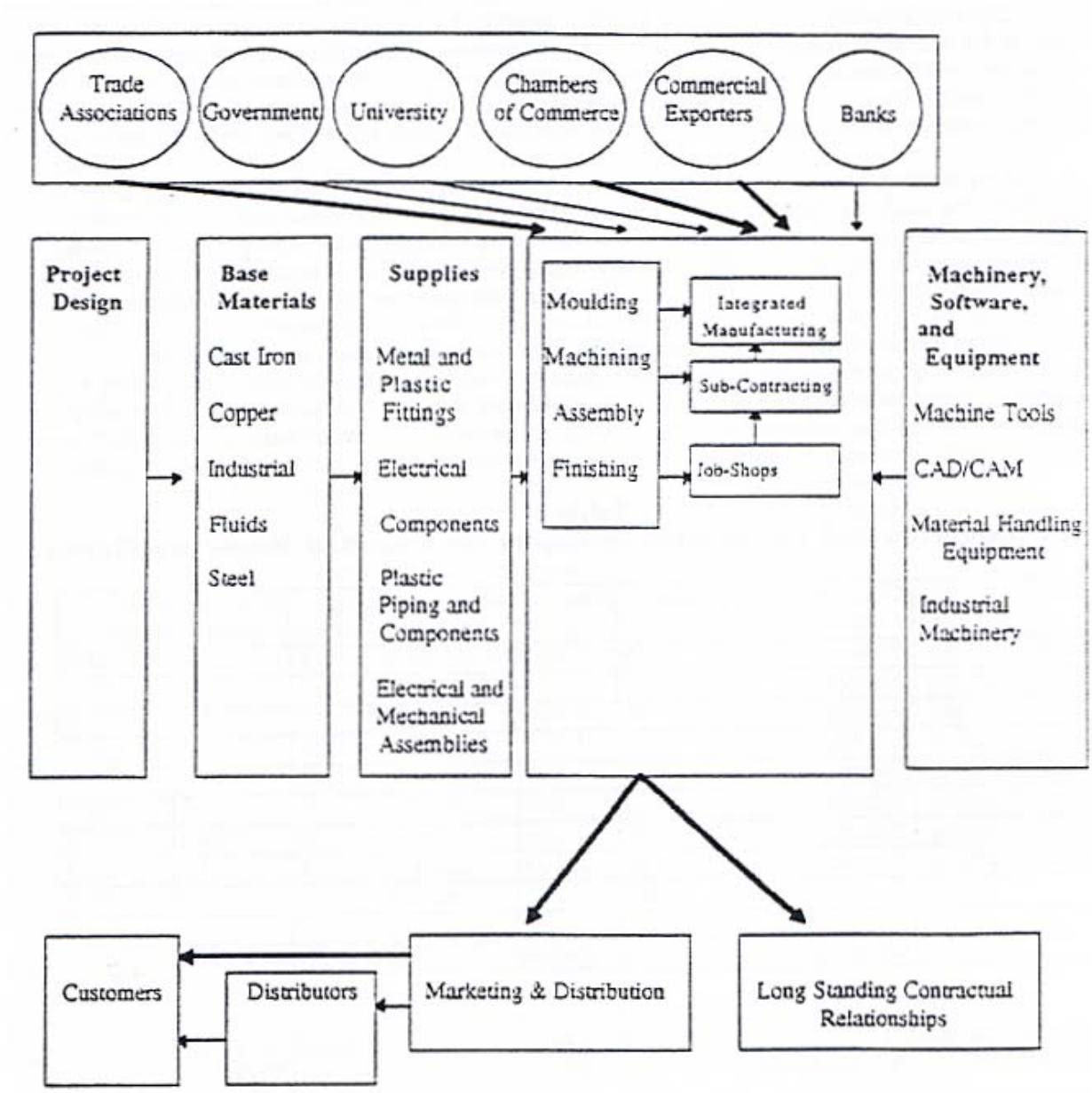
To analyze the industrial machinery cluster in the Appalachian counties of North and South Carolina, the study team conducted in-person and telephone interviews with 10 exporters, 10 non-exporters, and 7 service providers. Additional informal interviews were conducted with a number of individuals knowledgeable regarding technology, exports, and overall developments in the sector. Finally, four firms from outside the region were interviewed for comparison, to test whether there were fundamental differences between firms in the cluster and isolated firms. Virginia/ARC was selected for these interviews, to provide the perspective of a relatively under-industrialized part of the Appalachian region. In making the selection, preference was given to small and mid-size firms in the Spartanburg/Greenville area, the heart of the industry. Additional information was taken from national trade data and from informal interviews. Table 19 provides data on the number of establishments and jobs in this cluster with comparisons to total employment in each county.

Table 19
Establishments and Employment by County for Industrial Machinery Cluster

State	County	Units	Jobs	Total Employed	Empl. Share	% of Cluster	Avg. Empl.
North Carolina	Buncomb	56	1,495	80,604	1.9	8.8	26.7
North Carolina	Henderson	27	438	23,560	1.9	2.6	16.2
South Carolina	Anderson	36	884	49,199	1.8	5.2	24.6
South Carolina	Cherokee	7	1,171	16,853	6.9	6.9	167.3
South Carolina	Greenville	116	5,309	205,350	2.6	31.3	45.8
South Carolina	Oconee	20	698	19,109	3.7	4.1	34.9
South Carolina	Pickens	31	2,461	29,186	8.4	14.5	79.4
South Carolina	Spartanburg	89	2,305	102,388	2.3	13.6	25.9
	Cluster total	382	14,761	526,249		100	39.6
	Green/.Spar.	205	7,614	307,738	4.8	44.9	37.14

Several conclusions from this table deserve to be highlighted. First, this is a highly concentrated cluster, with 48 percent of manufacturing plants and 45 percent of manufacturing jobs located in the two counties of Greenville and Spartanburg. Second, the cluster is dominated by small firms, with average employment per plant of only 40 workers. Finally, this is an important cluster, but scarcely dominant in the region's economy, accounting for just under 5 percent of off-farm jobs.

Figure 12
Industrial Machinery Cluster in the Carolinas



Other data confirm that this is a highly diversified cluster. Although it may have had its start historically in the development of the textile machinery industry to serve the local spinning and weaving industry, it is now much more generalized, with strong concentrations in metalworking, general industrial machinery, and engines, as well as in the special industry category that includes textile equipment. The development of the automotive industry in the area, which will accelerate as the impact of the new BMW plant works its way through the local economy, is symptomatic of this development. Indeed, individuals knowledgeable regarding the sector indicate that the majority of the textile machinery firms are not local firms that grew up when the industry developed in the nineteenth century, but instead more recent immigrants, many of them from Europe, that were attracted to the region as part of a conscious local recruiting effort in the 1950s and 1960s.

Description of Survey Participants

There are more than 400 manufacturing plants in the industrial machinery manufacturing category in the 11-county region making up the Greenville/ Spartanburg cluster, which includes part of North Carolina, but is heavily concentrated in the Appalachian counties of South Carolina. In this region, the study team surveyed ten exporters, ten non-exporters, and seven service providers to determine the export potential and barriers, and usage and assistance of export services.

In keeping with their industry, the firms surveyed were highly diversified in terms of product mix, including packing equipment, rollers and pavers, material handling equipment, carding machines, lawn vacuums, and parts feeding equipment. Many of the companies are the sole or major international supplier of the product or have established, long-term relationships with customers, and thus perceive themselves to have little direct competition. The composition of this group was as follows:

- Sixty percent of the exporters interviewed were from North Carolina, while 40 percent were from South Carolina.
- All of the companies are privately owned or closely held corporations.
- Ninety percent of the companies had fewer than one hundred employees, and 40 percent had fewer than fifty.

The non-exporters constituted a mix of job shops making specialized machinery to order and equipment manufacturers who either don't produce an exportable product (profit margins too small, produce a specialized product used only in the United States, etc.), or have customer relationships that do not allow for exporting, such as sole source relationships. The composition of this group was:

- The firms were divided evenly between North and South Carolina.
- Ninety percent of the companies were privately or closely held corporations; one firm was foreign owned.
- All of the companies had fewer than one hundred employees, with half having fewer than twenty-five employees.

Economic Status

Because the industrial machinery sector is highly diverse and the performance of any given firm is more closely tied to its customers' industry than the machinery sector, it is difficult to generalize about performance in the cluster. The following discussion is based on the performance reported by the survey firms, but it must be emphasized that the findings from such a small sample cannot be applied to a specific firm or subsector. They nonetheless provide useful insights into the export operation of the industry, the barriers they face, and the problems they see in developing their markets.

The firms surveyed reported several trends:

- Sales have continued to increase, with 75 percent of the respondents citing increases of at least 10 percent, although two firms reported a decline.
- Export sales have not increased at a commensurate rate, with only half of the exporters experiencing growth of 10 percent or more; however, no firm reported a decline in exports.
- Wage growth has been steady in the sector, at an average three to five percent per year.

Competition

Exporters, non-exporters, and service providers interviewed put different emphases on the traits that they saw as competitive advantages for their industry. Exporters responded that they rely most heavily on their reputation, quality and price, followed by design. Non-exporters placed more emphasis on product quality and working relationships with customers, with design and price as important secondary traits. Service providers fall somewhere between, seeing the competitive advantages of the industry as product design, product quality, and customer service.

The study team interprets this difference as due in large part to the difference between the exporters group, which typically manufactures a batch product line for a relatively large group of customers, and non-exporters, which are typically job shops or contract manufacturers serving a single client. In the cluster area, and indeed in the nation as a whole, most industrial machinery manufacturers export. The team encountered only one or two firms among the non-exporters that had the potential to export, given their product mix and customer relations.

New technology is seen as an important element of competitiveness in the sector. The survey findings indicate that the primary vehicles for acquiring new technology is through vendor relationships and trade organizations, particularly trade association-based trade shows and trade journals.

The Greenville/Spartanburg cluster does not appear to operate at a disadvantage technologically, compared to other regions. The support service providers and exporters interviewed for the most part placed the region in the top forty percent in terms of technology utilization. Companies reported receiving their new technological information primarily from suppliers, trade journals and other trade media (including the Internet), and equipment vendors (tied for first place, with over half of the firms reporting each of these sources), customers, trade associations and chambers of commerce, and other companies, in that order. They reported only infrequent use of

such public channels as universities, colleges, small business centers, and government technology assistance centers.

There was no significant difference between exporters and non-exporters in this regard. Of 32 citations by exporters of frequent or occasional use of a source for information and assistance, 27 (86 percent) were from private sources, compared to 30 out of 34 (88 percent) for non-exporters.

Several companies cited trade shows, journals, and other national association activities as sources of information. This relative reliance on national sources may be related to the diversity of the industry. As the industry is highly diversified, many of a given company's colleagues, suppliers, competitors, and customers are likely to be in different states or even different countries. It is therefore natural for the firms to look to venues offering a way to exchange information within their own industry grouping, rather than to look to local organizations that are unlikely to have the detailed knowledge of, say, vacuum manufacture. Location did not appear to be a barrier to the flow of information for this group, and most attended national and international trade shows to keep current in the technology and make contacts.

Although the survey did not explore labor force development in detail, this was clearly of importance to the firms, based on the advantages cited for their location and informal comments. The noted technical schools in the region must be given a substantial share of the credit for the strength of the region's labor force, but do not appear to be making an important contribution to the trade skills or technological development of this sector.

Exporting

The value of industrial machinery exports in the Greenville/Spartanburg cluster grew by 63.7 percent between 1993 and 1995. In 1995, the Carolinas exported 18 percent of the industrial machinery exported by the industry in the ARC region as a whole. Examining the growth rates of the states in the cluster, it is evident that, between 1993 and 1995, North Carolina's machinery exports grew at over 80 percent, the highest growth rate in the ARC region, and South Carolina achieved a growth rate of approximately 35 percent, fifth ranked in the region. As mentioned previously, North and South Carolina are the highest ranked states in the Appalachian region in terms of export intensity, and display strong and growing export intensity indices.

The companies and service providers surveyed confirmed the importance of export markets to the sector, and the strong growth of export markets in their regions. Eighty percent of the exporters said that exports are important or very important to their industry's future. Most of the exporters polled had been exporting for over 20 years, and exports exceeded 20 percent of sales for 7 of the 10 firms. As a whole, the group's exports averaged 30 percent of sales. Yet of the exporters polled, only two had full time staff devoted to exporting and increasing export markets. In some cases, this may be evidence of a passive approach to exporting, but, given the importance given to exports by the firms and exports' share in total sales, as well as the reliance on distributors in this industry internationally, the lack of a dedicated export staff cannot be interpreted as a sign of low interest in or commitment to exporting. With a typical workforce of 50 or fewer employees, few of these firms have a large enough sales force to make specialization in exports appropriate or necessary.

As with assistance with technological issues, firms turned to their private sector colleagues for help with exporting. Among them, the exporters providing detailed information cited 26 sources for export information. Of these, 20 (77 percent) were from the private sector (with consultants and agents the leading source), five were from government sources, and one from a chamber of commerce. The nature of the assistance used differed as well, with public sources providing trade leads only, and the private sector providing both leads and technical assistance with the export process. These findings are consistent with more extensive survey work completed by the Kenan Institute.[20]

Information and financing are the primary obstacles noted by both exporters and service providers. As experienced exporters, the industrial machinery firms interviewed repeatedly commented on the difficulties they face in finding export finance. This situation is increasingly common among U.S. small and midsize exporters, as their export sales increase as a share of their total sales volume and exceed their capacity to finance them internally. For these experienced exporters, finance is a major problem that is not being effectively addressed by export support organizations.

Other perceived obstacles to exporting by exporters included access to information about overseas distributors, foreign markets, and technologies, and access to financing for themselves and for their customers. Service providers saw the major obstacles to be tariffs and government trade barriers, financing, information, and lack of time. Most firms had never received export assistance from trade promotion organizations, did not seek out information about exporting or export services from public sources, and were unfamiliar with the availability of such services.

At the same time, several companies cited the subsidies and other financial assistance available to their overseas competitors (particularly European firms) and were disparaging of U.S. efforts to compete with this support. Indeed, none of the exporters had made use of the limited financial support for exporters that is offered by ExIm Bank or SBA (the former is generally not available for small exporters, or is too expensive, despite some progress in the past two years). Exporters cited getting paid and tariffs or other government barriers as other important barriers (demonstrating that they are, indeed, experienced exporters!).

With regard to export services, it is intriguing that the two public sector export advisors interviewed regarded information on markets as an unimportant problem for exporters, whereas the firms themselves ranked it first in importance, with 7 of the 10 firms giving it 4 or 5 out of a possible 5. This difference may be attributable to a different perception regarding the information needs of exporters. As experienced exporters, the firms surveyed clearly have figured out what they need to know to make an overseas sale. Their challenge is to find additional, customer-, product-, and market-specific information that will help them find and win new customers, particularly in markets where they are not currently active.

For these experienced exporters, basic information on exporting and general leads (of the "things are hopping in Brazil" sort) are equally useless. They are too sophisticated to need the latter, but not sufficiently market-savvy to know how to capitalize on the latter. How should they approach the market in Brazil? Is there likely to be a market for their product and, if so, what types of modifications are likely to be needed? The answers to these questions are rarely available from public sources and, even if they are, the exporters are generally not skillful in wading through the

morass of public information to find the data they need (as regular users of these data sources, we fully understand why they do not try to penetrate the trade information thickets).

Dynamism

As previously mentioned, this sector is highly fragmented by subsector, and firms therefore tend to relate to each other within their own subsectors, making use of structures that link the subsector together, such as trade shows and industry associations, rather than local organizations. This is not a cluster that values cooperation among firms in the region, or that displays a high degree of trust. The firms ranked trust at 3 on a scale of 5 and could cite few examples of cooperation between firms. Interestingly, firms tended to cluster, either ranking cooperation at 2 or 5 with no firms in the middle. Firms displayed a willingness to collaborate, or to participate in a collaborative program for the sector if one were to be developed, but expressed little demand for this type of program.

Some firms are active in broader private sector groups, such as the local chamber or economic development organizations, which could possibly provide a venue for programming. Given the diversity of firms in such organizations, however, it would be difficult to develop effective programs serving their needs. One possibility would be skills training for export processing, such as the international trade certificate program developed by Trident in South Carolina. One of the technical colleges in the cluster region is in fact considering offering this program, which would appear to be a promising step to provide concrete help to the area's exporters.

Asked to cite the sources of strength for industrial machinery in the Carolinas, firms gave top ranking to "quality of life," suggesting that the respondents had chosen the Carolinas for reasons unrelated to the machinery industry as such. The availability of skilled labor ranked second, and was also emphasized in the respondents' informal comments. The generally excellent training support offered by the technical colleges in this region deserves recognition as a significant source of the region's continuing and growing competitiveness. Production of a high-quality, high-value product, such as exportable industrial machinery, depends on skilled labor, and firms gave this factor high marks in explaining their choice of location in the Carolinas.

Exporters and non-exporters differed in the extent to which they relied on local suppliers. Exporters reported local purchases averaging 36 percent of their sales, while non-exporters reported the value of local purchases at only 13 percent of sales. Half of the non-exporters (five firms) estimated local purchases at five percent or less of total sales, whereas only one exporter gave such a low percentage. Given that exporters produce a different range of products and are more likely to be batch producers, it is difficult to interpret this finding. The difference may be due to a lower rate of outside purchases overall by the non-exporters (that is, they fabricate a higher share of the total product in-house), rather than to a lower rate of local purchases relative to purchases from outside the area.

Contrasts with Industrial Machinery Firms Outside the Cluster

The study team conducted a limited survey effort focusing on industrial machinery firms in western Virginia, to complement the work on the Greenville/Spartanburg cluster. It proved difficult to locate industrial machinery firms in the Kentucky-W. Virginia-Virginia region, and those interviewed tended to serve industries that are historically strong in that region, such as mining. Although it is difficult to generalize from the small sample (four firms were interviewed), there appear to be few differences between those in the cluster and those outside it. The two exporters interviewed both exported at a rate well below the average for the Greenville cluster, but with such a small sample it is difficult to generalize from their responses on this issue. By contrast, the four firms showed a very similar pattern on local sourcing, with the exporters sourcing a much higher percentage of their inputs locally (approximately 30 percent) than the non-exporters (about five percent).

The firms interviewed tended to cite very similar strengths and weaknesses to those in the cluster. Access to skilled labor and transportation infrastructure were seen as important advantages, as was the quality of life. The private sector was the leading source of trade assistance for these firms as for those in Greenville. Interestingly, the team encountered one exporter using the Export Import Bank to finance exports, indicating that firms in this relatively remote location have no special problems in gaining access to services.

Export Prospects for Industrial Machinery

This discussion focuses on the core elements of the industrial machinery sector: metalworking machines and equipment (SIC 354), special industry machinery (SIC 355), general industrial machines and equipment (SIC 356), and other industrial machinery not otherwise classified (n.e.c.) (SIC 359). The research team examined these sectors' export performance and potential using information from the Department of Commerce's Country Commercial Guides for the listed countries, the International Trade *Commissions U.S. Trade Shifts in Selected Commodity Areas*, and interviews with industry experts and U.S. manufacturers. Statistical accuracy and comparability to other sources are affected by a number of factors, including lack of published figures in certain markets, variances in data collection techniques, different sources of data, and industry definitions.

The companies in this sector historically have been focused on domestic markets, but as the U.S. market is flooded by imports and markets in the United States have become developed, U.S. manufacturers have increasingly looked internationally for new and quickly growing markets (see Table 20). Compared to other industries, the industrial machinery industry exports a large percentage of its shipments, with small companies exporting 16 percent of dollar value of shipments, medium sized companies (100-499) exporting 18 percent, and large companies exporting 23 percent.[21]

Table 20
Foreign and Domestic Exports, "Free Along Side," $ millions

FY 1995	NAFTA	Japan	EU-15	Asian NICS	Other Americas	Rest of world	Total
Metalworking machinery, equip. (SIC 354)	$ 2,263	$ 279	$ 1,235	$1,007	$ 525	$ 576	$ 5,885
% of total	38%	5%	21%	17%	9%	10%	100%
Spec indust mach (SIC 355)	$ 1,458	$ 1,210	$2,252	$2,777	$ 775	$ 897	$9,369
% of total	16%	13%	24%	30%	8%	10%	100%
General ind mach & equip. (SIC 356)	$ 4,076	$ 660	$ 2,074	$ 2,352	$ 1,142	$ 1,359	$11,663
Fluid power pumps, etc. (SIC 359)	$ 1,217	$ 257	$812	$ 943	$ 178	$ 365	$ 3,772
% of total	35%	6%	18%	20%	10%	12%	100%
% of total	32%	7%	22%	25%	5%	10%	100%
Total : Industrial Machinery	$ 9,015	$ 2,406	$ 6,374	$ 7,080	$ 2,620	$ 3,197	$30,692
% of total	29%	8%	21%	23%	9%	10%	100%

U.S. total exports, 1995 by area and three-digit SIC product groups; (Census Bureau; foreign and domestic exports, Free Along Side; $ millions).

Table 21
Exports of Domestic Merchandise, Percent of Output (SIC 354)

		Value in Millions			Percent		
Sub-sub-sector		1993	1992	1991	1993	1992	1991
3541	machine tools, metal cutting types	$ 974.5	$1,017.1	$ 877.5	33	33	31
3542, 35495	machine tools, metal forming types	$ 769.4	$ 818.8	$ 677.5	37	43	35
3543	industrial patterns	$ 32.2	$ 10.7	$ 5.7	5	2	1
3544, 3545, 1	special dies, tools, jigs, and fixtures	$1,239.2	$ 132.6	$ 863.1	9	8	7
35455	precision measuring tools	$ 53.5	$ 62.0	$ 48.0	14	15	11
3546	power driven hand tools	$ 600.1	$ 567.6	$ 549.6	20	24	25
3547	rolling mill machinery	$ 203.2	$ 115.2	$ 134.1	38	21	30
3548	welding apparatus, electric	$ 655.3	$ 624.2	$ 599.1	24	26	25
total		$4,527.4	$3,215.6	$3,754.6			

As data Table 21 indicate, machine tools (SIC 354) have moderate export dollar values, excepting special dies, tools, jigs, and fixtures, which are job shop operations, and do not traditionally export. The companies making SIC 354 products export between five (SIC 3543, Industrial Patterns) and 39 percent (SIC 3547 Rolling Mill Machinery) of their total sales. Further, for every sub-sector except precision measuring tools (SIC 35455), the percent of exports compared to total domestic output increased between 1991 and 1993. These companies, already among the most export oriented, are becoming even more export oriented.

Table 22
Exports of Domestic Merchandise and Percent of Total Output, 1991-93 (SIC 355)

		Value in Millions			Percent		
Sub-sub-sector		**1993**	**1992**	**1991**	**1993**	**1992**	**1991**
3552	textile machinery	$ 522.9	$ 547.1	$ 534.4	34	41	43
3553	woodworking machinery	$ 169.0	$ 132.9	$ 127.0	19	17	19
3554	paper industries machinery	$ 652.0	$ 582.0	$ 636.9	29	26	31
3555	printing trade machinery	$1,064.0	$1,053.6	$1,072.0	46	46	34
3556	food products machinery	$ 695.7	$ 687.1	$ 621.0	30	33	32
35592-4, 6, 7	special ind mach n.e.c.	$2,481.1	$2,002.9	$2,025.7	44	42	48
Total		$5,584.7	$5,005.6	$5,017.0			

Table 22 indicates that, special industry machinery (SIC 355) have moderate export dollar values, excepting SIC 3555, printing trade machinery, which has strong export values, exporting almost half of its products. Overall, the special industry machinery sector is more export oriented, exporting between 19 percent and 46 percent of its production, but these numbers have decreased through the first part of the 1990s.

Table 23
Exports of Domestic Merchandise and Percent of Output, 1991-93 (SIC 356)

Sub-sub-sector		Value in Millions 1993	1992	1991	Percent 1993	1992	1991
3561	pumps and pumping equipment	$1,183.6	$1,045.2	$1,035.8	24	23	23
3562	ball and roller bearings	$ 657.9	$ 659.3	$ 673.7	15	16	17
3563	air and gas compressors	$1,220.1	$1,214.2	$1,153.4	32	34	32
3564, 36341	blowers and fans	$ 765.1	$ 807.4	$ 880.3	19	23	28
3565	packaging mach.	$ 672.3	$ 606.3	$ 610.7	22	21	22
3566	speed changers, drives, and gears	$ 466.1	$ 413.2	$ 373.9	24	24	20
35671, 4, 5	industrial furnaces and ovens	$ 368.2	$ 336.7	$ 371.4	29	28	32
3568	power transmission equipment, n.e.c.	$ 281.9	$ 252.6	$ 235.0	12	11	10
3569, 35492, 3559, 5, 8, 35676	general industrial machinery, n.e.c.	$3,330.8	$3,208.4	$3,020.6	28	30	29
Total		$8,946.0	$8,543.3	$8,354.8			

Table 23 indicates that general industrial machinery, (SIC 356) have experienced small to moderate export growth in value and are exporting a constant percentage of output over time. The sub-sub-sectors that are growing strongly in this sub-sector, are SIC 3563, air and gas compressors, SIC 3561, pumps and pumping equipment, SIC 3566 speed changers, drives, and gears, and SIC 3568, power transmission equipment. The sub-sector SIC 356 exports between 12 percent and 29 percent of its domestic output.

Table 24
Exports of Domestic Merchandise and Percent of Output (SIC 359)

		Value in Millions			Percent		
Sub-sub-sector		**1993**	**1992**	**1991**	**1993**	**1992**	**1991**
3593, 35942	fluid power cylinders and related equipment	$266.8	$ 286.4	$ 297.7	14	14	15
35943-6	fluid power pumps and motors	$246.1	$ 248.8	$ 218.7	25	25	16
3596	scales and balances, except laboratory	$126.4	$ 120.4	$ 115.6	19	18	18
35994	machinery, except electrical, n.e.c.	$1,918.0	$1,576.9	$1,498.3	a[22]	87	65
total		$2,557.3	$2,232.5	$2,130.3			

Table 24 indicates that other industrial machinery not otherwise classified (SIC 359) have experienced small to moderate export growth in value and are exporting a constant percentage of output over time. The sub-sub-sector that is growing strongly in this sub-sector, is SIC 35994, machinery, except electrical, n.e.c. The sub-sector SIC 356 exports between 14 percent and over 100 percent (exporting more than domestic production) of its domestic output. Export data are not available for the sector as a whole, and only limited data is available on the sub-sectors, so the remaining portion of this report will cover the industrial machinery sector as a whole.

Table 25
Exports by Selected Country Destination, 1994-1995

U.S. Machinery Exports $ Million	**Total Exports**	**Canada**	**Mexico**	**Japan**	**Germany**	**Korea**
1994	49.8	12.3	6.7	2.6	1.7	2.4
1995	57.0	13.0	5.9	3.5	2.3	3.8
% of Total	100%	23%	10%	6%	4%	7%
% Change	14%	6%	-12%	36%	38%	58%

Table 25 indicates that Canada, Mexico, Japan, Germany and Korea were the primary export markets for industrial machinery, accounting for 50 % of total exports. In 1995 the U.S. had a trade deficit of $3.4 billion for these sectors.

Canada: The U.S. exported $13 billion in industrial machinery products in 1995, 23% of U.S. total exports in this sector. Demand for U.S. machinery is expected to grow due to the revival of the economy, the strengths of the automobile and forest products industries, the strong linkages between U.S. and Canadian firms, and the financial benefits of NAFTA.

Mexico: The United States is a net importer of machinery from Mexico. In 1995, the U.S. exported approximately $740 million in industrial machinery to Mexico. Demand for U.S.

machinery was weak because of the continuing economic fallout after the peso crisis. The major competitors in this market are the Germans, Italians, and Japanese. The market seems to be on the road to recovery, and the United States is well positioned to take advantage of the new economic stability due to market proximity and benefits from the NAFTA agreements.

Japan: The United States benefited from a 36% increase in exports to Japan in 1995, 6% of U.S. totals for industrial machinery, but continued to have a trade deficit of $8.8 billion. The primary export markets in Japan were centrifuges and filtering equipment and specialized semiconductor manufacturing equipment.

Germany: Germany is a major producer of industrial machinery, and is a primary competitor of the United States in almost every major market. This market is considered saturated in many sectors, but the United States has strengths and market share in some specialty equipment.

Korea: The United States had a $1.4 billion (58 percent) rise in exports to Korea. This increased the trade surplus with Korea by $1.2 billion to $2.6 billion. Korea is currently taking on large infrastructure projects, and making additions to capital equipment that drives its major export industries. Some of the largest gains in the Korean market were in non-metalworking machine tools, gas turbines, and thermal processing equipment.

Specific Market Analysis

- *Textile Machinery (SIC 3552)*. The textile machinery sub-sector exports almost half of its production. Major markets include China, Canada, Japan, Mexico, Germany, Thailand, and Italy. The sector is expected to continue to be successful, but will need to focus on its ability to include energy efficiency and pollution prevention features on new equipment.

- *Packaging Machinery (SIC 3565).* In 1993, the packaging machinery sub-sector exported approximately 22 percent of its products. NAFTA countries accounted for about 35 percent of exports. Other primary markets were Italy, Spain and the United Kingdom. The primary competitors in this industry are the Western Europeans. NAFTA and the EU tariff reductions are expected to cause a shift in this market balance.

- *Paper Industries Machinery (SIC 3554).* Canada is the major export market for paper industries machinery, with Mexico, Germany, and Japan as other major purchasers. Russia is also showing promise as an export market. U.S. manufacturers have a strong competitive position in de-inking systems and other machinery used in recycling paper products. With the increase in global consciousness around paper-recycling sales in this sub-sector are expected to grow strongly.

Summary

The United States industrial machinery sector exports approximately a quarter of its production, with a weighted average exports by production of 26 percent in 1993, 29 percent in 1992 and 25 percent in 1991. Almost fifty percent of the export sales in this sector come from five categories, SICs 3541 (machine tools, metal cutting types),3544, 3545, 1 (special dies, tools, jigs, and fixtures), 3555 (printing trade machinery), 35592-4, 6, 7 (special industry machinery, n.e.c),

3561 (pumps and pumping equipment), 3563 (air and gas compressors), and 35994 (machinery, except electrical, n.e.c.).

The industrial machinery is and continues to be one of the United States strongest sectors in terms of exports. Export growth has grown consistently to the major industrialized markets, and as new markets develop, such as those in Asia and Latin America, industrialized machinery manufacturers are preparing to increase their exports to those countries.

Implications for Export Development and Modernization in the Industrial Machinery Cluster

The industrial machinery cluster has high potential to continue its export growth and its role as a leading source of high-valued U.S. exports. Several factors underlie this positive perspective:

- It produces a high-value product, which is and will remain the type of product that the U.S. exports most effectively.
- It produces a high-quality product that is used by a rapidly growing customer base (that is, industry), particularly in the emerging market countries to which U.S. exports are growing most rapidly and which do not produce a full range of such equipment themselves.
- It is a technology-driven industry, that increasingly derives its growth from the incorporation of information technology (computer controls, etc.), at which the U.S. excels.

The success of this cluster is dependent on a skilled labor base and a strong transportation system, rather than proximity to the customer. The choice of the Carolinas as a location is thus based on factors (including quality of life) that do not readily translate to the economically depressed parts of the ARC region. It may be difficult to transfer the success of this cluster to other regions of the ARC states unless these regions take steps to upgrade their skilled labor pool, transportation infrastructure, and such other "quality of life" factors as tend to feature in any location decision. It is noteworthy that the growth of the Greenville/Spartanburg cluster had its origin in precisely this type of local initiative, in which local business leaders joined together with the state to improve support services, particularly worker training, and to attract outside investors.

The foregoing analysis provides several pointers to the type of program likely to provide an effective export development and competitiveness program for this sector. Such a program would have the following features:

- It would target specific subsectors that are important in the region and offer strong export growth potential (additional research would be required to narrow down the list of prospects, but textile machinery and automotive machinery are two possible candidates).
- It would target current exporters, with a view to increasing their exports by helping them to penetrate new markets by bringing them together with potential customers and providing concrete market information relevant to their sector.
- It would focus on linking exporters to distributors and other private service providers knowledgeable about these markets and on supporting export penetration of new markets

through such mechanisms as support to trade show attendance, possibly in conjunction with national trade associations (building on an approach with which the exporters are already comfortable).

- It would strengthen relationships between the good local job shop suppliers and the strong original equipment manufacturers and organize groups of firms to address their common problems and needs, such as skill upgrading, work force development, and technical support.
- It would incorporate an export finance component, addressing a key need of experienced exporters and helping to build a base of financial support for exporters in the Carolinas, particularly among community banks.

The survey findings and interviews with service providers demonstrate that the exporters in this industry are highly experienced and sophisticated, despite their location in a region identified as economically underdeveloped. Any program designed to assist them must meet them on their own turf, and provide services that respond to the needs of this dynamic and skilled groupof firms.

Overall, the evidence from those surveyed does not suggest an approach that treats all industrial machinery firms uniformly, although it does leave the door open for collectively addressing generic issues that apply to common needs, such as training of skilled labor and specialized technology services. Rather, for exporting, the data indicate an approach more linked to the clusters to which the firms sell (e.g., automotive or textile).

Geographic location is not the primary factor for marketing among the original equipment manufacturers in this industry, whose members are accustomed to working with suppliers and customers across substantial distances. But it is important in terms of labor force, quality of life, and business climate. The specificity of the technologies and markets in the industrial sector suggest strong links to the customer base, which may be local, and the need to improve access to wholesalers and distributors suggests that a sub-sector focus (working with firms in one or more subsectors across the ARC region) would be more appropriate for this industry than a regional focus. Automotive machinery exporters in Spartanburg, and their export markets, have more in common with automotive producers in than they do with textile machinery manufacturers that happen to be located nearby.

ENVIRONMENTAL TECHNOLOGIES IN EASTERN TENNESSEE
NATURAL NETWORKERS

by Pat Dusenbury
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Preface

Cold War activities of the federal government virtually created Oak Ridge, a city of some 30,000 people nestled in a scenic Tennessee mountain valley 25 miles west of Knoxville. Scientists at the Oak Ridge National Laboratory (ORNL) developed nuclear weapons and conducted related research and weapons-grade uranium was produced at a nearby facility on the federal reservation. The Cold War has ended, but the highly sophisticated R&D facilities remain sites severely polluted by radioactive and hazardous by-products of government activities. Now the responsibility of the Department of Energy (DOE), the federal facilities in Oak Ridge include, in addition to ORNL, facilities once so secret that they still are known only by their map coordinates—Y-12 and K-25.

DOE operations in Oak Ridge purchase each year hundreds of millions of dollars in environmental goods and services for facilities management and operation and for clean-up projects. A number of environmental technology firms opened Oak Ridge offices in the late 1980s when DOE strongly encouraged the ORNL contractor for operations and management to expand its sub-contracting. The acceleration of clean-up work effectively opened the door to another group of environmental technology firms in Oak Ridge. Government procurement has shaped the local environmental technology industry. Most large U.S. environmental technology firms, believing it almost essential to securing DOE contracts for work there, have a branch office in Oak Ridge. The number and proportion of smaller firms have increased in recent years, consequent to federal procurement regulations that encourage prime contractors to subcontract with small and disadvantaged firms.

Chattanooga is establishing itself as an environmental technologies cluster from a different sort of pollution. An old industrial hub, it was rated in 1969 as the most polluted city in the US. Since then it has worked to clean up its environment, achieved clean air standards, and, in the process, redefined itself as a living laboratory for environmental technology. There is strong emphasis on environmental issues in the operation of existing industry. A 1996 Chattanooga Summit highlighted several local industries that had reduced harmful by-products or wastes through improved technologies and processes. Thus, Chattanooga's environmental technologies cluster is built into the existing industrial base. River Valley Partners, the local economic development agency for greater Chattanooga has adopted a plan that includes environmental services and equipment among its target industries, and a 7,000 acre army munitions factory in Chattanooga is being redeveloped as an eco-industrial center. Target industries for the facility include recyclers, plus the environmental technology, chemical, and distribution industries. This cluster and the exports that can result, at this point, still lie latent, but given the resources and emphasis, it does appear to have considerable potential.

General Industry Description

The National Science and Technology Council (*Technology for a Sustainable Future*, July, 1994) recognizes and defines four types of environmental technologies: pollution avoidance, monitoring and assessment, control, and remediation. Therefore, it encompasses businesses that are:

- avoidance technologies to reduce or eliminate the production of hazardous substances through product substitution or redesign of industrial processes;
- monitoring and assessment technologies to measure and track the condition of the environment and the releases of pollutants;
- control technologies to render hazardous substances harmless before they enter the environment;
- remediation technologies to render hazardous substances harmless after they enter the environment; and
- restoration technologies to improve an environment already adversely affected.

Consistent with those categories, the U.S. Department of Commerce has defined the environmental technologies industry. The following definition, which will be used for this report, is set forth in a "Fact Sheet" produced by the International Trade Administration Environmental Technologies Exports project:

> Environmental Technologies (ET), advances sustainable development by reducing risk, enhancing cost effectiveness, improving process efficiency, and creating products and processes that are environmentally beneficial or benign. The ET sector includes: air, water, and soil pollution control; solid and toxic waste management; site remediation; and environmental monitoring and recycling.

The Department of Commerce's definition proceeds from the understanding that ET firms deal with harmful by-products of human activity. Industry products involve both goods and services—and frequently are combinations of the two. Environmental technology products embrace a range of items produced by industries with many different SICs that includes a large service component as well as manufactured goods. Defining environmental technologies industries is further complicated by the fact that products and technologies used in environmental applications may have other industrial applications. For example, certain filters used in textile dyeing are also used to screen pollutants from a waste stream. Thus, an *environmental technology or product may be defined by its use rather than in its production process*.

National Overview

Environmental Business International, a widely recognized source of Environmental Technologies industry information, estimates the 1994 industry revenues in the United States firms to be $170.4 billion, up from $145.0 billion in 1990. That revenue total is projected to exceed $200 billion by 1999. Table 26 shows recent and projected industry revenues for each product segment. Total revenue growth is projected to slow slightly from a 1990-1994 annual average just over four percent to a 1994-1999 average of four percent.

Table 26
U.S. Environmental Industry Revenues
1990 & 1994, and 1999 Projected

Environmental Industry Segment	1990 revenues ($ billion)	1994 Revenues ($ billion)	1990-94 Revenue Increase	199 Proj.. Revenues ($ billion)	1994-99 Projected Increase
SERVICES					
analytical	1.5	1.6	6.7%	1.9	18.8%
water treatment	19.8	25.7	29.8%	33.6	30.7%
solid waste management	26.1	31.0	18.8%	37.7	21.6%
hazardous waste mngmt.	6.3	6.4	1.6%	5.6	(12.5%)
remediation/industrial	8.5	8.6	1.2%	10.2	18.6%
consulting/engineering	12.5	15.3	22.4%	19.3	26.1%
EQUIPMENT					
water equip & chemicals	12.1	13.5	11.6%	17.1	26.7%
instruments/info systems	2.0	2.9	45.0%	3.6	24.1%
air pollution control	10.7	11.7	9.3%	12.9	10.3%
waste management	10.4	11.2	7.7%	10.9	(2.7%)
process/prevention tech	0.4	0.8	100.0%	1.5	87.5%
RESOURCES					
water utilities	19.8	24.2	22.2%	30.0	24.0%
resource recovery	13.1	15.4	17.6%	20.1	30.5%
environ. energy sources	1.8	2.2	22.2%	3.2	45.5%
TOTAL	**145.0**	**170.4**	**17.5%**	**207.7**	**21.9%**

Note: Columns may not total due to rounding. Resource recovery revenues are solely those generated by the sale of recovered materials; they exclude revenues from waste collection.
Source: *Environmental Business Journal*, EBI, (San Diego CA) April-May 1995.

Projected revenue changes for the various environmental industry segments range from an increase of 87.5 percent in process and prevention technologies to a decline of 12.5 percent in hazardous waste management. The only other industry segment expected to earn less in 1999 than in 1994 is waste management equipment. These revenue projections—along with the healthy growth projected for the resource recovery segment—reflect the on-going movement of the U.S. environmental technologies market away from "end of the pipe" waste management and toward waste minimization through modifications in production processes, improved technologies, re-use and recycling. Remediation technologies are giving way to prevention technologies.

Information about individual firms is provided by an industry report in the August 12, 1996 issue of *ENR,* an environmental industry magazine. Although some 60,000 U.S. firms provide environmental products and services, a relatively few large corporations dominate the industry. *ENR* reported that the top 200 U.S. environmental technologies firms combined to earn almost $20 billion in 1995, and the eleven largest firms accounted for half of those revenues. Bechtel Group Inc., Rust International, and Foster Wheeler each earned over $1 billion from

environmental services and products. The other eight firms reported environmental revenues between $500 million and $1 billion each.

Most environmental firms also offer non-environmental services and products, and the importance of environmental revenues to total sales varies widely from firm to firm. The largest environmental technologies consulting and construction firm in the U.S., Bechtel Group, earned only 18 percent of its revenues from environmental work; the second largest firm, RUST International, earned 74 percent of its 1995 revenues from environmental work. In construction particularly, the line between general purpose and environmental projects is blurring, and only three of the 43 firms with over $500 in 1995 environmental revenues earned 100 percent of their revenue from environmental operations. General construction projects can help smooth ups and downs in environmental contract work.

Despite gloomy market projections for environmental technologies industry segments dealing with hazardous waste, the clean-up, management, disposal and recycling of hazardous wastes continues to be the top source of income for the largest firms in the industry. Dealing with hazardous waste, including radioactive and mixed waste, provided over $10 billion of the just under $20 billion in environmental revenues earned by the 200 largest U.S. environmental firms in 1995. The second largest market was for water quality products and services, which produced $4.5 billion in revenues. Remaining revenues were produced by air quality ($2.4 billion), solid waste management ($2.0 billion), and miscellaneous environmental services ($1.0 billion).

EBI estimates that the worldwide market for environmental goods and services reached $408 billion in 1994. The U.S. accounts for some forty percent of the global market, making it the largest single market in the world by a wide margin. That margin is expected to shrink because the environmental technologies market in the U.S. is maturing, and its rate of expansion is projected to slow. Actual decline is forecast for the U.S. hazardous waste clean-up and management markets. International markets, however, are projected to grow at an increasing rate over the next several years, and hazardous waste remediation and management is expected to contribute a large part of that growth.

Until recently, the strong domestic demand for environmental services and products has reduced the incentive for American firms to market overseas as aggressively as firms from Japan and Germany, for example. Those two countries are leading exporters of environmental technologies. German companies earned 30 percent of 1994 revenues from export sales, while Japanese firms earned 24 percent. The comparable share for U.S. firms was only six percent.

ENR projects growing foreign sales for U.S. environmental technologies firms, and for the 200 largest U.S. firms, overseas markets provided 10 percent of 1995 revenues. Efforts to expand U.S. exports of environmental products can expect to meet stiff competition from German and Japanese firms who were there first and want to hold onto their markets.

Market Patterns

The public sector is the best customer for environmental goods and services, and the largest share of revenue earned by the top 200 firms came from customers in federal, state, and local governments. While the federal government currently accounts for almost two of every three

dollars in industry revenues from the public sector, the trend toward privatization of government services is expected to create more demand for water and solid waste from local governments. Table 27 shows 1995 environmental technologies revenues by source for the 200 largest U.S. firms.

Table 27
Sources of Environmental Revenues, 200 Largest U.S. Firms, 1995

TOP 200 ET FIRMS	REVENUES	
1995 MARKETS FOR ET	BILLIONS OF $	% OF TOTAL
Private Sector Firms	$9.14	45.7
Federal Government	$7.09	35.5
State and Local Gov.	$3.75	18.8

Source: Calculated from information in "The Top 200 Environmental Firms", *ENR*, August 12, 1996.

Private companies—large manufacturers, chemical firms, and utilities—are an important market for environmental services and products. Manufacturers may provide in-house environmental services, and some corporations purchase environmental technologies companies to keep that business in the corporate family. For example, Dow Chemical now owns 60 percent of Radian, the seventeenth largest U.S. firm. Private sector demand for environmental technology products and services has been driven by the need to comply with government regulations. This produced a compliance-based emphasis on control and remediation plus a unique life cycle for environmental products, which is summarized as follows:

1. Published research, or less often a catastrophic event, makes the public aware of an environmental problem.
2. The public demands that the government take action.
3. The government adopts legislation and promulgates regulations.
4. Enforcement commences, creating demand for the environmental technology—goods and services—that will "clean it up."
5. Regulated industry looks for ways to avoid the clean up costs, including less costly solutions such as waste reduction.
6. Production processes are modified to reduce waste and thus the demand for the "clean it up" technology.

Industry leaders recognize that many environmental problem areas are far along their life cycle. For example, in most of the US, leaking underground storage tanks have moved to step six. Clean-up and remediation of U.S. sites polluted by hazardous and radioactive waste is proceeding. When it is completed, the domestic market will shrink dramatically, because practices that created the contamination are now illegal. Export sales offer firms a way to extend the product life of their environmental technologies, which can increase profitability. However, the environmental technologies industry is not yet one of the nation's major exporters.

According to EBI, 1994 export sales of U.S. environmental equipment and products reached $4.8 billion and accounted for just one percent of manufactured exports from the United States. The combined export sales of environmental equipment and products from the ARC member states

was $1.3 billion also one percent of the value of their total manufactured exports. Export sales of manufactured products is only part of environmental exports. Service and resource provision are important segments of the environmental technologies industry and contribute to export sales. Table 28 lists export totals for each industry segment.

Table 28
1994 Environmental Technology Exports ($ billions)

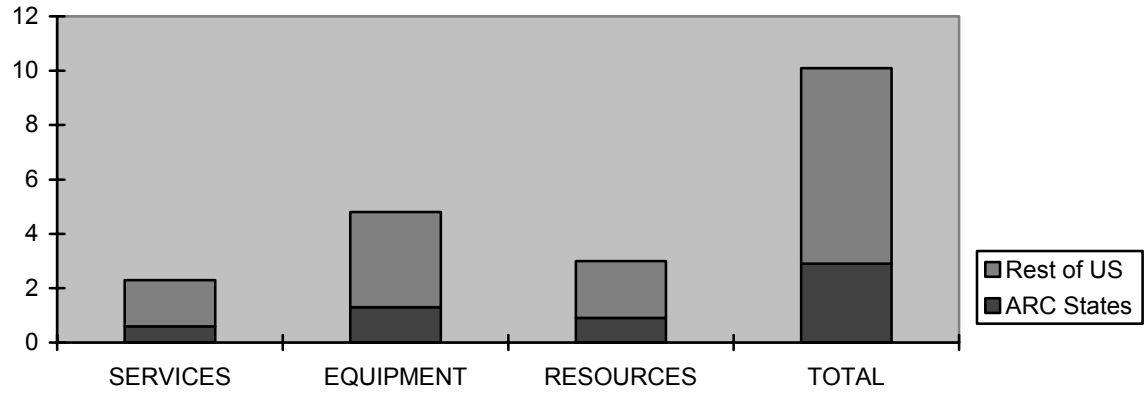
AREA	SERVICES	EQUIPMENT	RESOURCES	TOTAL
ARC States	$0.6	$1.3	$0.9	$2.9
United States	$2.3	$4.8	$3.0	$10.1

In 1994, the 13 ARC states accounted for $ 0.30 of every dollar in environmental technologies export sales. A comparison of exports by segment reveals that good and equipment provide a proportionately larger share of environmental technology export sales in the ARC member states, while services provide a proportionately smaller share. Figure 13 illustrates the ARC states' share of U.S. exports.

Export activity among the largest U.S. environmental technology firms presents a mixed picture. Many large environmental corporations not only export but also have international offices or subsidiaries. Still, fewer than half of the top 200 firms reported international revenues in 1995. Revenues from outside the United States accounted for only $2 billion of the almost $20 billion earned by the 200 largest firms in 1995. Only seven of the top 200 U.S. companies earned at least 30 percent, the average for the German environmental technologies industry, of revenues in non-U.S. markets. Smaller firms are less likely to participate in foreign markets.

Figure 13

ARC Share of 1994 ET Exports by Industry Segment (millions of dollars)



The large size and strong growth of the domestic market may have reduced the incentive for U.S. environmental firms to enter the international market, but the U.S. market has entered a period of transition. The U.S. is becoming a mature market for clean-up and remediation, the largest

environmental industry segment in terms of revenues generated. As environmental problems are addressed, the U.S. remediation market is projected to shrink. These projections make foreign markets more attractive to U.S. firms, especially those firms that specialize in end of the pipe management and remediation.

Western Europe is currently the top foreign market for U.S. environmental technologies firms, but it too is a mature market and shifting attention from end of the pipe management to waste reduction. In contrast, Eastern Europe, Latin America, Asia, and Africa are emerging and growth markets with extensive need for remediation and for construction of environmental infrastructure. These markets are limited by the resources available to pay for environmental goods and services.

Federal and state governments actively promote environmental exports. The President's Environmental Technologies Export Initiative identifies the most promising ET export markets and prepares export market plans for those countries. The U.S. Department of Commerce targets environmental technologies for export promotion and in 1994, set up the Environmental Technologies Exports (ETE) office of the International Trade Administration to lead its efforts. ETE implements the President's Initiative and provides grants to fund private sector for environmental technologies export promotion activities with outreach, trade promotion, business counseling, and training. According to the National Association of State Development Agencies (NASDA), several states also have targeted environmental technologies as an industry with export potential. ARC member states promoting exports include Georgia, Kentucky, Maryland, Mississippi, North Carolina, Pennsylvania, Tennessee, and Virginia.

Locational Patterns: Environmental Technologies in Appalachia

Because the industry is not described by SIC codes, standard data sources do not provide information on the location of environmental technologies firms or distribution of employment on state or sub-state levels as they do for the other target industries. A special report produced by EBI for ETE estimates the number of firms and jobs in environmental industries by state in 1994. Table 29 summarizes information on the number of firms and jobs for each ARC state.

Together the ARC states accounted for 31 percent of the nation's environmental firms and 33 percent of its environmental technologies employment. Individual states show wide variation in the size of the industry. The largest number of environmental firms and highest environmental technology employment are in the northern tier of ARC states, which have the largest economic bases. A similar pattern is found in the state-by-state distribution of environmental technologies revenues. The highest are estimated for the northern tier of ARC states.

EBI estimates of state level revenues for the environmental technologies industry show relatively strong growth in revenues within the ARC states. Between 1992 and 1994, the environmental technologies industry in the ARC member states experienced a 36.0 percent rate of growth, while national industry revenues expanded by 27.5 percent. As a result, the ARC states' share of national environmental technologies revenues increased from 30.6 percent in 1992 to 32.7 percent in 1994. The industry's growth trends are positive for all ARC states, and the rate of growth is above the national average in seven of the thirteen ARC member states. Table 30 describes the growth trends between 1992-1994 for the ARC member states.

Table 29
Companies and Jobs for ARC States, 1994

STATE	# OF FIRMS	# OF JOBS
Alabama	1,252	18,273
Georgia	2,312	27,361
Kentucky	1,161	15,348
Maryland	2,070	20,318
Mississippi	537	8,306
New York	6,394	95,553
North Carolina	2,161	28,157
Ohio	4,207	56,080
Pennsylvania	4,952	63,558
South Carolina	1,257	17,683
Tennessee	2,115	22,672
Virginia	2,618	28,241
West Virginia	585	10,270

Table 30
Industry Revenues by State, 1992-1994 (millions of dollars)

STATE	1992 REVENUES	1994 REVENUES	1992-1994 CHANGE	1992-1994 % CHANGE
Alabama	$1,999	$2,459	$460	23.0%
Georgia	$2,738	3,767	$1,029	37.6%
Kentucky	$1,651	2,066	$415	25.1%
Maryland	$2,050	2,812	$762	37.2%
Mississippi	$970	1,124	$154	15.9%
New York	$8,156	12,979	$4,823	59.1%
North Carolina	$2,947	3,819	$872	29.6%
Ohio	$5,539	7,540	$2,001	36.1%
Pennsylvania	$6,677	8,422	$1,745	26.1%
South Carolina	$1,753	2,388	$635	36.2%
Tennessee	$2,625	3,084	$459	17.5%
Virginia	$2,681	3,886	$1,205	44.9%
West Virginia	$1,170	1,346	$176	15.0%
ARC States	$40,956	$55,692	$14,736	36.0%
United States	$133,700	$170,436	$36,736	27.5%

The northern tier ARC states also have the highest environmental technologies export values. Together, New York, Ohio, and Pennsylvania account for over half of the value of environmental exports from the thirteen member states. Almost $600 million of 1994 ET exports

originated in Pennsylvania. New York was a close second with just under $500 million in export sales, followed by Ohio with just over $450 million. Georgia and Virginia are in the second tier of exporters, with between $200 and $300 million in export sales. At the other end of the scale, Kentucky and Mississippi originated less than $50 million of exports in 1994 (see Table 31).

Table 31
Exports of Environmental Technologies by Industry Segment for ARC States, 1994
(millions of dollars)

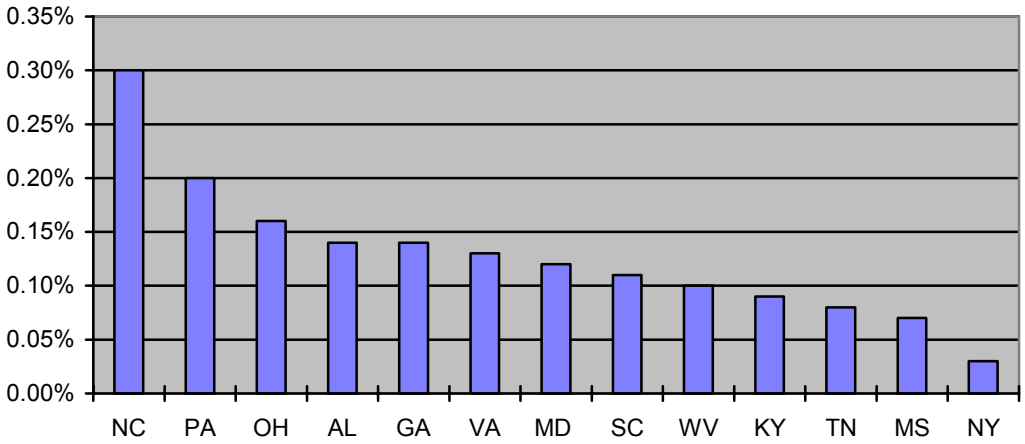
STATE	SERVICES	EQUIPMENT & PRODUCTS	RESOURCES	TOTAL
Alabama	$21.0	$51.8	$54.9	$127.7
Georgia	$47.9	$139.3	$74.1	$253.1
Kentucky	$22.9	$33.9	$22.9	$79.6
Maryland	$35.4	$69.9	$54.2	$159.0
Mississippi	$6.7	$10.1	$21.1	$38.0
New York	$129.6	$169.5	$259.4	$549.0
North Carolina	$39.3	$76.5	$62.8	$178.5
Ohio	$91.9	$266.4	$97.6	$456.0
Pennsylvania	$128.7	$354.2	$111.1	$594.0
South Carolina	$11.9	$33.7	$43.3	$89.2
Tennessee	$28.8	$32.3	$45.8	$107.0
Virginia	$55.9	$98.5	$74.9	$229.3
West Virginia	$4.6	$8.5	$23.3	$36.5

Absolute numbers tell part of the story, but the impact of a given level of employment, revenues, or export sales depends in part upon the overall size of the economy. One way to accommodate size differences so that comparisons can be made is to calculate the value of environmental technologies exports as a percentage of the gross state product (GSP). That ratio measures the contribution that environmental technologies exports make to a state's economy. Figure 14 ranks the ARC states by their 1994 environmental technologies export intensity.

Export intensity also allows comparisons between the ARC states and the national average. The environmental technologies export intensity for the Appalachian Region states is 0.13 percent, while the ratio for the nation as a whole is 0.16 percent. That gap describes the additional contribution that export sales of environmental technologies products would make to the regional economy if export performance was at the national average. Within the region, environmental technologies export intensity varies widely. Adjusting for the size of the state economy brings North Carolina to the forefront as the regional leader in environmental technologies exporting and moves New York from the top to the bottom of the list.

Figure 14

Environmental Technologies Export Intensity, 1994



To facilitate comparisons of ARC states' environmental technologies export performance with that of the nation and each other, export intensity can be calculated as an index relative to the national average. The resulting number is the export intensity index (EII) for the target industry. The national EII is always 1.00. States where environmental technologies exports make an above average contribution to the economy have an environmental technologies EII greater than 1.00. Conversely if environmental technologies exports make a relatively small contribution to the state economy, the EII is less than 1.00. For example, the EII for the combined ARC states is 0.81, almost twenty percent below the national average. Table 32 lists the environmental technologies EII for each ARC state.

Table 32
Industry Export Intensity Index by State, 1994

STATE	EXPORT INTENSITY INDEX	STATE	EXPORT INTENSITY INDEX
Alabama	0.91	Ohio	1.05
Georgia	0.89	Pennsylvania	1.27
Kentucky	0.59	South Carolina	0.70
Maryland	0.77	Tennessee	0.54
Mississippi	0.46	Virginia	0.83
New York	1.92	West Virginia	0.67
North Carolina	0.21	ARC States	0.81

The environmental technologies EII reveal a relatively large contribution to the state economy in only three ARC states. North Carolina's EII is almost 2.00, indicating that the contribution of environmental technologies export sales to the state's economy is almost double the national

average. Pennsylvania and Ohio also have an EII greater than one, while Alabama, Georgia, and Virginia have an EII less than one, yet above the ARC average.

The EBI data describes the state industry but does not identify concentrations of environmental technologies firms within the ARC region counties of these states. In the absence of quantitative data, descriptive information from individual states is used to define the locational pattern of the industry within an individual state and identify concentrations that are not in the ARC region. For example, North Carolina state data shows a strong environmental technologies industry with a large export component, but further investigation reveals the largest concentration in the Research Triangle Area and a second, smaller concentration along the I-85 corridor between Greensboro and Charlotte. Neither is in the ARC region.

Environmental technologies is a knowledge-intensive industry, and therefore it tends to locate near research and development resources such as federal laboratories and R&D universities. It is also an industry that counts polluters among its best customers, and thus it locates in proximity to environmental problems. In Appalachia, those factors merge in the Knoxville, Oak Ridge, Chattanooga corridor to produce the largest concentration of environmental technologies firms not only in the ARC Region but also in the world. Other ARC locations with a strong environmental technologies industry presence include Pittsburgh, where university-related research facilities are an asset and Greenville-Spartanburg, where manufacturing activities have created a market for environmental services.

Components of the Environmental Technologies Industry

Environmental technologies industries market goods, services and frequently a combination of the two in the context of a single project or product. Within the broad category of environmental services are analytical services, water treatment, solid waste and hazardous waste management, remediation or clean-up and industrial services, consulting and engineering (see Appendix B). Environmental equipment includes water treatment equipment and chemicals, measuring and analytical instruments and information systems, air pollution control equipment, waste management equipment, as well as process and prevention technology. Finally, ET industry members provide potable water, recycle and recover usable materials from waste, produce energy from solar, wind, and geothermal resources, and encourage lower use of energy resources with process improvements.

Regulations have driven the growth of the industry, and so regulators should be recognized as an important component of the industry. These regulation—most notably federal EPA regulations—have also been force behind industry research and development. Regulations not only create demand for environmental technologies, they also encourage innovation. If a company can develop a technology or application that regulators deem to be the best available technology for a certain application, the market for that technology or application is guaranteed.

The Environmental Technologies Industry in East Tennessee

The cluster selected for this study is in southeastern Tennessee. Originally defined as the technology corridor running from Chattanooga north to Oak Ridge and Knoxville, a visit revealed that the corridor is actually two centers, each with its own distinctive character,

connected by 100 miles of Interstate 75. The economic base and culture in Oak Ridge is heavily governmental, and in Chattanooga it is private. Knoxville has a higher proportion of private-sector oriented environmental firms than Oak Ridge but is still in the government environmental orbit.

Oak Ridge: Cleaning up the Mess

Government facilities and operations created the cluster in Oak Ridge. Department of Energy (DOE) operations in Oak Ridge include the Oak Ridge National Laboratory plus two facilities, Y-12 and K-25—so secret that they are known only by their map coordinates. Although enriched uranium operations at Y-12 uranium manufacturing and storage facility are inactive, the facility continues to receive materials obtained through international non-proliferation activities. DOE operations in Oak Ridge create a market for hundreds of millions of dollars in environmental goods and services each year—for management and operations of the facilities and for clean-up of environmental damage caused by previous, cold war related activities. That market has attracted a concentration of ET firms that is the largest in the world. Environmental technology firms believe that an Oak Ridge office is almost essential to getting DOE contracts for work there, and so most large U.S. ET firms maintain a presence in Oak Ridge.

The Oak Ridge National Laboratories have been in operation for decades, but relatively few ET firms have been in Oak Ridge that long. Several firms opened Oak Ridge offices in the late 1980s when DOE strongly encouraged its prime contractor for operations and management to expand sub-contracting, thus opening up the market for more environmental technology firms. Another group of ET firms opened their doors in Oak Ridge in 1994, when the clean-up accelerated. Government procurement regulations call upon prime contractors to subcontract with small and disadvantaged firms, and so that a large number of small and 8(a) firms developed to fill that niche. Unlike the large firms that operate in Oak Ridge as branch offices, smaller firms usually have headquarters offices in East Tennessee.

The US environmental technologies industry is extremely diverse, but the Oak Ridge industry concentration is highly specialized; its focus is the management of radioactive and mixed hazardous/radioactive materials—including waste, the remediation of environmental damage caused by previous improper management of those wastes, and the decontamination and decommissioning of nuclear facilities. Individual firms and project teams provide services and equipment for the containment, characterization, and monitoring of radioactive and mixed wastes as well as technologies for waste destruction/stabilization and for waste separation/extraction. Because of the public health aspect, specialities also include health physics and emergency preparedness.

DOE facilities both dominate the Oak Ridge market for environmental services and drive the search for new technologies by the local industry. The top DOE priority is developing technologies for economical and effective clean-up of its Oak Ridge and similar facilities. Private industry echoes this orientation, and so the Oak Ridge environmental industry is research and development oriented. Both DOE and local firms have begun to seek broader applications for the technologies developed to implement projects in Oak Ridge—at other nuclear facilities and in the management of other hazardous substances.

Chattanooga: Building a New Image and Cluster

Chattanooga is an old industrial center, rated in 1969 the most polluted city in the US. Since then it has worked to clean up its environment, achieved clean air standards, and, in the process, redefined itself as a living laboratory for environmental technology. There is strong emphasis on environmental issues in the operation of existing industry. A 1996 Chattanooga Summit highlighted several local industries that had reduced harmful by-products or wastes through improved technologies and processes. For example, BASF Corporation reduced its generation of ignitable hazardous wastes by converting waste to a salable co-product and saves $23,000 a year. In a similar effort, DuPont reduced its hazardous waste generation by 95 percent and saved some $300,000 the first year by purifying acid for re-sale rather than disposing of it. Thus, Chattanooga's environmental technologies cluster is built into the existing industrial base.

The environmental emphasis in Chattanooga extends to economic development activities, but an industry cluster in Chattanooga is more potential than realized at this point. River Valley Partners, the local economic development agency for greater Chattanooga has adopted a plan that includes environmental services and equipment among its target industry clusters. A 7,000 acre army munitions factory in Chattanooga is being redeveloped as an eco-industrial center. The huge expanse of government-owned property includes areas suffering from pollution plus an analytical laboratory. It is being marketed as a "no risk" site for testing environmental sensors and monitors, assessment, mitigation, and treatment techniques. Target industries for the facility include recyclers, plus the ET, chemical, and distribution industries. The latter due to its location near Interstate 75.

Creating an environmental technologies cluster has proven to be formidable, and some early efforts were not able to become self-sufficient. Chattanooga State Technical Community College received a grant from Regional Technology

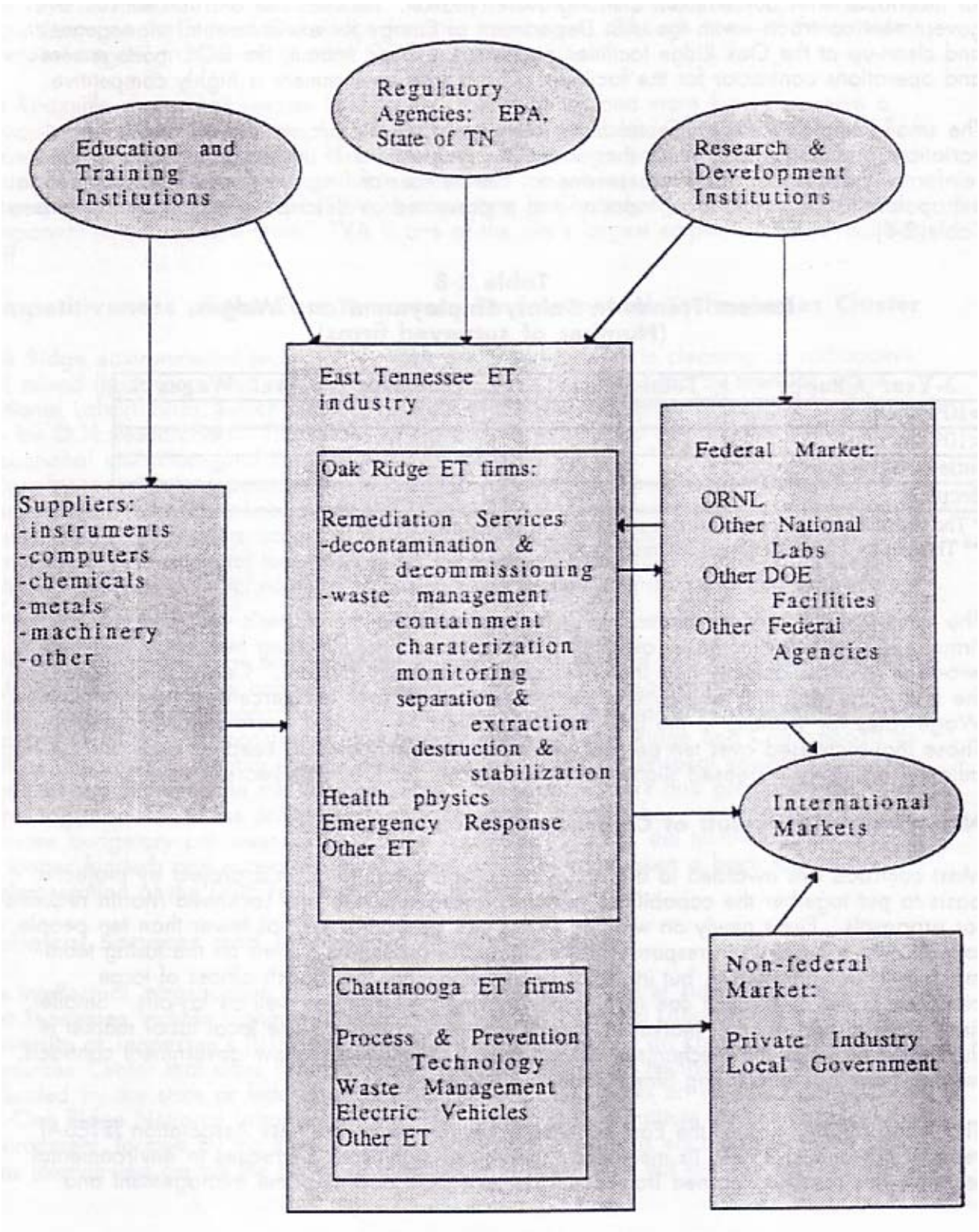
Strategies, Inc. to form networks of small and medium sized environmental technologies firms in a mutually supportive problem solving framework. They established a pilot materials waste exchange and a small network of platers. A French-American Environmental Technology Center was created with the support of Oak Ridge National Laboratories, Chattanooga, TVA, the University of Tennessee, the National Technology Applications Corporation Center for Hazardous Materials Research at the University of Pittsburgh, the EPA, and—from France—the Ministry of Research and Industry, Ministry of Environment, City of Evry, and University of Evry. The agreement culminated in the signing in August 1991 of a Chattanooga-Evry Environmental Partnership. Neither the network nor the French-American Center was able to survive the end of outside funding. However, ideas such as materials waste exchange survived the demise of their institutional framework, and other efforts have been more successful.

The experience with local transit demonstrates what Chattanooga intends to achieve in environmental technologies. In 1991, the local transit agency issued an RFP for electric buses that would move people throughout downtown Chattanooga without adding to air pollution. A local company, Advanced Vehicle Systems (AVS), was created to respond and won the contract. Electrotek, the only electric-vehicle testing facility in the U.S. was already in Chattanooga. The first electric buses began rolling in 1993. The AVS electric buses are really rolling laboratories with constantly evolving technology demonstrate their effectiveness in operation, and have

attracted worldwide attention. The attention is beginning to produce sales orders. A firm that manufactures a key component may re-locate from the northeast to Chattanooga. This success is inspiring continued efforts to build the local economy around the ET industry.

Currently, there is relatively little interaction between the environmental technologies industries in Chattanooga and those in Oak Ridge/Knoxville. Individuals interviewed in Chattanooga complained that they could not get people in Oak Ridge to return calls. Chattanooga appears to view the Oak Ridge/Knoxville cluster as impractical and not market-oriented, while standing in awe of its technical expertise. Industry executives in Oak Ridge, when asked about Chattanooga, seemed surprised by the very question. However, DOE administrators reported that there are limited efforts to establish links. The weak connection is unfortunate given the enormous potential for shared benefits and synergy from cooperation between the research and the living laboratories. Because of that potential, the original target area definition has been maintained.

Figure 15
East Tennessee Environmental Technologies Cluster



Economic Status of the East Tennessee Environmental Technologies Cluster

Federal contracts for environmental services in Oak Pine produce a high level of volatility for individual firms but maintain a strong overall market. Fortunes rise and fall with government contracts—with the U.S. Department of Energy for environmental management and clean-up at the Oak Ridge facilities and with Lockheed Martin, the DOE management and operations contractor for the facilities. The market environment is highly competitive.

The small sample of environmental firms interviewed for this project showed an extreme variation in recent growth trends that underlines the volatility of the Oak Ridge market and reinforces the broader industry assessment. The number of firms interviewed is too small to extrapolate to the whole local industry and is presented as descriptive information only (see Table 33).

Table 33
Recent Trends in Sales, Employment and Wages,

3-Year Change*	Total Sales	Employment	Ave. Wages**
>10% increase	14	12	8
<10% increase	2	0	5
little or no change	3	4	4
decrease	1	4	0

* The two relatively new firms use two-year trends to avoid a base level of zero..
** Three of the firms interviewed declined to answer.

The summary of interview information actually understates the cluster's volatility. Of the 14 firms reporting sales increases over ten percent, nine firms, including two measuring only two-year records, actually had increases greater than fifty percent. Conversely three of the four firms reporting employment decreases, laid off over ten percent of their employees. Wage rates for workers in the East Tennessee firms, in contrast, were relatively stable. Those that increased over ten percent generally were attributed to keeping pace with inflation and only increased slightly over ten percent for the three years.

Networking in Pursuit of Contracts

Most contracts are awarded to a team of firms, and teams form on a project by project basis to put together the capabilities required to answer DOE and Lockheed Martin requests for proposals. Firms newly on winning teams can go from a staff of fewer than ten people to well over a hundred in response to the signing of a contract. Firms on the losing team make a similar adjustment, but in the other direction. For the branch offices of large companies, the adjustment can involve transferring personnel as well as lay-offs. Smaller firms have to find another market or reduce staffing drastically. The local labor market is fluid, and provides the mechanism for adjustment. Individuals follow government contracts, moving from jobs at a losing firm to jobs at a winning firm.

The local industry group, the East Tennessee Environmental Business Association (ETEBA) reports that during 1996, its members experienced significant decreases in environmental technologies revenues earned from contracts with DOE and its prime management and operations contractor, Lockheed Martin. The end of the cold war reduced nuclear weapons production, and DOE environmental management budgets have declined annually since 1994. A recent members' survey found that ETEBA member firms earned approximately half their revenues outside the local market. Clearly, the movement away from overwhelming dependence on the federal Oak Ridge facilities has begun, although some of the outside revenues are still from work at other DOE nuclear facilities.

The Knoxville cluster has weaker links to the DOE facilities and more firms that serve a primarily private sector market. One hundred miles to the south, Chattanooga's cluster focuses on private sector clients. Knoxville and Chattanooga both have a population and industrial base large enough to generate a demand for services and products. The Tennessee Valley Administration (TVA) headquarters in Chattanooga adds a public sector component to the industry there. TVA is one of the city's largest employers but is reducing staff.

Competitiveness of the East Tennessee Environmental Technologies Cluster

Oak Ridge environmental technologies firms are world leaders in cleaning up radioactive and mixed (hazardous and radioactive) wastes. They are supported by the Oak Ridge National Laboratories, which include 15 state of the art, experimental science facilities for use by DOE researchers. These labs are available to selected researchers from educational institutions and the private sector as "user facilities." Access is determined on a case-by-case basis depending upon scientific validity of the proposed research. The Materials and Chemistry Laboratory (MCL) is DOE's first environmental technologies user facility. MCL gives users access to 30 labs where they can develop, validate and demonstrate environmental technologies for treating any hazardous and/or radioactive material, using an unmatched array of cutting edge analytical instruments and supported by MCL staff expertise.

DOE recognizes the large environmental business sector in East Tennessee as a resource and has tried to promote cooperation between Oak Ridge's resources and the private sector, including Chattanooga firms in its programs. A Center for Environmental Technology financed technology demonstration and transfer involving Oak Ridge and Chattanooga as well as initiatives to identify international market opportunities for local environmental products and services. In the last two years, collaborative work and promotion of technology transfer to the private sector for commercialization has received less attention because budgetary pressures on DOE have increased. Today, the technology program is no longer funded, and economic development activities have taken a back seat to the implementation of the DOE Ten-Year (clean-up) Plan.

Technical Services and Intellectual Resources

The intellectual infrastructure and resources for technology transfer supporting the cluster in East Tennessee include higher education as well as the National Laboratories and TVA. The University of Tennessee's (UT) flagship campus in Knoxville has an Energy, Environment and Resources Center that does contract research in environmental technologies, most of which is funded by the state or federal government. The Center works on research projects with the Oak

Ridge National Laboratories and TVA through a Joint Institute for Energy and Environment, formed by the three entities. Technology transfer is encouraged. One of the firms interviewed assays the health of microbes that have been put into the soil to clean up pollution with a unique technology developed by a UT professor. The University of Tennessee at Chattanooga is adding its first Ph.D. program in environmental engineering.

The concentration of environmental technologies firms, outstanding local school system, training programs at community colleges and the University of Tennessee support the high level of human resources required by the industry. Chattanooga State Technical Community College offers a two-year course in specialized areas for environmental technicians, which includes many college graduates among its students. The Continuing Education Department offers certificate courses and exams in environmental specialties such as hazardous materials management. Roane State Community College Institute for Environmental Health and Safety in Oak Ridge offers training and consulting services to meet environmental industry needs, including OSHA and EPA AHERA and ASHARA model Accreditation Programs. Training courses are offered both on campus and on-site. The service firms and R&D facilities, which dominate the environmental technologies industry in Oak Ridge, employ the highest percentage of research and management staff. These positions are most likely to require advanced degrees, and many of the jobholders are educated outside East Tennessee.

East Tennessee firms are highly competitive on national and world markets—when they choose to compete. Public and private research facilities are excellent, and at all levels, technical expertise is abundant. The local labor force is highly skilled and highly educated, especially in environmental technologies related to management of radioactive substances. Moreover, salaries are relatively low, reflecting the local cost of living. There are exceptions, but for most firms, especially in Oak Ridge, marketing outside the local area has not been a high priority. DOE dominates the local environmental market. The top DOE priority is developing technologies for economical and effective clean-up of its Oak Ridge and similar facilities. Private industry echoes this orientation. Several firms with offices in Oak Ridge are multi-national corporations that serve DOE from Oak Ridge offices.

Chattanooga firms lack the critical mass found in Oak Ridge, but local resources promote competitiveness. These include a local government commitment to developing a strong environmental technologies industry; the Volunteer Site industrial park, with its laboratory and real world testing facilities; and the TVA headquarters office, which is a source of expertise in management of environmental projects. A TVA engineering laboratory at Norris, Tennessee, about 15 miles north of Oak Ridge, also is part of the cluster. It functions like a private enterprise and generates revenues by developing and then selling or licensing technologies to TVA and other customers, including customers outside the U.S. Although TVA does most of its environmental research at its laboratory in Muscle Shoals, Alabama, the TVA Norris Lab develops and sells environmental technologies. Exporting infrastructure in Chattanooga includes a licensed Foreign Trade Zone, with a sub-zone proposed for the Volunteer Site

Environmental Technologies Exports from East Tennessee

When industry executives interviewed for this study were asked about exporting, many initially defined that as meaning outside Oak Ridge, not outside the U.S. Their response underlines the very strong focus on the local market that has prevailed until recently.

Project interviews were structured to include ten firms that sell goods or services abroad from an East Tennessee office and ten firms that do not. When the ten exporters were asked to rank the importance of foreign markets to the industry's future, only one described exports as not very important. The others divided evenly, with three each selecting three, four, and five on a five-point scale of importance. Still, half of these firms earned five percent or less of their 1996 revenues in foreign markets. The others estimated that exporting accounted for from under twenty five to approximately fifty percent of revenues. Most export sales occur in the context of very large, multi-year projects, and so year to year variations are, like overall revenues, extremely volatile.

The most-often mentioned export destinations for environmental goods and services were Russia and the other countries that were part of the USSR, Central Europe, Germany and Japan, countries in Southeast Asia. The U.S. Department of Commerce International Trade Administration ETE Office produces market reports for several of the countries mentioned as export destinations, but no exporter interviewed was familiar with the reports. In several cases, however, a federal government agency was involved in securing the initial export opportunity by providing trade leads, access to decision makers, and—in one case—by paying for the work through a foreign assistance grant. DOE provided funding because the project called for disposition of nuclear waste, an area of expertise for Oak Ridge firms that has political as well as environmental importance due to concerns over proliferation of nuclear weapons. The U.S. Trade and Development Agency also promotes ET exports by funding feasibility studies, reverse trade missions, business conferences and training grants.

As noted above, environmental technologies firms in Oak Ridge have begun seeking broader markets. The interviews, while too few to extrapolate, suggest a recent movement toward increased exporting. Only two of the exporters had been selling abroad since the 1980s, while three began exporting in 1996. Six of the ten had at least one individual assigned to export sales, part-time if not full-time. Exporting rarely requires modifications in standard operating procedures relative to environmental products or service provisions. Most projects are tailored to a specific client and situation in the U.S. and elsewhere; exporting requires adjustments to accommodate differences in culture and in business practices.

Obstacles to Exporting

The biggest barrier to increased export sales is the cost in money and time of doing business abroad. The high cost of marketing, establishing and maintaining a presence is exacerbated by the lag between starting to market abroad and realizing revenues from the typical project with its long lead time. As a result, breaking into foreign markets requires deep pockets, which many small firms lack. Great distance and time zone variations add complexity to the partnerships and collaborations by which most projects are implemented. Off-site environmental technology projects often involve a local partner, and several people mentioned the difficulty of finding a

dependable local partner for a project outside the US. Another issue arises from the knowledge dependence of environmental technologies. Foreign governments may resist hiring a U.S. firm to provide an environmental service, preferring to purchase the technology and do it themselves. Firms wants to sell their services and hold on to their technological secrets.

More and better market information was mentioned most frequently as something that would help exporters increase their overseas sales. Help in identifying foreign partners, joint marketing efforts, and bringing potential clients to Oak Ridge instead of having firms go abroad were also suggested. Exporting is a new experience for most of the firms interviewed, and if export sales increase as a share of total revenues, management may become willing to invest more heavily in overseas marketing.

Among the firms interviewed that did not export from their East Tennessee office, half have considered seeking customers from other countries. The reasons they have not done so relate to lack of resources—time, money, and information. Also, this industry includes new firms that have not thoroughly explored the domestic market and want to pursue that avenue first. The firms that had not considered exporting from East Tennessee were branches or subsidiaries of large corporations with international divisions operating from a different location.

East Tennessee Cluster Dynamics

The East Tennessee concentration of companies in and around Oak Ridge has several characteristics of a successful cluster. Firms are highly competitive with each other, but also value the network of expertise that strengthens all of them. It is common for firms form partnerships on a project by project basis to compile the strongest array of skills. One respondent noted the shifting alliances when asked to rank the level of trust and cooperation among local environmental technology firms. When firms are partners, it is high; but next year when the same firms are competitors, it is low. Competition is tough. Still, for every person who rated inter-firm trust and cooperation as below average, three people rated it above average.

The larger firms, most branch offices of national corporations, compete horizontally and partner vertically. Vertical partnerships include mentoring relationships with small firms, especially firms that are classified as disadvantaged or certified by the Small Business Administration 8(a) program. Large firms invite participation of SDBE and 8(a) firms to strengthen proposals for government contracts, and because government contracts dominate this market, 8(a) and SDBE firms are important. On their own, small and medium sized firms partner horizontally and vertically, acting as sub-contractors on some contracts and prime contractors on others.

Recent years have seen an increase in the number and proportion of small firms in East Tennessee. As noted above, when government procurement regulations began to encourage sub-contracting with small and disadvantaged businesses small and disadvantaged businesses came into the market. A second force is at work here, too. East Tennessee is seeing environmental technology company start-ups as a result of lay-offs at major facilities—TVA in Chattanooga and DOE facilities in Oak Ridge

Most Oak Ridge environmental technology firms belong to and participate in the local business associations, the East Tennessee Environmental Business Association (ETEBA) and the East Tennessee Economic Council (ETEC), which recently spun off from the Chamber of Commerce.

ETEC works to promote economic development based upon the skilled work force, technologies, and facilities that have been created by the federal activities in East Tennessee. ETEBA serves the local environmental industry, a subset of ETEC members. Both organizations are in transition periods, trying to gear up to address the impacts of cutbacks on the federal reservation in Oak Ridge. ETEC is moving to become self-supporting, and ETEBA has drafted a strategic plan, which if accepted, would commit the organization to hire professional staff and take a more active posture in representing its members. Members include an increasing proportion of small companies.

The industry concentration is an information resource for firms, but it is also apparent that information technology is moving free of locational bounds. During interviews, people were asked how often they used various sources of information. The two most frequently used resources are other companies and the Internet. Several people remarked that the Internet was becoming an increasingly useful source of information. Community colleges were least often used as an information resource, perhaps because the technology involved is so advanced (Table 34). The ratings are calculated from the interview responses. Each *frequently* is worth three points, *occasionally* is worth two points, *rarely* is worth one point and *never* is worth zero.

There are weak points in the East Tennessee cluster. The most significant is the local business support infrastructure. The area has not developed a resource pool of lawyers, accountants or other business services specializing in environmental technologies. The fact that the largest firms are branches of national corporations may well have depressed the demand for those services from local sources. When firms were asked where they received assistance in entering export markets, most replied that they did not receive assistance.

Table 34
Information Resources for East Tennessee Firms

Information Resource	All Firms (20)	Exporters(10)	Non-exporters (10)
Other Companies	46	26	20
Internet/Journals	46	24	22
Customers	41	21	20
Equipment Vendors	34	18	16
Suppliers	33	16	17
Private Consultants	33	17	16
Trade Assoc's/Chambers	32	17	15
Other Gov't Agencies	31	21	10
Universities	26	13	13
Gov't Tech. Assistance	25	16	9
Small Business Centers	22	12	10
Community Colleges	12	7	5

Local financial resources also receive a strong vote of no confidence as a source of long term capital. This has not been a problem because most Oak Ridge firms have been able to access other resources. Subsidiaries and branch plants get capital infusions from their parent or headquarters. Smaller, independent firms also reported generating capital internally. Key

sources of capital have been government contracts and grants to fund research and development. One person attributed the very conservative posture of local banks to continuing fallout from the Bucher Brothers banking collapse in Chattanooga a few years back.

What Will the Future Bring?

Export Potential

There is no question that the larger firms in the East Tennessee environmental technologies industry have the capacity to export; the question is whether or not they will choose to export from an East Tennessee office. Most have offices in major cities where air service is far more convenient for overseas travel. The smaller environmental technology firms are more closely tied to East Tennessee and would export from that location if they exported. The smaller firms also have unique technologies and capabilities, especially for cleaning up and managing radioactive and mixed hazardous-radioactive waste. Clearly, their technological capacity provides them with a product that is competitive on international markets.

More than one environmental technology firm that did not market abroad but had considered exporting reported that an unsolicited inquiry from a potential foreign customer piqued their interest in exporting, at least temporarily. Management skills, most notable marketing capacity, may not be adequate to the task, frequently because the small firm cannot make or chooses not to make the necessary investment of time and staff resources. If the local market declines as sharply as is projected, more small firms may decide that they have to make that investment. For small companies, the key barrier to increased exporting is the high cost of marketing abroad.

Export support services are available locally, but most focus on manufacturing and not on the environmental technologies industry. Chattanooga has a Foreign Trade Zone (FTZ) and a World Trade Club. The Tennessee Small Business Development Centers, operated through the University of Memphis, has an International Trade Center in Chattanooga, which is staffed by one person who works closely with the Chattanooga Chamber of Commerce. That office offers seminars and one-on-one counseling to help firms enter export markets. It does not target any particular industry but works mostly with manufacturers. The U.S. Department of Commerce has an International Trade Administration Export Assistance Office in Chattanooga, but it has not been staffed since September, 1996, and calls are referred to the Nashville office. The Department of Commerce has an environmental technologies sector team and will fill the Chattanooga position with a person from that team.

Knoxville also has a Foreign Trade Zone (FTZ). The Knoxville FTZ has four sites, two of which are active. The active sites are 45.6 acres with a 120,000 square foot warehouse in Knoxville and a 27,000 square foot cargo warehouse at the Knoxville Airport. The inactive sites are almost 4.5 acres in Blount County Industrial Park, which is five miles from the Knoxville Airport, and 6.5 acres in Valley Industrial Park in Oak Ridge, which is owned by the City of Oak Ridge.

Growth Potential

The next couple years are expected to bring increasing volatility and difficult adjustments to the local ET industry. As the DOE Ten-Year Plan begins to be implemented, the type of ET services sought by DOE will shift from study and containment to clean-up. Moreover, the government market for ET in Oak Ridge is shrinking. Diminished local demand is leading some firms to seek broader markets, including private sector and foreign markets. Others are cutting back their Oak Ridge presence. Some local offices of large multi-national corporations, are expected to close their local office when the DOE work dries up. One industry observer noted that only one large firm actually owns its Oak Ridge facility; the others all rent. To date, closings appear to be more rumored than actual. No-one named a specific firm that had already shut down its local operation or announced plans to do so. Still, the immediate question is about survival not growth. The issue is whether or not East Tennessee will be able to retain enough of the world's largest concentration of ET firms to have a viable industry cluster.

To a large extent, decisions made outside East Tennessee will shape the future of the ET cluster there. Decisions about DOE contracts will be made in Washington. Decisions about closing or continuing branch office operations will be made in distant headquarters. The Oak Ridge community wonders if the branch offices close, can the small firms make it on their own. ETEC has organized to promote continued federal presence and to exploit the enormous economic development potential of the federal investments in place. ETEBA is trying to expand its capacity to promote the economic interests of its members.

The future outlook also depends upon the locational advantages and disadvantages of the East Tennessee location for environmental technology industries. The high quality of life is an important locational advantage. Costs of living are reasonable, public schools are excellent, and the scenery is spectacular. The area is already seeing start-up activity from people laid off by large firms and government facilities. Rather than go elsewhere for a job, people are trying to create their own jobs so that they can remain in the Oak Ridge area.

The interviews produced a sharp contrast in those assessments between the firms that export and those that do not. Representatives of the environmental technology firms that do not export from their East Tennessee office find the primary advantages of an East Tennessee location to be geographic. The most mentioned advantage is proximity to customers, an advantage that could shrink with the value of local DOE contracts. The non-exporters also valued the good distribution channels, primarily the interstate highway network. Interstate highways 75, 40, and 81 pass through the area and represent a more lasting geographical advantage. A second tier of locational advantages reflect the industry concentration—access the R&D services and technology, proximity to other firms, and the skilled labor force.

The environmental firms that export from an East Tennessee location have a totally different perspective on locational advantages. Proximity to customers is not mentioned except as a negative—the distance from customers. The advantages all relate to the industry concentration. Those most frequently mentioned are access to R&D services and technology, proximity to other firms, and the skilled labor force. In Chattanooga, local government support is an asset.

A similar dichotomy appears when disadvantages of the East Tennessee location are considered. The non-exporting firms complain about the poor quality of local business services and the high dependence upon federal contracts. The exporters consistently describe poor service for air travel as the biggest disadvantage. Less important are deficiencies in distribution channels and

weak business services. As the East Tennessee environmental technologies industry shifts from public sector to private sector markets, traditional sources of capital probably are becoming more important. It is not clear that the local lending community is prepared to meet that challenge. Local lenders are a limited source of working capital and lines of credit, but firms often have to go to Nashville or Memphis for specialized services.

Both ETEBA and ETEC have developed new strategic plans to address the transition from public to private markets in response to the phasing out of DOE activities at Oak Ridge. Despite the weakening demand from its primary customer, the Oak Ridge/Knoxville ET industry faces the future with a strong resource base in terms of work force, technologies, and facilities. Human resources are outstanding, and the high quality of life makes people want to stay in Oak Ridge. This is a very positive factor is assessing the future of this knowledge-intensive industry in Oak Ridge. Already new firms are being started by highly skilled individuals laid off by large environmental technology firms.

Making the Oak Ridge/Knoxville to Chattanooga Linkage

The luxury of large, long-term government contracts has allowed Oak Ridge environmental firms to avoid more difficult markets and harder to manage working situations. Chattanooga was included in the target area for this report not because it has an environmental technologies industry cluster but because it offers a future direction for the environmental technologies cluster in Oak Ridge. Chattanooga has a stronger market orientation than Oak Ridge, and that extends to foreign markets.

Efforts to realize the economic development potential of the environmental technologies expertise and facilities that federal activities have build in East Tennessee should encourage cooperation between the environmental technology communities in Oak Ridge and Chattanooga. Oak Ridge can bring technical expertise and the habit of working cooperatively to the partnership. Chattanooga can bring a living laboratory and a private sector market orientation determined to translate technology into profitable business.

Appendix A
Environmental Technologies

Environmental technologies make up a $ 408 billion market worldwide, which continues to grow rapidly as constituencies in countries across the world lobby their governments for pollution prevention and remediation regulations and urban and industrial growth add new customers for basic services. Additionally, environmental restrictions on imports, such as the EU regulations and the ISO14000 series regulations, encourage less developed countries to focus on the environmental effects of their production methods. Table 1 illustrates the strength of the international environmental market by country and segment.

In 1995, DOE commissioned an assessment of export opportunities for selected remediation technologies developed or under development at DOE and the national laboratories, including ORNL. *Analysis of the International Environmental Restoration and Waste Management Market; An Overall Assessment of Selected markets and Technologies,* was prepared by the University of Tennessee and Martin Marietta Energy Systems, Inc. Foreign markets were evaluated based upon the presence of waste generating industries, the regulatory and enforcement climate, the availability of funds to finance environmental activities, the acceptance of US technology, and the presence of remediation sites.

Most countries are just beginning to identify their remediation needs, and so the demand is primarily for containment, characterization, and monitoring technologies. As they progress and become more sophisticated, the demand will shift to waste destruction/stabilization and separation/extraction technologies.

During the next five years, Germany, Mexico, and South Korea represent the best overseas markets for remediation technologies. Moreover, Germany was seen as a basis for entering the Central European market, which has extensive need for remediation. The greatest market opportunities in the next five to ten years include China, India, and Brazil. All six of the target countries operate nuclear power production facilities.

Japan meets the criteria for inclusion as a marketing target, but that country was dropped from the list because it is such a difficult market to penetrate. Japan buys less than one percent of its environmental technologies from other countries. Although the US accounts for about 70 percent of that one percent, the research team felt that the limited resources available to promote exports of US remediation technologies would be better invested in a more hospitable market.

Country Analysis

Environmental technology, as defined for this section, includes production of goods and services for measuring, preventing, limiting, or treating environmental damage, the pollution of water, air, land, noise pollution and solid waste. The study team recognizes that untraded services, such as garbage collection are not included in the data, thus the quoted figures may be slightly distorted. The analysis is based on information from the Department of Commerce's Country Commercial Guides for the listed countries, the International Trade Commissions document U.S. Trade Shifts in Selected Commodity Areas, and interviews with industry experts and U.S. manufacturers. Statistical accuracy and comparability to other sources are affected by a number

of factors, including lack of published figures in certain markets, variances in data collection techniques, sources of data, and industry definitions.

Japan: Due to a very competitive domestic market, Japan only imports approximately 0.74% of its pollution prevention equipment and services. The U.S. supplies 71% of these imports, which is less than 1% of Japan's total market share. Following commitments made by Japan during the Rio Summit of 1992, and a tightening regulatory structure in Japan, the market for environmental products in Japan is expected to expand nearly 10% to over $19.3 billion in 1997. A key factor in this market expansion is Japan's imminent adoption of ISO14000. Equipment and services with high demand in this expanding market are likely to be those utilizing biotechnology applications for waste treatment and contamination remediation. Cost effective U.S. technologies dealing with soil and groundwater contamination are also anticipated to do well in Japan.

Air pollution prevention and control equipment is another area of expansion, as the air quality standards have become tighter at the national level. Japan currently accounts for 15% of the global air pollution prevention and control equipment market. The largest consumers in Japan are thermal electric power producers, petroleum refineries, and steel and chemical manufacturers. The fastest growing market for air pollution prevention and control equipment is in equipment for municipal solid waste incinerators, a disposal process becoming more common as landfill space becomes increasingly scarce. From 1990 to 1995, Japans imports of equipment in this area increased 75%, and in 1995, 60% of the equipment imports came from the U.S.

Table A-1
Market for Environmental Technologies: Japan, $ in Millions

	1995	1996	1997
Total Market Size	$ 16,270	$17,590	$ 19,360
Total Local Production	$ 16,500	$17,950	$ 9,750
Total Exports	$ 350	$ 500	$ 550
Total Imports	$ 120	$ 140	$ 160
Imports from the U.S.	$ 85	$ 100	$ 120
U. S. Market Share	1%	1%	1%

Japan: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, U.S. Department of Commerce

Mexico: Mexico imports approximately 40% of its pollution prevention equipment and services. The U.S. supplies 69% of these imports, or 28% of Mexico's total market share. From 1995 to 1997, U.S. pollution prevention equipment exports to Mexico in the sectors of air pollution, solid waste and toxic waste are expected to grow an average of 8%.

Some of this growth may be regulatory driven, as Mexico City authorities have recently announced a five-year program targeted at reducing air pollution in Mexico City and twelve other municipalities in the State of Mexico. This air quality program, at an anticipated cost of US$13.3 million, requires installation of air emission control equipment in industry, vehicle inspection, and erosion reduction measures.

Another anticipated area of market growth for environmental equipment and services in Mexico is in municipal landfill construction and management. It is expected that private companies will be awarded 15 new concessions for landfills in mid-sized cities within the next five years. Imports of U.S. environmental equipment may be stimulated by a recently introduced tax incentive program, which allows private companies to write off the value-added tax for purchases of environmental equipment used to comply with environmental regulations.

Industry sectors in Mexico that appear to be promising markets for U.S. exports include: air emissions control equipment and systems, emissions testing equipment, hazardous and toxic waste management equipment, solid waste management equipment, and solid waste recycling equipment.

Table A-2
Market for Environmental Technologies: Mexico, $ in Millions

	1995	1996	1997
Total Market Size	$ 1,882	$ 1,773	$ 1,784
Total Local Production	$ 1,267	$ 1,241	$ 1,254
Total Exports	$ 141	$ 239	$ 287
Total Imports	$ 756	$ 771	$ 817
Imports from the U.S.	$ 522	$ 532	$ 607
U. S. Market Share	28%	30%	34%

Mexico: Leading Sectors for U.S. Exports and Investments,
Country Commercial Guides, U.S. Department of Commerce

Canada: Canada imports approximately 38.8% of its pollution prevention equipment and services, 77% of which is provided by the U.S. This is approximately 30% of Canada's total market. As demand for pollution prevention equipment grows, it is matched by expansion of the need for services and management expertise within certain industries. The demand for pollution prevention equipment and services is expected to grow between three and five percent annually.

Industries that show the greatest promise for U.S. exports include: air pollution reduction, water and wastewater treatment, and hazardous waste. Mining and forestry industries are focusing more on air pollution reduction with the move towards adopting ISO14000 standards. In addition, many Canadian air filtration companies have begun to show interest in capturing CFCs. In the area of water and wastewater treatment, some municipal governments are interested in privatization options with hopes of reducing spending. Finally, in the area of hazardous waste, several military sites have been targeted for waste evaluation, followed by treatment or removal of contaminated soil.

Due to the small size of most Canadian firms active in the provision of pollution prevention equipment and services, a team approach is favored for many projects. This team approach will provide opportunities for U.S. firms with specific capabilities in the provision of services, equipment, or components to complement the existing Canadian firms. U.S. companies may be assisted in this end by a recent policy statement, the Canadian Environmental Industry Strategy, issued by the federal government, which has dedicated funding to programs supporting joint

ventures, strategic alliances, and consortia, both in Canada and off-shore. U.S. companies may qualify for this program in partnership with Canadian companies.

US pollution prevention equipment has a very strong reputation in Canada among end-users, consultants, and companies, for being more advanced based on the size and history of the U.S. market.

Table A-3
Market for Environmental Technologies: Canada, $ in Millions

	1995	1996	1997
Total Market Size	$ 4,227	$ 4,460	$ 4,629
Total Local Production	$ 3,331	$ 3,517	$ 3,679
Total Exports	$ 744	$ 797	$ 877
Total Imports	$ 1,640	$ 1,740	$ 1,827
Imports from the U.S.	$ 1,260	$ 1,300	$ 1,365
U. S. Market Share	30%	29%	29%

Canada: Leading Sectors for U.S. Exports and Investments,
Country Commercial Guides, DOC; US$ millions

Korea: Korea imports approximately 47% of its pollution prevention equipment and services, 20% of which is provided by the U.S. This is approximately 9% of Korea's total market share. Rapid industrial growth has resulted in substantial increases in pollution, which in combination with a rising standard of living have resulted in increased environmental awareness. The size of the Korean market, import markets are both expected to rise sharply over the next few years. This expansion will be due in part to the more stringent regulations that the government is placing on industrial emissions and attempts to streamline pollution prevention and clean up projects by employing more efficient processes and equipment. Sales of equipment and expertise in specific industries, in addition to joint venture manufacturing and construction ventures hold strong potential for U.S. participation.

The best prospects for sales of U.S. equipment in Korea are: automatic strainers, aerators, ozone generators, FRP chains, decanting centrifuges, water reuse systems, sludge dewatering equipment, screw-decanters, and hydrasive screw/ultra-screen systems. Due to a tightening of standards on sulfur dioxide, this may be one of the most lucrative areas for imports.

Although the U.S. holds a smaller share of the import market than Japan, which holds approximately 45% of the market, U.S. equipment is generally regarded as being equal to or superior to Japanese equipment. However, U.S. sales still lag behind those of Japan due to a perceived lack of follow-up service. The Korean Government is seeking to diversify its international trade, and has established a policy intended to reduce Japanese imports.

Table A-4
Market for Environmental Technologies: Korea, $ in Millions

	1995	1996	1997
Total Market Size	$ 1,369	$ 1,774	$ 2,132
Total Local Production	$ 836	$ 1,114	$ 1,344
Total Exports	$ 104	$ 130	$ 155
Total Imports	$ 637	$ 790	$ 943
Imports from the U.S.	$ 127	$ 165	$ 205
U. S. Market Share	9%	9%	10%

Korea: Leading Sectors for U.S. Exports and Investments,
Country Commercial Guides, U.S. Department of Commerce.

France: France imports approximately 25% of its pollution prevention equipment and services. The U.S. supplies 10% of these imports, or 2.45% of France's total market. Major competition in this field comes from Germany, the UK, Sweden, the Netherlands, and Switzerland. The French market for environmental technologies has been dampened by a slowdown in the economy, but is expected to grow strongly in the next 10 years due to new French legislation and desire to bring France's environmental protection standards up to those of the rest of the European Union. The French Ministry of Environment is focusing on issues of cleaning up contaminated land sites. Some of the technologies that they are pursuing in relation to this are landfill management techniques, waste incineration, recycling methods, and bio-remediation.

To address European directives, France has developed a long-term plan to develop their environmental standards. Massive expenditures in water distribution, waste water treatment infrastructure, and environmental equipment and services will be made over the next ten to fifteen years. The most promising prospect for U.S. exporters to France's environmental technologies market is to focus on high-tech, innovative and unique or proprietary pollution control.

Table A-5
Market for Environmental Technologies: France, $ in Millions

	1995	1996	1997
Total Market Size	$ 13,240	$13,913	$ 14,607
Total Local Production	$ 20,368	$20,765	$ 21,801
Total Exports	$ 10,387	$10,382	$ 10,682
Total Imports	$ 3,259	$ 3,530	$ 3,488
Imports from the U.S.	$ 325	$ 353	$ 419
U. S. Market Share	2.45%	2.54%	2.87%

France: Leading Sectors for U.S. Exports and Investments,
Country Commercial Guides, U.S. Department of Commerce.

Summary

As the environmental market continues to grow internationally, the United States has an excellent opportunity to position itself as a world leader in environmental technology. The strengths of the U.S. market stem both from technological strengths and the benefits of being one of the first countries to focus on the environment on a large scale. Some of these strengths include:

- innovative technologies for a variety of environmental problems;
- excellent reputation for technology and service; and
- strong export promotion programs.

The best prospects for the U.S. environmental technologies market lie with sophisticated environmental technology and specialty products.

Appendix B
Standard Industrial Classification Codes for Environmental Industry Firms

1389 oil and gas field services not elsewhere classified (NEC)
1623 water main line construction
1629 waste disposal plant, sewerage treatment plant construction,
1711 water system balancing and testing
2299 processing of textile mill waste and recovering fibers
2493 reconstituted wood products
2499 reqround sawdust, pressed logs of sawdust
2679 converted paper and paperboard products NEC
2899 water treatment compounds
3089 plastic products NEC, including recycled
3272 incinerators, concrete
3341 recovery and refining of non-ferrous metals
3399 recovery of iron ore from open hearth slag
3443 heating equipment, inc. wood waste burning and biomass systems
3564 air purification and dust collection equipment
3567 incinerators, metal: domestic and commercial
3569 air separators
3589 water treatment equipment, industrial scrubbers and sweepers
3634 air purifiers, portable
3823 water quality monitoring systems, industrial process control instruments
3826 analytical instruments
3829 measuring and controlling instruments
4941 water supply systems, except irrigation
4952 sewerage systems
4953 waste materials disposal, including hazardous incinerator operation
4959 sanitary services NEC
5075 air pollution control equipment and supplies—wholesale
737 computer programming, data processing, other related services
7389 business services NEC, including solvent recovery, aluminum processing (recycling); scrap metal, plastic, fiber, paper recycling
8711 engineering services, except architectural and surveying
8731 engineering laboratories, commercial physical research; except testing
8734 testing laboratories, pollution testing, except automotive emissions

EBI data describing ET revenues include public sector operation of water and sewer facilities and of waste management and resource recovery. However, they do not include the regulatory participation of government, which would fall under SIC code 9511, government. environmental protection, quality and control agencies.

HOUSEHOLD FURNITURE IN ALABAMA AND MISSISSIPPI (SIC 251)
EXPORTING FOR MASS CONSUMPTION

by Brian Davis
Alabama International Trade Center, University of Alabama

Preface

Competitive pressures in the U.S. furniture industry are pressing manufacturers to look outside the U.S. for new markets. Several trends within the industry point toward an increasingly competitive environment. Sales have been increasing by less three to six percent per year, consolidation among a smaller number of large firms are dominating shipments and product brands within the industry, low profitability is low as evidenced by low after tax returns on sales, and advances in production technologies are increasingly important but costly for smaller firms.

Export markets can provide an outlet for future growth for Appalachia's furniture manufacturers. One of the highest concentrations of furniture companies in the nation is located in northeastern Mississippi and northwestern Alabama. The furniture industry in this region has a number of advantages—it is strategically located near major wood and suppliers, it has a good reputation for traditional styles of furniture, and it is home to a domestic trade show that attracts international attention. There is some evidence that the region's furniture manufactures are starting to take advantage of export opportunities—but at a lower rate than the industry nationally. U.S. export shipments of household furniture grew by 75 percent from $756 million in 1990 to over $1.3 billion in 1995.

The industry has not fully realized its potential to export. Executives in the furniture industry located in the ARC cluster are optimistic that exporting increase. Yet firms are reluctant to aggressively seek out foreign markets. Unlike the U.S. hardwood lumber and components industry, the main furniture manufacturer's association in the U.S. has virtually no export promotion programs. Few companies in the cluster have full-time export managers who travel abroad, seek foreign distributors, or attend overseas trade shows. Export sales of the industry's top 25 firms are, on average, three to five percent of total sales. Many firms export in a reactive manner by "order-taking" from the growing number of foreign buyers who attend the U.S. furniture shows.

Given the scale and capacity of the industry, its strategic location near quality, wood-based raw materials, and its utilization of advanced production methods, it is surprising that exports have not been greater. There are two critical problems impeding the growth of exports and accompanying growth in employment: (1) lack of skilled workers to run advanced woodworking equipment, and (2) lack of active, internal export systems within the firms. To help Appalachia's furniture industry grow, demonstration projects should be initiated within this cluster to assist firms with cooperating on worker training and export development.

Introduction

In the northeastern corner of the state of Mississippi, centered in the city of Tupelo (perhaps best known as the birthplace of Elvis Presley), about 250 companies employing 22,000 people last year (up from 7,800 in 1980) produce mid-range furniture for mass markets.[23] Of the 14,904 new jobs in industry Mississippi reported during 1992, 41 percent were in furniture. The ten-county Appalachia region anchored by Tupelo has become the second largest producer of upholstered furniture in the nation, behind only the Hickory-High Point region of North Carolina, and it is the nation's leader in mid-range recliners and incliners. "Almost everyone you meet around here," observed one company owner, "has [or will have] worked in furniture by age thirty." The products of this cluster are not the fashionable traditional pieces of North Carolina or stylized pieces of Oregon, but functional furniture made in quantity and distributed largely though mass marketing to chain stores. In Alabama another, less dense and smaller cluster of furniture companies makes solid wood furniture purchased by retailers as low-priced promotional pieces.

Industry Structure

The ARC target industry SIC 251, household furniture, includes wooden, upholstered, and metal household furniture; mattresses, foundations and convertible beds; television, sound system, and sewing cabinets; plus household furniture not elsewhere classified such as porch, lawn, and camp furniture. (*Standard Industrial Classification Manual*; Executive Office of the President, Office of Management and Budget, 1987.) Household furniture industries are part of SIC major industry 25, furniture and fixtures. SIC 25 data is used in this analysis of recent export trends.

National overview and market patterns

Furniture manufacturing is no longer a traditional domestic industry but is global. The U.S. represents the world's largest furniture market. It is a net importer of furniture and advanced furniture manufacturing equipment. The South, in particular, is known world-wide as a hub for furniture production. Over 70,000 visitors each year—10 percent from abroad—come to High Point, North Carolina to buy furniture at its semi-annual trade shows.

U.S. trade in furniture—both imports and exports—has grown over the last 20 years. As Table 35 shows, exports grew by approximately 75 percent, from $ 756 million in 1990 to over $ 1.3 billion in 1995. Imports grew by 62 percent over the same period, from $ 2.7 billion in 1990 to over $ 4.4 billion in 1995. Yet the industry's exports as a percent of sales ranks low among states in the ARC region. It ranks only 37th among the top 50 three-digit sectors, far below the national average for the industry.

U.S. exports of household furniture in 1995 were less than five percent of domestic shipments. The top 25 U.S. furniture manufacturers exported, on average, less than five percent of total sales. Imports accounted for 24 percent of the domestic market. China will soon outpace Taiwan as the major import supplier of furniture; Italy and Germany lead as U.S. import suppliers of advanced woodworking machinery.

Table 35
U.S. Import- Export Trade in Household Furniture
1990-1995 ($ Value Millions)

Product Category	1990	1995	% Change
Total HHF (SIC 251)			
Exports	$ 756	$ 1,320	75 %
Imports	$ 2,738	$ 4,448	62 %
Wood HHF (SIC 2511)			
Exports	$ 382	$ 669	75 %
Imports	$ 1,711	$ 2,826	65 %
Uph. HHF (SIC 2512)			
Exports	$ 128	$ 163	27 %
Imports	$ 295	$ 430	45 %

Source: U.S. Department of Commerce

Exports of both wood and upholstered furniture accounted for approximately 60 percent of U.S. exports of all household furniture categories. The leading export destinations for household furniture in 1995 were Canada, Japan, Mexico, Saudi Arabia, and the United Kingdom. The top five import suppliers of household furniture were Canada, Taiwan, China, Italy, and Mexico.

Domestic Trends

Domestic industry shipments in 1995 exceeded $ 18 billion, with a retail market estimated to be over $ 50 billion. A small number of large firms dominate; 25 account for almost 50 percent of total shipments. Industry analysts point toward several trends in the domestic furniture industry that signal changes and possible reasons for the industry to be more aggressive to looking for exports markets.

- The industry is in a state of flux. Consolidation quickened in 1996 with industry leaders getting larger through mergers and acquisitions. Some large firms, however, are losing market share to aggressive, relatively young, small niche firms (many of which don't survive long).
- Sales growth in 1995 was flat and growth slow in 1996 (average of 3.7 percent). But they are expected to increase in 1997, with estimates of growth rates at just less under six percent.
- The industry's financial performance is poor and companies are highly leveraged. Average debt to equity ratio doubled in the last ten years, profit margins are slim, and after-tax return on sales is only 2-3 percent. Some firms may not be able to withstand a market downturn.
- Utilization of advanced manufacturing technology is widespread among
- large companies, but increases in skills needed to operate the technology has not kept pace. Labor skills and worker training are one of the greatest concerns of industry—next to government regulation, wood supply, and price competition.
- Manufacturing strategies are important with a growing demand for short production runs, just-in-time (JIT) delivery, and a more outsourcing of parts.

- The industry has an abundance of design expertise and product variety. U.S. manufacturers introduce new product lines with innovation in finishings, materials, style and pricing semi-annually at each market.
- The bulk of the domestic retail trade is dominated by a few traditional styles and brands made by industry leaders. Smaller firms follow with new introductions and pursue niche markets.

Recent Export Trends[24]

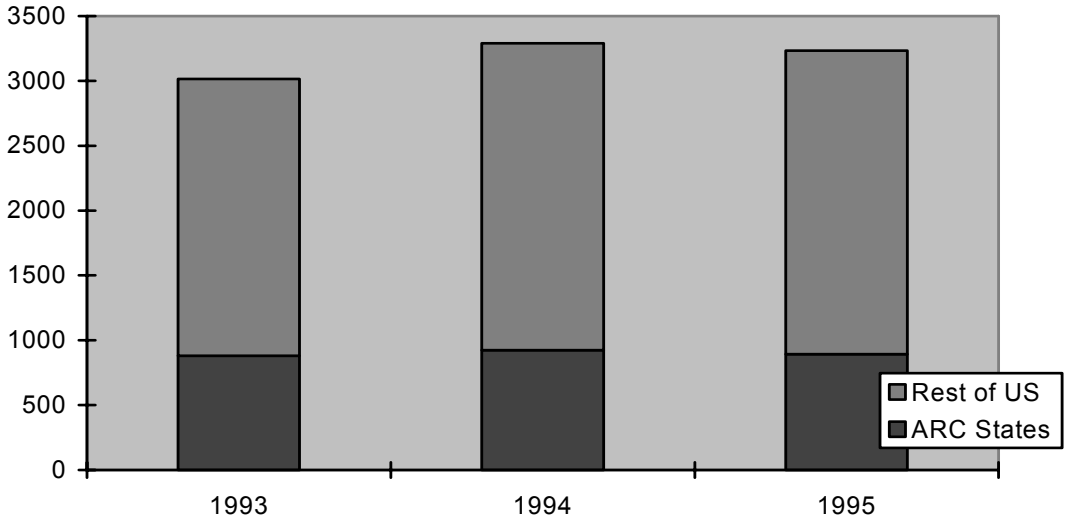
In 1995, furniture and fixtures accounted for 0.6 percent of the value of manufactured products exported from the United States and 0.6 percent of the value of manufactured exports from the ARC states. The similar ratio indicates that the ARC states contribute a proportionate share by value of US furniture and fixture exports. The U.S. 1995 furniture and fixtures export total of $3,234 million represented an increase of just over $218 million dollars from 1993 when furniture export sales were $3,015 million. At the same time, furniture manufacturers in the ARC states increased their export sales from $880 million in 1993 to $893 million in 1995, an increase just under $ 13 million. This growth in export sales represents an increase of 7.3 percent for the United States and only 1.5 percent for the combined ARC member states. Table 36 lists the 1993 through 1995 values for furniture exports for the states that are members of the ARC and for the US as a whole.

Table 36
Value of Furniture and Fixture Exports, 1993-1995 (millions of $)

AREA	1993	1994	1995	1993-1995 CHANGE
ARC States	$880.0	$924.3	$892.8	$12.8
United States	$3,014.9	$3,289.0	$3,233.5	$218.7

As a result of the recent very slow growth for the multi-state total, the ARC states are providing a diminishing share of the nation's furniture exports, by value. Figure 16 shows the ARC contribution to United States furniture export sales. Appalachia's share decreased from 29.2 percent in 1993 to 27.6 percent in 1995.

Figure 16



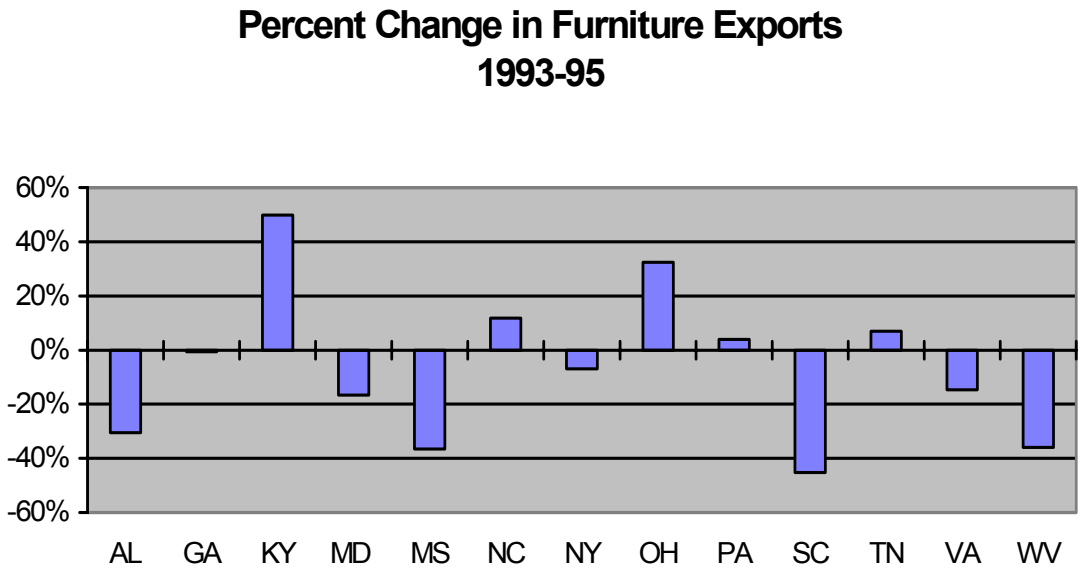
The ARC furniture industry is clustered in several sub-areas within the region, with North Carolina, Tennessee, and Ohio the leading furniture exporting states. Table 37 lists the 1993 through 1995 value of furniture and fixture exports attributed to each ARC member state, and the changes in the value of exports over the three years. The value of furniture exports decreased in eight ARC states and increased in five. The changes ranged from a gain of over $37 million for Ohio furniture exports to a loss of over $33 million in Mississippi.

The change in dollar value tells only part of the story. The impact of a given increase or decrease in export sales depends in part upon total export activity. For example, South Carolina had a $10 million decline in exports that cut foreign sales almost in half, but a similar drop in Virginia exports translated into a much smaller percent decrease in exports. Calculating the rate of change helps put the movement in perspective. Table 37 shows that the rate of change in furniture exports varies dramatically among the ARC states. Seven of the ARC states had absolute decreases in the value of furniture and fixture exports—the highest number of states with declining export sales for any targeted cluster.

Table 37
Value of Furniture and Fixture Exports by State, 1993-1995 (millions of dollars)

AREA	1993	1994	1995	'93-'95 Change
Alabama	$42.3	$40.3	$29.3	$(13.0)
Georgia	$35.4	$32.8	$35.2	$(0.2)
Kentucky	$33.0	$43.2	$49.5	$16.5
Maryland	$11.0	$11.9	$9.2	$(1.8)
Mississippi	$91.3	$74.8	$57.9	$(33.5)
North Carolina	$181.3	$211.9	$202.7	$21.4
New York	$88.6	$79.1	$82.3	$(6.2)
Ohio	$115.1	$149.3	$152.4	$37.3
Pennsylvania	$71.9	$70.1	$74.7	$2.8
South Carolina	$21.6	$18.0	$11.8	$(9.8)
Tennessee	$126.7	$137.9	$135.5	$8.8
Virginia	$60.5	$54.3	$51.6	$(8.9)
West Virginia	$1.2	$0.6	$0.8	$(0.4)

Figure 17



As Figure 17 shows, Kentucky had the highest growth rate in value of furniture exports, at almost fifty percent in just two years—although the growth in the dollar value of exports was small. Ohio also experienced relatively strong growth. Most states, however, showed sharp declines. South Carolina, Mississippi, and West Virginia each lost more than a third of their the value of furniture exports, and Alabama lost thirty percent.

Export Intensity

Another technique for accommodating size differences among the ARC states so that export performance can be compared across the states and with the national average is to calculate the value of furniture exports as a percentage of the gross state product (GSP). That ratio measures the contribution that furniture exports make to the overall state economy.

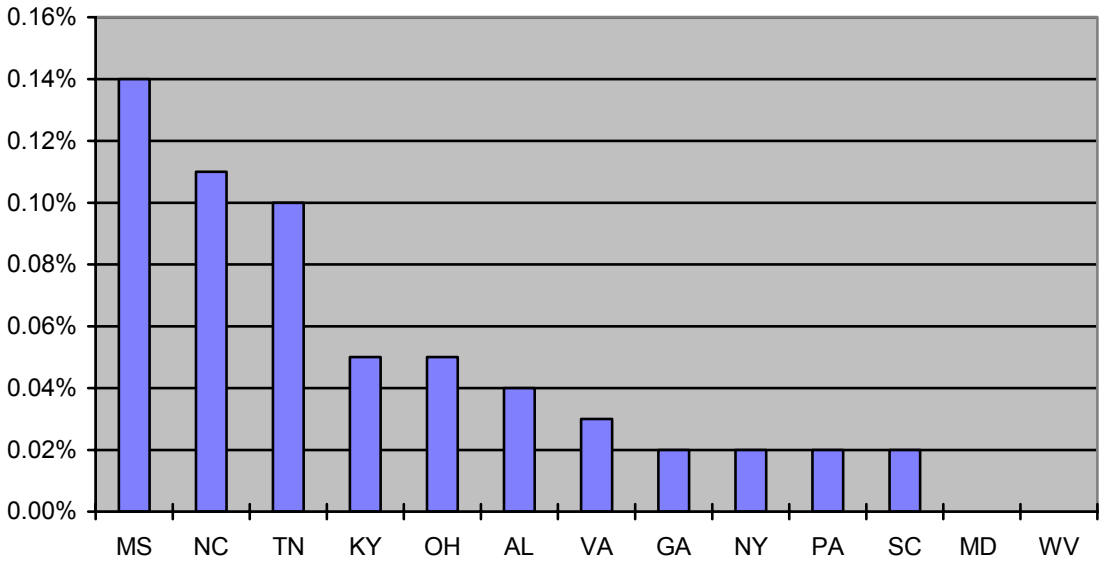
The furniture export intensity for the Appalachian region states is 0.04 percent, just below the national rate of 0.05 percent. The difference describes the gap between the contribution that export sales of furniture and fixtures is making to the regional economy and the contribution it would make if export performance was at the national average. It reveals that as a group, the ARC states are receiving slightly less than average benefit from the export of furniture and fixtures. However, export intensity varies widely between ARC states.

Three ARC states have furniture export intensities well above regional and national averages (see Figure 18). The highest furniture export intensity is in Mississippi—despite recent steep declines still almost three times the regional average. Furniture export intensities for North Carolina and Tennessee also are strong. Moreover, those two states have increased exports, albeit small in percentage terms. Ohio has a furniture export intensity equal to the national average, and Alabama is at the regional average. The eight other ARC states have ratios below both national and regional averages. Maryland and West Virginia, with few furniture exports, have export intensity very close to zero.

To compare export performance over time, ARC states' export intensity can be calculated as an index relative to the national average. The national Export Intensity Index (EII) is always 1.0. Therefore, states where furniture exports make an above average contribution to the economy have an EII greater than one and where exports make a relatively smaller contribution to the state economy, it is less than one. The ARC states combined had a 1995 furniture EII of 0.84, down from 0.88 in 1993.

Figure 18

Furniture Export Intensity 1993-1995



Changes over time in the EII reflect a change in the contribution of that industry's exports to the state or regional economy that is greater (an increasing EII) or less (a decreasing EII) than the national trend. Calculating the EII for individual states allows a state-by-state assessment of exporting performance in the target industry (see Table 38). The ARC states show wide variation in their furniture and fixture EII. Mississippi, North Carolina, and Tennessee have an EII well over 2.0 for furniture and fixtures. At the other extreme, West Virginia has an EII of 0.05.

Kentucky had the largest increase in furniture EII, reflecting strong growth in furniture exports. At the other extreme, a sharp decline in the furniture export intensity index for Mississippi reinforces the absolute and percentage declines in the value of its furniture exports, while the fact that its EII is still above 2.0 signifies the importance of furniture exports to the state's economy. North Carolina and Tennessee show a high and reasonably steady furniture EII, while an increase in the furniture EII for Ohio brought it over 1.0. Alabama, which had a furniture EII above 1.00 in 1993, experienced a steep decline that brought it below the national average.

Table 38
Furniture and Fixture Exports SIC Code 25
National Export Intensity Index, 1993-1995

STATE	1993	1994	1995
Alabama	1.07	0.93	0.70
Georgia	0.45	0.38	0.41
Kentucky	0.88	1.05	1.23
Maryland	0.19	0.19	0.15
Mississippi	3.94	2.96	2.33
North Carolina	2.23	2.38	2.30
New York	0.37	0.30	0.32
Ohio	0.95	1.13	1.17
Pennsylvania	0.55	0.49	0.54
South Carolina	0.61	0.47	0.31
Tennessee	2.27	2.26	2.25
Virginia	0.79	0.65	0.63
West Virginia	0.08	0.03	0.05

Industry Concentrations

Household furniture is the ARC region's largest single employer-sector, with more than 75,000 employees in 1991. Much of the industry is concentrated in two regions. One is centered in Hickory and High Point, North Carolina, just outside of the eastern boundary of Appalachia. But the entire cluster extends well into the ARC region in western North Carolina and eastern Tennessee. The other cluster is in northeast Mississippi and northern Alabama. While the ARC areas of these two states are contiguous, their household furniture manufacturers are not closely linked and do not share services or interact to any extent. Thus, they really comprise two distinct clusters, one in Mississippi and one in Alabama.

In Mississippi, household furniture production is dominated by the upholstered household furniture (Table 39), taking up over 70 percent of the state's total number of furniture establishments. This cluster is the nation's leading center for the production of upholstered furniture. It contains 92 percent of all the upholstered establishments in the ARC cluster.

In Alabama, firms make a more diverse range of household furniture, with about 65 percent of the companies engaged in the production of solid wood and other household furniture products (Table 39). Firms in the ARC counties represent about 86 percent of all the wooden furniture manufacturers in the two states. Alabama's cluster, while not as well known for furniture, ranks fourth in the U.S. in total shipments behind North Carolina, Mississippi, and Tennessee. Furniture production in Alabama and Mississippi employed over 64,000 people in over 500 manufacturing establishments in 1995, according to surveys conducted by each states' official economic development agencies. Approximately 70 percent of the employment in furniture production in Alabama and Mississippi was concentrated in the household furniture sector.

Table 39
Concentration of Furniture Industry in Alabama and Mississippi ,by Products, 1995

	Mississippi		Alabama		Total	
Sector	**# Firms**	**Employ.**	**# Firms**	**# Emp**	**# Firms**	**# Empl.**
2512 Upholstered	107	19,519	30	1,073	137	20,592
2511 Wood	51	5,089	81	5,935	132	11,024
2515 Mattresses	69	12,570	16	496	85	13,066
25/14-29 Other HF	14	2,461	14	1,803	28	4,264
Total Household Fur	241	39,639	141	9,307	382	48,946
Non-HF (office)	77	9,990	64	5,554	141	15,544
All Categories	318	49,629	205	14,861	523	64,490
Percent State/ Total MS + AL	60	75	40	25		

Note: Figures are for entire states, not only ARC counties.
Source: *Annual Survey of Manufacturers, 1995*. Alabama Development Office and Mississippi Department of Economic and Community Development.

Within these two furniture producing states, there are clusters of companies located in a ten-county area centered around Tupelo, Mississippi and a seven-county area centered around Haleyville, Alabama. As Table 40 and the map in Figure 19 indicate, these clusters contains over half of household furniture establishments and half the employment of the total furniture industry in both Alabama and Mississippi combined.

Table 40
Profile of Household Furniture Industry Cluster
ARC Counties of Mississippi and Alabama, 1995

	MS	**MS**	**AL**	**AL**	**Total**	**Total**
	# Firms	# Employed	# Firms	# Employed	# Firms	# Employed
ARC Cluster	122	23,289	76	5,080	198	28,369
State Total	241	39,639	141	9,307	382	48,946
ARC / State	0.50	0.58	0.53	0.54	0.51	0.57

Source: Annual Survey of Manufacturers, ADO and MSDECD, 1995.

Figure 19


FURNITURE MANUFACTURING CLUSTER
MISSISSIPPI/ALABAMA
Number of Establishments
SIC 25, 1995 (>1)

Table 41
Product Concentration within the ARC Furniture Cluster
Alabama and Mississippi, 1995, (Number of Establishments)

Category	Mississippi		Alabama		Total	
	ARC (1)	State	ARC (2)	State	ARC 1+2	MS+AL
Upholstered	94	107	8	30	102	137
Wooden	8	51	51	81	59	132
Total	102	158	59	111	161	269
ARC / State	0.64	0.53	0.60			

Note: (1) Itawamba, Monroe, Chickasaw, Pontotoc, Lee, Union, Tishamingo, Prentiss, Tippah, and Alcorn counties.
(2) Franklin, Marion, Lauderdale, Cullman, Morgan, Winston, and Walker counties.
Source: Annual Survey of Manufacturers, 1995 from the Alabama Development Office and the Mississippi Department of Economic and Community Development.

Table 42
Household Furniture by County and State with the Number of Establishments, Employment and Location Quotient

County	State	Establishments	Employment	Location Quotient
Chicasaw	MS	38	4,796	216.7
Itawamba	MS	7	942	65.8
Lee	MS	26	3,533	35.2
Monroe	MS	14	1,925	59.2
Ponotoc	MS	32	3,183	162.4
Pretiss	MS	12	869	43.7
Tishomongo	MS	10	438	27.5
Franklin	AL	7	33	1.3
Marion	AL	6	293	11.2
Winston	AL	36	2,571	100.5

Origin of clusters

The two furniture clusters grew out of the hard work of early entrepreneurs. Mississippi's industry cluster was born when Morris Futorian, a Russian immigrant living in Chicago, became convinced in the 1940s that upholstered furniture could be made more affordable by mass producing it using the lessons of the automobile industry. Turned away by North Carolina which prided itself on craft production, Futorian found in Mississippi access to raw material, lower cost labor, and a community open to his ideas and willing to raise money for his plant. He opened the doors of his new company in New Albany in 1948.

To this day, mass production methods distinguish Mississippi's upholstered furniture industry from North Carolina's, where more firms use flexible, modular production methods with a team of workers often producing an entire piece. The plant that Futorian started now is part of the Mohasco Corporation and covers over 25 acres. Over time, many of Futorian's employees

acquired a sufficient store of skills and knowledge of the industry—and also some of his entrepreneurial drive—to leave and set up their own shops. Many of the people trained in Futorian's methodology and "apprenticeships" are now the industry leaders in the U.S. upholstered industry based in and around Tupelo—Action Industries, Franklin, and PeopLoungers. They refer to themselves as graduates of the "University of Futorian." Factory spawned factory, and as the cluster grew it attracted other companies producing similar and compatible furniture as well as parts, suppliers, and support services. Community leaders also worked to recruit key suppliers to the area, such as producers of mattresses, frames, and springs and are presently working to attract a fabric company. The state, aiming to diversify, also aggressively has recruited non-upholstered furniture companies such as Krueger International, an office furniture maker that moved to Tupelo in 1963.

In Alabama, the furniture industry in remote Haleyville was a spin-off from the growth and development of the manufactured housing industry concentrated in the area. The mobile home industry got a boost in the early 1960s from entrepreneur Don Tidwell who started his own business to build and assemble mobile homes. By the mid-1970s there were some 50 mobile home plants in the area. Tidwell trained a number of people to operate his numerous plants. Many left to start factories to supply the local industry with furniture and other components. Today those entrepreneurs own and manage some of the leading wooden furniture manufacturing establishments in the area that are known nationally for promotional (low cost) residential furniture—Harden, Quality Dinette, and Caldwell Chair.

The promotional furniture industry has its own trade show and furniture market based in Tupelo. This trade show was started in the early 1980s by local entrepreneurs in the furniture industry who saw a niche for the promotional, lower-priced furniture trade that was not a large component of the High Point market. Today the market is recognized in the industry, is held twice per year, and attracts over 20,000 buyers each year.

Industry Suppliers

The sources of much of the new technology for the industry—the machine builders—are global and easily accessible by U.S. manufacturers. German and Italian companies are the main source of new equipment, and their representatives regularly call on ARC manufacturers. Furniture executives and purchasing managers shop for supplies and equipment at a bi-annual International Woodworking Fair (IWF) held in Atlanta and at numerous regional shows. The IWF attracts worldwide suppliers and buyers. Thus, in the finished furniture trade, U.S. manufacturers do not have to go far to see and purchase new equipment.

Suppliers, however, tend to be local—one of the competitive advantages of these clusters. Many producers of raw materials, panels, veneers, springs and other hardware, foams, fabrics, and finishing materials are nearby and easily accessible. According to Mississippi development officials, the region is home to about 75 percent of the suppliers of its upholstered furniture industry. For example, Tupelo has one of the largest producers of polyurethane foam in the U.S. and serves as a fabric distribution center. While this has been a major advantage, some industry executives are cautious about the upward trend in prices and pressures on the supply of wood based materials.

The ARC Clusters

Description of the survey respondents

Over 160 establishments manufacture household furniture in the ARC clusters in Northeast Mississippi and Northwest, Alabama. The Alabama International Trade Center surveyed 20 companies—ten firms that export and ten firms that do not export. These companies include:

- twelve that make wooden household furniture and eight that make upholstered furniture;
- six exporters in Mississippi and four in Alabama, with the reverse for the non-exporting participants—six in Alabama and four in Mississippi;
- six exporters that are privately owned and four branch plants, eight non-exporters that are privately owned and two branch plants; and
- a mix of industry leaders and small companies (four with more than 500 employees and ten with fewer than 10 employees).

Economic Status

The cluster's future is in a state of flux, corresponding to national trends. Large firms are growing larger, smaller firms are growing rapidly, but firms of all sizes are experiencing downturns in sales and employment. Companies surveyed reported the following trends:

Downward pressure on sales and prices due to sluggish consumer demand and increased competition. Sales had advanced slightly (less than 10 percent) over years previous among a majority of respondents.

- Some upward pressure on wages (less than 10 percent) due to demands for higher skilled workers.
- Exports were up over previous years for those already exporting. Nine of the ten exporters reported an increase in export sales. Exports represented, on average, five to eight percent of overall sales efforts. Half of the exporters had a full time export sales manager.

Competitive Situation

Companies within the cluster were unanimous in believing that in today's competitive economy, they need a combination of all the factors listed in the survey to be successful: design, quality, price, service, customer relations, and delivery. But when forced to choose among them, price and product design (at low cost) were cited as their greatest competitive advantages. Some noted pressures for faster delivery times from consumers and retailers and a move toward out-sourcing.

Comparing adoptions of new technologies and techniques to others in their industry outside of the cluster, executives believe that they are more advanced than the industry on average (in the upper twenty percent), perhaps because they use mass production methods for their less customized products. CNC machinery and other advanced machinery is commonplace in the region's large and mid-sized firms, if not the small firms. Many of the people from firms interviewed travel to woodworking equipment shows in Italy and Germany and regularly attend the International Woodworking Fair in Atlanta.

The single most important obstacle to growth—noted by every respondent—was skilled labor shortages. They cannot use new technologies effectively without skilled employees to operate them. Some firms noted a shortage of workers altogether, regardless of skills. Others were concerned about high labor turnover rates. Workers will move to other local manufactures in the same or related industry within the cluster area for higher pay.

Export Behavior

A *majority* of the firms within Alabama and Mississippi in these ARC clusters produce furniture that is aimed at U.S. promotional markets to attract buyers and build volume sales. Therefore, the product ranks low in the price spectrum. Can such low priced promotional wood and upholstered furniture be exported? Industry analysts and support service staff made several comments that suggest problems in achieving success in overseas markets:

- promotional furniture has an element of being "cheap" while overseas customers are looking for American style furniture that is quality oriented and higher priced and
- upholstered furniture is difficult to export because its bulk makes transportation costs high.

Our findings indicate that these statements are misleading. First, furniture pricing for the U.S. wholesale and retail market does not necessarily mean that products are not of high quality. Many companies interviewed were proud that they offer value to their customers by selling quality furniture at low prices. The survey also revealed an interesting industry practice with respect to quality versus price. The same products sold through promotional channels can also be sold to higher-end markets. But firms making promotional items are unable to enter these markets alone because of high costs of marketing, advertising, and sales promotion needed to establish their own product image and brand. Instead, they sell to higher end markets by cooperating with large U.S. companies that control domestic markets

Second, many of the firms interviewed are already selling promotional furniture overseas. Promotional furniture is exported to Europe and Japan, two regions known as primary markets for upper-end, high-priced goods. Yet two promotional firms were doing well targeting segments of the European and Japanese consumers who want lower-priced, quality-oriented furniture. As in the domestic market, export markets offer opportunity for all types of products sold at different price levels. Further, some companies interviewed are targeting large emerging markets in newly-developed nations that have large numbers of potential consumers at lower income levels. Because of rapid economic growth, upwardly mobile consumers with rising income are able to purchase reasonably priced furniture.

Third, companies that want to export can export. Those that are committed to exporting and have hired a full-time export managers are able to promote and sell their products to foreign customers. Committed exporters also are able to sell upholstered and wooden furniture that is produced fully assembled rather than as "knock-down" furniture for export shipment, despite the higher costs of shipping the products overseas. Some of the larger industry leaders in upholstered furniture have pursued a strategy of international licensing to overcome high transportation costs and tariffs. They ship components to partners overseas that assemble and sell the furniture through its own distribution channels under license.

A majority (80 percent) of respondents agreed that exports are "important" or "very important" to the industry's future. Yet only five respondents had a full-time export sales manager actively seeking out foreign representatives at trade shows abroad. These exporting firms were relatively new at it, with less than five years experience on average. Exports accounted for less than eight percent of total sales on average. The other five exporting firms were "order takers" from contacts that visit the shows in High Point or Tupelo and did not have overseas representatives or distributors.

The more successful exporters employ a full-time export sales manager, travel to overseas trade shows, and seek out foreign based distributors. Exporting firms have learned to adapt their products to foreign standards (flammability laws in UK), customer preferences (firmer seat cushions in Germany), and industry norms (smaller scale furniture in Japan). Perceived obstacles are largely external to the firms. The top two barriers cited were lack of market information and transportation costs. Foreign exchange rate fluctuations and high tariffs rank top among their other concerns.

Most firms had not received export assistance, did not seek out information about exporting or export service providers, and were generally unfamiliar with the availability of export services. This is largely due to the nature of the domestic market—orders are taken at shows where foreign buyers are shopping for the latest American styles. They contend that they get all the international contacts they need at the High Point furniture shows. The exports of many firms interviewed are secured in this reactive, order taking manner. As a result, as Table 43 shows, furniture exports from Mississippi are at the same level in 1995 as in 1990. Alabama doubled its furniture exports over the period 1990-95, but they still are negligible as a percent of sales.

Table 43
Furniture Exports from Mississippi and Alabama, 1990 and 1995, $ in millions

	1990	1995
MS	$ 58	$ 57
AL	$ 15	$ 30
Total	$ 73	$ 87
Percent of U.S. Total HH Furniture Exports	0.09	0.06

Source: U.S. Department of Commerce

The top five markets for furniture exports for in 1995 from Mississippi were Canada, Germany, Saudi Arabia, Israel, UAE, and Japan, and from Alabama, Canada, Mexico, Saudi Arabia, Kuwait, and Japan. The items respondents believed to be most useful to exporters are (1) access to credit for foreign customers, (2) more information on foreign distributors and retailers, and (3) support for attending furniture trade shows abroad.

Service Providers

Ten organizations responded to the ARC survey of support services to the cluster. Most are state supported institutions that provide services for product testing, technical training, and exporting. A majority believe that exporting will be "important" or "very important" to the industry's future. This group noted that:

- the top two competitive advantages of the industry are product design and price;
- the main barriers to exporting are (1) lack of market information, (2) product specifications, transportation costs, and (3) export procedures; and
- to increase exports, owners must be committed, have dedicated export staff and budgets, travel to foreign trade shows, and improve product quality and price.

The research uncovered no significant export initiative in Alabama that exclusively focused on furniture exports. Given the economic development potential of this industry and the potential for export expansion, more could be done. Alabama's Forestry Commission (AFC) has a multi-agency task force called the Forestry TEAM that supports a full-time trade specialist at the AITC to work on export of wood products. A portion of this person's time is devoted to furniture exports and the preparation of an industry wide export directory. The Forestry TEAM devised an economic development strategy which targets the secondary wood industry. These agencies (the Alabama Development Office, Alabama Forestry Commission, Auburn University's Forest Products Development Center, and the Alabama International Trade Center at the University of Alabama) have collaborated to start an advanced woodworking training center at Northwest Shoals Community College near Haleyville, Alabama. It will start operation in January 1997 and focus on worker training for the secondary wood products industry, including furniture.

Despite the specialized services for the industry, there is no specific furniture export initiative in Mississippi. The community college and state university offer technical services that are well-received by industry but not concentrated on furniture SMEs. The official state trade organizations of neither state explicitly targets household furniture. Mississippi's Department of Economic and Community Development and the Alabama Development Office both invite firms to participate in its overseas promotion events and have worked with furniture companies, but that is the extent of their involvement.

Key Services

The Community Development Foundation (CDF), a non- profit, private foundation primarily recruits industry to the Tupelo area but has taken a number of initiatives to support and expand the furniture industry and its suppliers in Tupelo. They have eight staff available to work with companies, offering business management services, problem solving, and special projects such as quality circles to boost the local cluster. CDF was instrumental in getting the Tupelo furniture mart started and they have promoted trade missions for furniture to the Middle East.

Mississippi Department of Economic and Community Development's International Trade Department provides research, trade leads, and overseas promotion for Mississippi companies. The wood products sector is one of its industry targets where they attend foreign trade shows for the lumber industry, The wood product efforts do not include the furniture cluster, but the office

does provide leads and promotion for a number of furniture companies. One state trade official, however, was pessimistic about the prospects for export opportunities for two reasons: the promotional, low priced products and the inability to ship in a "knocked-down" stage. The official contended that firms had to offer higher quality, higher priced goods and make it knocked down in order to compete in overseas markets.

Itawamba Community College offers services specifically geared toward the upholstered companies located within about a l00 mile radius from Tupelo, including a two-year associate degree; training in and demonstrating new technologies, placement services, and diagnostic problem solving. It is well-known nationally and is a member of the Consortium for Manufacturing Competitiveness and Trans-Atlantic Technology and Training Alliance, and could be helpful in making European connections. Given the demand, graduates are placed in local factories immediately. The budget for marketing and promotion is quite small, and the center worked with only 25 firms in 1996—mostly medium to large size companies. SMEs generally either cannot afford or don't yet see the value in the Center's services.

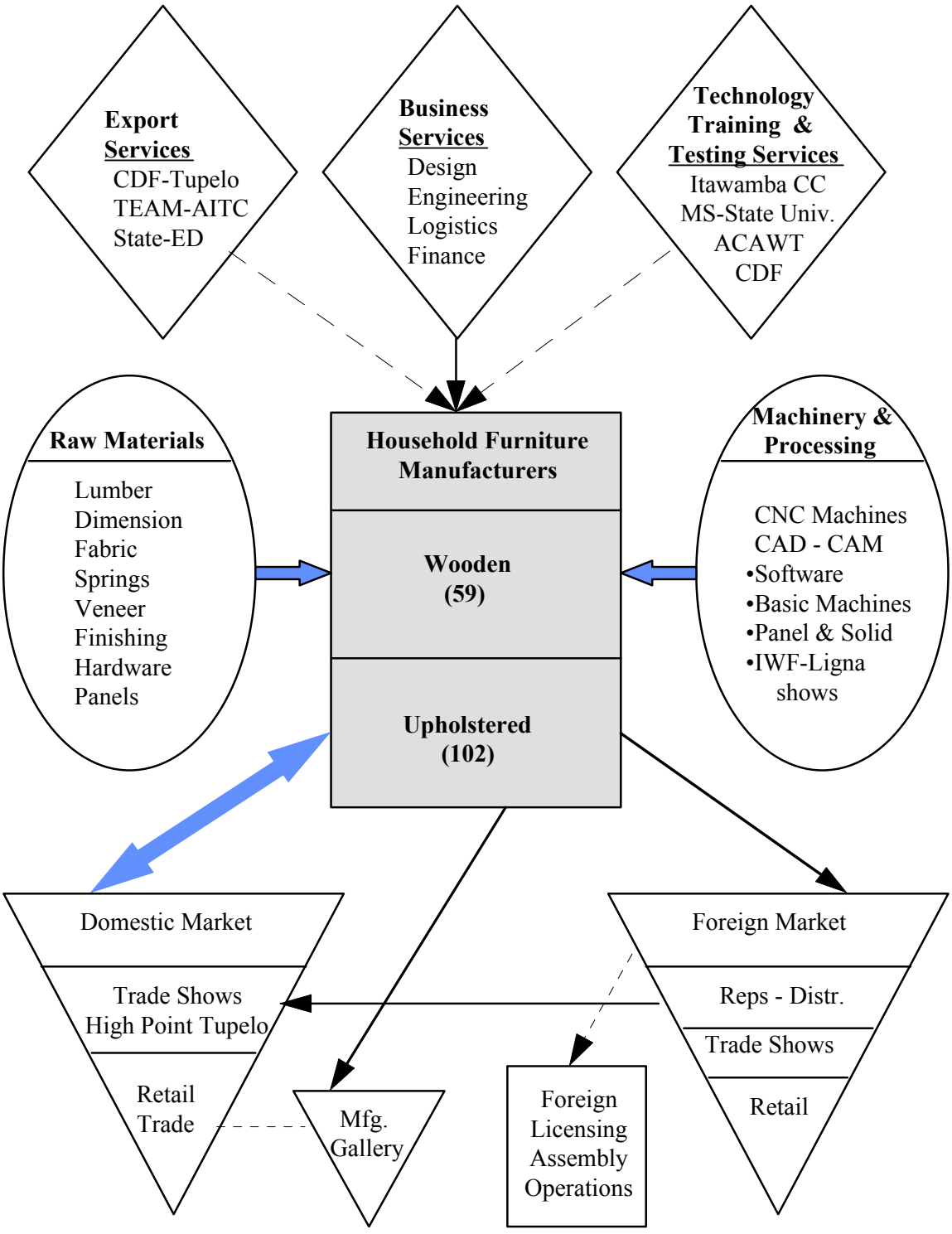
Mississippi State University's Furniture Research Unit is part of the University's Forest Product Laboratory and focuses exclusively on the furniture industry in Mississippi. It operates statewide and provides research, product testing, demonstration technologies and transfer, extension and education, and publications. They have been instrumental in helping firms with competitiveness and productivity, The unit has at least six full-time research and industry oriented staff split their time between teaching, research, and extension activities. Staff members have developed new "furniture" specific software to help firms utilize raw materials and other advanced production methods. While the unit does not offs export services, they have worked on projects with firms to find ways to "knock-down" upholstered furniture. They also worked with the AITC on an ARC sponsored furniture export conference in Tupelo in 1990.

Based on information gathered in the survey, *Hinds Community College's International Trade Center* helped one firm with export procedures and contacts. The *Alabama International Trade Center* at the *University of Alabama* helped two firms with market research, contacts, in-house training, promotion of trade shows, and foreign study tours of factories.

The Alabama Forestry Commission's Forestry TEAM has a furniture specific export initiative for Alabama with two distinct components. One is working with individual furniture companies to provide export research, in-house training, and counseling. This part is done through the AITC at the University of Alabama. Working with the Japan External Trade Organization, it has been successful in helping furniture companies target Japanese markets. The AFC and AITC, in cooperation with the Appalachian Regional Commission, will offer in-house export training programs to 5 to 10 furniture companies during 1996-1998. The second component of the Forestry TEAM is the improvement of the skill levels of work force. Beginning in late 1996, the Alabama Center for Advanced Woodworking Technology, which operates out of the Northwest Shoals Community College, will help furniture manufacturers with training and production technology.

Figure 20

Figure
Household Furniture Cluster in Alabama and Mississippi



Dynamic Factors and Linkages

Companies contend that their location gives them certain advantages—e.g., access to raw materials, lower wage rates, and transportation efficiencies (proximity to major markets). The main disadvantage again was lack of skilled labor and competition for labor within the cluster. About 80 percent of firms surveyed purchased over 75 percent of their raw materials and supplies within a 100-mile radius of their factory. (See Figure 20 for a graphical presentation of the relationship between furniture manufacturers, raw material suppliers, industrial suppliers, business, technical and export services, and the penetration into the domestic and foreign markets.)

The main forum that affords executives the opportunity to meet and talk with peers is the furniture markets in High Point and Tupelo. Most firms belonged to and received benefit from the American Furniture Manufacturers Association (AFMA). Outsourcing, while a growing national trend, was not particularly evident among the group interviewed. Some firms were working through sub-contractors on furniture parts to cut costs and eliminate the need for equipment.

Cooperation among firms was rare and without exception executives felt there was a very low or low level of trust between firms. The reason cited for this was intense competition among producers of similar product lines within the cluster. There were only two concrete examples of cooperation cited. One firm had joined with another non-competitor to quote on a potential export order. Two other firms that are part of a large holding company participated in a worker tour to review equipment. Executives interviewed felt that cooperation would be welcome in technical, problem solving areas, but not in the area of design, marketing and sales. Firms noted that they would cooperate on export sales promotion with non-competing lines. Two organizations in Alabama and Mississippi replied that cooperation would become more common but that there would have to an external stimulus.

Companies Outside the Cluster

Four firms were interviewed that were located outside the heart of the ARC cluster (over 150 miles). There were no noticeable differences among firms in the outlying areas of the cluster in terms of access to suppliers, services, information gaps, export trends, competitiveness issues, and use of technology. The industry is fairly harmonized.

Projections

Export Potential and Growth

This sector is not fully exploiting its potential to grow through exporting. Another downturn in the U.S. market would likely trigger a move to look at exports. Looking for exports when the domestic economy is down is exporting for the wrong reasons. There are two obstacles to overcome before a real shift in export development can occur.

- **The skill levels of the existing work force must be raised**. Companies are using more advanced machinery and production methods, but cite a strong need for skilled workers

trained to run the machinery. This is essential to stay competitive on the domestic market and the export market.

- **More skilled and more committed workers are needed.** More youth have to be encouraged to pursue technical employment opportunities in the industry and more companies have to find ways to reward and involve workers in ways that build loyalty.
- **Firms need to transition from the passive (order-taking) export sales approach which is commonplace to a more aggressive stance**. Companies must hire export specific staff and provide them with a budget to seek out foreign markets, attend trade shows abroad, and identify and establish distribution networks.

Employment growth will not likely come in this industry from the domestic market. Employment in the ARC region within the furniture sector can expand, however, if something is done to remedy both the skill levels of workers and the export capability of the firms to aggressively pursue trade abroad. The potential exists and the ARC can play a role in stimulating that development.

Suggestions

The industry is ripe for cooperation and networking. ARC pilot initiatives in the two areas of export development and worker training would be well-received by the industry. The survey highlighted several facts that support this statement.

- The firms were not proactive exporters now, but see it as a future opportunity. The firms that had full-time export managers were doing better than those that did not have one.
- The firms were not cooperative now evidenced by the low level of trust, but they would be willing to do so in the areas of technical support and export development among non-competing firms.
- The industry has several "export" advantages including close access to wood based raw materials and other components, a growing reputation overseas for quality craftsmanship in furniture, an abundance of product design and production capabilities, and a large number of firms that are flexible enough to introduce new product lines twice per year at the domestic trade shows.
- Lack of skilled workers and the need for training on advanced manufacturing equipment and accompanying production systems was a barrier to growth.
- Export promotion which provides more market information, foreign product specifications, and access to foreign trade shows was a primary need. Mississippi and Alabama firms share common export market destinations for their products, making cooperation more likely for overseas shows.

The ARC can play a role in stimulating the development of worker training and export development. Companies within the cluster were independent minded, but looked to industry shows and associations for the leadership. Programs which would help stimulate the formation of industry-led initiatives would be more likely to succeed.

- Strengthen worker training programs that currently exist at the community college and University level in Alabama and Mississippi. Tie funding to participation among groups of non-competing furniture lines.

- Provide training for increasing the internal export commitment of furniture manufacturers including training of management, sales, and order processing staff on export procedures. Help companies set up export sales departments. There is a lack of knowledge about how to export within the firms, what assistance is available, and how to utilize it.
- Evaluate the need, feasibility, and cost for a major, regional export promotion service at the industry level that links the association (American Furniture Manufacturer's Association) to various programs at the federal, state and local level.
- Based on the outcome of the feasibility study, start a small, trial program which combines the resources and interests of organizations in the lead furniture producing cluster areas of Appalachia including North Carolina, Mississippi, and Alabama. This effort should include a number of new program elements and carefully delineated roles among organizations within the region.

  - **Grant support for participation in overseas furniture trade shows**. Funding should help defray the cost of booth space, not overseas travel. Link the funding to conditions that 2-3 firms cooperate in sharing a booth space.

  - **Conduct new market research** which profiles overseas furniture markets distributor profiles, product specifications, and retailing trends. The research should be readily usable to generate sales not dust on a shelf.

  - **Target and promote the use of existing export financing programs** specifically to furniture companies that have export potential. Existing programs at EXIM, SBA, the state, and the private banking sector for working capital, export receivables financing, export credit insurance, and other related programs such as linked-deposits. These programs were relatively unknown to the furniture companies surveyed within the cluster.

A model for such an industry wide effort exists within the hardwood lumber industry in the United States. This industry is highly competitive in nature and is a "commodity" type product. The industry associations cooperate and are funded in part by the U.S. Department of Agriculture's Foreign Agricultural Service. Programs include overseas offices, export research, working on product specifications in foreign markets, training of and hosting foreign buyers, organizing foreign industry tours, and other product specific export promotion.

Appendix C
Industry Analysis: Household Furniture

The study team examined the export performance and potential of SIC 251, household furniture, using information from the Department of Commerce's Country Commercial Guides for the listed countries, the International Trade Commissions document U.S. Trade Shifts in Selected Commodity Areas, and interviews with industry experts and U.S. manufacturers. Some of the export data, particularly statistics to Latin America may be distorted because of direct sales and shipments to customers that are not counted in the statistical data. Statistical accuracy and comparability to other sources are affected by a number of factors, including lack of published figures in certain markets, variances in data collection techniques, sources of data, and industry definitions.

The United States is a net importer of furniture, with export values less than 25 percent of import values. As Table C-1 shows, more than half of U.S. furniture exports are shipped to the NAFTA countries; Canada and Mexico. A reduction and elimination of tariffs due to the NAFTA treaty, and the relatively inexpensive shipping costs make Canada and Mexico strong markets for most types of household furniture. In the European Union and the Middle East the successful markets for U.S. furniture are high end, stylized, and branded furniture, although producers of promotional furniture are beginning to make inroads, too.

Table C-1
Growth of sector over time, foreign and domestic Exports, F.A.S.; $ millions

	NAFTA	Other Central America	East Asia NICs	EU - 15	Middle East	South America	Former Soviet Republics	Central & Eastern Europe	World Total
1993	$693	$65	$35	$116	$118	$47	$19	$1	$ 1,183
1994	$744	$67	$72	$111	$120	$58	$13	$2	$ 1,307
1995	$704	$81	$80	$112	$107	$76	$11	$1	$ 1,320

U.S. Total Exports, 1995 by Area and Three-digit SIC Product Groups; (Census Basis; foreign and domestic Exports, F.A.S.; $ millions.

Furniture exports are expected to remain fairly constant over the next five years, increasing three to five percent in dollar sales. The majority of furniture exports are miscellaneous wood products, accounting for 28% of total furniture exports in 1995. The primary markets for household furniture include NAFTA countries, Europe, and the Middle-East. South America is emerging as an importer of furniture as trade barriers are lowered and disposable income increases. The following data combine growth and value figures to determine the best long-term export markets. As Table C-2 shows the best potential markets for U.S. exporters are Canada, Japan, Mexico, Saudi Arabia, and Germany.

Table C-2
U.S. Domestic Exports, F.A.S. $ thousand

	Canada	Japan	Mexico	Saudi Arabia
1993	$ 566,115	$ 52,671	$ 127,586	$ 79,455
1994	$ 564,342	$ 79,091	$ 179,631	$ 75,578
1995	$ 627,133	$ 93,331	$ 76,954	$ 56,976
1995-1993	$ 61,018	$ 40,660	$ (50,632)	$ (22,479)
% change	11%	77%	-40%	-28%

Germany	Brazil	Singapore		Colombia
$27,177	$ 6,537	$ 4,535	$ 13,660	$ 8,516
$ 21,966	$ 10,392	$ 24,056	$ 14,762	$ 10,399
$ 25,298	$ 24,051	$ 18,465	$ 16,645	$ 14,122
$(1,879)	$ 17,514	$ 13,930	$ 2,985	$ 5,606
-7%	268%	307%	22%	66%

U.S. Department of Commerce; Office of Consumer Goods, U.S. Domestic Exports.

Country Analysis

Canada: As Table C-3 shows, Canada has a steadily increasing market in furniture. There was a slow-down of purchases in 1993 and 1994 due to the recession, but the consumer purchasing indicators are showing a resurgence of the economy. Currently, housing starts are up, consumer confidence is growing, and interest rates are at a long time low. These events should increase the market for furniture in Canada and thus, U.S. furniture sales to Canada.

Table C-3
U.S. Exports to Canada, 1993-1995, $ in thousands

1993	1994	1995	Change, 1994-1993	Change, 1995-1994	% Change, 1993-1994	% Change, 1994-1995
$566,115	$564,342	$627,133	($1,773)	$62,791	-0.03%	11%

U.S. Department of Commerce; Office of Consumer Goods, U.S. Domestic Exports, F.A.S. $ thousand

Japan: As Table C-4 shows Japan imports approximately 8.5 % of its furniture, including office and home furnishings. The U. S. supplies 12 % of those imports, or 1 % of Japan's total market share. Household furniture accounts for approximately 60-70 % of the entire market. The market for U.S. furniture in Japan is expected to increase steadily due to the growing reputation for quality and style of U.S. furniture and the appreciation of the yen. Increased tourism to the United States has increased Japanese knowledge and appreciation of western-style furnishings. The two primary areas of growth in Japan are high-end quality furniture and contracted furniture.

Table C-4
Japan: Current and Projected Market, $ in millions

	1995	1996	
Total Market Size	$ 2,699	$ 2,610	$ 2,628
Total Local Production	$ 2,506	$ 2,380	$ 2,356
Total Exports	$ 37	$ 34	$ 32
Total Imports	$ 230	$ 265	$ 304
Imports from the U.S.	$ 28	$ 28	$ 29
U. S. Market Share	1%	1%	1%

Japan: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, U.S. Department of Commerce.

Mexico: U.S. exports to Mexico decreased dramatically in 1995 due to the Peso crisis, as shown by Table C-5. With the devaluation of the peso, U.S. made furniture prices rose considerably, and thus were priced significantly higher than domestic brands. In addition, Mexican furniture manufacturers are increasing their efforts to both improve their Mexican market share, and gain market share in the United States. As Mexican producers focus on the low- and mid-priced segments, the best markets in Mexico for household furniture are the higher end markets where brand names and styling override price.

Table C-5
Exports to Mexico, 1990-1995, $ in millions

	1990	1991	1992	1993	1994	
Value of Exp	$69,761	$98,508	$125,673	$127,586	$179,631	$76,954
Value change		$28,747	$27,165	$1,913	$52,045	($102,677)
% change		41%	28%	2%	41%	-57%

U.S. Department of Commerce; Office of Consumer Goods, U.S. Domestic Exports

Saudi Arabia: As Table C-6 shows, Saudi Arabia is the largest furniture market in the Middle East, with the majority of demand on high-end products for consumption by upper-middle and high income Saudis and expatriates, and younger Saudis who find U.S. products fashionable. Household furniture is approximately 60% of the market, and is expected to grow 3-4% annually over the next three years. The United States is well on its way to overtaking Italy in the Saudi Arabian market. Some of the factors included in this market shift are: the increasing prestige of U.S. products, the perceived quality of U.S. furniture, particularly brand name furniture, and competitive pricing due, in part, to favorable exchange rates with the Lira.

Table C-6
Saudi Arabia: Current and Projected Market, $ in millions

	1995	1996	1997
Total Market Size	$ 395	$ 406	$ 420
Total Local Production	$ 40	$ 42	$ 44
Total Exports	$ 16	$ 17	$ 18
Total Imports	$ 371	$ 381	$ 394
Imports from the U.S.	$ 78	$ 82	$ 86
U. S. Market Share	20%	20%	20%

Saudi Arabia: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, U.S. Department of Commerce.

Germany: Germany, like the rest of the European Union (EU), is largely self-sufficient in furniture, as shown by Table C-7. Its major trading partners are other EU countries. Imports of U.S furniture are steadily increasing, due to the increased reputation of U.S. furniture. The best prospects for this market are in high-end furniture.

Table C-7
Exports to Germany, 1990-1995, $ in millions

	1990	1991	1992	1993	1994	1995
	$16,187	$20,697	$22,948	$27,177	$21,966	$25,298
Value change		$4,510	$2,251	$4,229	($5,211)	$3,332
% change		28%	11%	18%	-19%	15%

U.S. Department of Commerce; Office of Consumer Goods, U.S. Domestic Exports

Summary

The U.S. furniture export market is highly developed with Canada and Mexico, and moderately developed in Europe and the Middle East, but is underdeveloped in Latin America and Asia. The best prospects for the overseas markets are high end branded furniture. Overall the furniture market is growing slowly for three primary reasons:

- the U.S. furniture manufacturers have focused so intensely on the U.S. market that they have not seriously explored export markets;
- the U.S. has a distinctive style that has only recently begun to be demanded by the rest of the world;
- furniture is a heavy, labor intensive product that is made by many countries, so imported furniture is often not price competitive with domestic production; and
- promotional furniture has growth potential in export markets as well. Producers of promotional furniture can follow the lead of high end exporters to build their own sales networks abroad.

NOTE: Projected figures for 1996, 1997, and 1998 are estimates made by U.S. embassy officials in the respective countries. The country by country industry analysis may differ in exact composition from the selected SIC code. The general category contains approximately the same products.

KNITTING MILLS IN NORTH CAROLINA, TENNESSEE, AND VIRGINIA *COMMITTED TO COOPERATION*

by Cynthia Liston
Regional Technology Strategies, Inc.

Preface

Knitting mills remain one of Appalachia's most stable and most mature industries, employing more than 50,000 people in more than 450 companies. Although that number is declining as a result of automation and intensified import competition, it still ranks fifth among Appalachia's top 50 sectors and is home to 28 percent of the nation's total jobs in that sector. Historically, the businesses, which have competed mainly on the basis of cost, have been drawn South by the lower wages and surplus and non-union labor. The sector has not been large exporters; in 1991, only 2.4 percent of the sector's output was exported, placing it 39th among Appalachia's top 50 sectors.

That situation may be changing. A small number of consolidated retail outlets now virtually control domestic markets and are able to force manufacturers to produce and quickly deliver smaller batches at lower costs—and take back unsold merchandise. As s result of these tight domestic markets, more aggressive small and mid-sized firms are looking for new outlets for their merchandise overseas where retailers are still more independent and numerous. Some hosiery firms are also banding together in networks to give them more leverage with customers and reduce their market development costs. A study tour of northern Italy's knitwear industry in spring of 1996 by a group of industry representatives demonstrated the potential for exports among even small firms, and the importance of more immediate access to advances in technology, vis à vis with machine builders, and the value of cooperative efforts.

General Industry Description

National Overview

Knitting mill production nationwide has increased significantly since the mid 1980s, while wage growth has been moderate and employment growth has been very low.

Table 44
Knitting Mills in the United States, 1986-1994

	1986	1988	1990	1992	1994	% chg, 86-94
Value of Shipments (10^6)	$12,203	$13,224	$14,597	$16,968	$19,128	57
Employees	189,900	197,400	197,900	193,200	194,400	2
Average Wage/Hour	$6.45	$6.96	$7.16	$7.74	$8.36	30

Source: *Annual Survey of Manufacturers*, U.S. Bureau of the Census.

As the Table 44 shows, while the value of shipments from knitting mills nationwide increased 57 percent from 1986 to 1994 (not adjusted for inflation), employment fluctuated with the economy—growing in the late 80s, declining during the early 90s recession and rebounding slightly more recently. The overall job growth was an anemic two percent during the period. Production wages experienced moderate growth of 30 percent over the eight year period.

The ARC target industry SIC 225, knitting mills, comprises (1) integrated mills that purchase the input materials for knitted goods and then manufacture and sell those goods; (2) contract mills that manufacture knit goods using input materials owned by the contractor; and (3) jobbers who purchase input materials, contract with mills to produce knit goods from the material, and sell the product. Knitting mill products include hosiery, socks and gloves; knit outerwear, underwear and nightwear; fabrics, and other knit articles. (*Standard Industrial Classification Manual*; Executive Office of the President, Office of Management and Budget, 1987.) The knitting mill industry is part of SIC major industry 22, textile mill products, which also includes woven material producers, dyeing and finishing, carpets and rugs, yarn and thread mills, and miscellaneous textiles such as rubberized and coated fabrics, cords and twine.

Components of the Knitting Mill Industry

The following is a brief discussion of the primary sectors that comprise the knitting mill industry and recent trends affecting their growth and competitiveness.

Hosiery and Knit Underwear: The hosiery and knit underwear sectors mostly produce standardized products that require little or no additional sewing. These include brand-name socks, pantyhose and tights such as Hanes, Fruit of the Loom and L'Eggs as well as generic brands sold by discount retailers. Firms producing women's pantyhose and knit underwear have rapidly consolidated in recent years. More than 70 percent of women's pantyhose were produced by the nation's eight largest producers in 1987, up from about 40 percent in 1967. For knit underwear, the largest eight firms produced slightly more than 80 percent in 1987, up from about 55 percent in 1967.[25]

Other hosiery firms (i.e., socks and tights producers) have not experienced this same consolidation. In 1987, only about 35 percent of total production came from the industry's eight largest firms, up from about 31 percent in 1967. For those products, manufacturers are still best

characterized as small, frequently rural firms. Yet there are signs that consolidation is beginning to occur among sock producers as well.

Like other components of the textile industry, U.S. hosiery and knit underwear producers have experienced tremendous productivity increases since 1960 with women's hosiery ranking fourth among 450 manufacturing sectors in productivity growth between 1960-89, and other hosiery producers ranking 52nd.[26] Increasing wages and almost zero job growth, as indicated in Table 1, have accompanied the rise in productivity.

Knit Fabric Trends: The major supplier of fabric for knit apparel producers come from the knit fabric sector. These companies produce knit fabric by looping yarn into a series of interconnected loops, rather than interlacing strands of yarn as when fabric is woven. The knit fabric sector had 669 establishments in 1992 and employed almost 42,000 workers in 1994. The industry grew tremendously in the 1970s when knit clothing such as leisure suits came into vogue. After years of shrinking markets, the industry is once again experiencing market growth due to the rising popularity of active wear.

Like the hosiery and knit underwear sectors, knit fabric producers have achieved significant productivity increases since 1960, ranking 36th among the 450 manufacturing sectors in productivity growth. The sector is highly automated; labor costs were on average 16 percent of unit costs in 1989, about the average for manufacturers. The knit fabric industry is quite concentrated with the largest eight firms producing more than half of the US output.

Knit Outerwear: Knit outerwear in many ways shares more in common with what is traditionally called the apparel industry than other knit products because its production involves more labor-intensive cutting and sewing, processes which are still typically manual. The apparel industry is made up of primarily small and medium-sized firms (fewer than 500 employees), many of which are subcontractors to clothing labels such as Liz Claiborne or the Gap. Productivity rises have been less evident among knit outerwear firms compared to other knitting sectors. Therefore, competitive issues such as moving from inefficient bundle production systems to modular manufacturing systems which speed up the manufacturing process and reduce inventory costs are critical to these companies.

Industry-Wide Competitiveness Issues

The general productivity rises among knitting mills stand in contrast to the apparel industry (SIC 23) which, because it is more labor-intensive, has lost a considerable share of the domestic market to foreign competitors. This is evidenced by a comparison of industry ratios of the dollar value of domestically produced shipments (including exports) to the dollar value of domestic consumption. For the entire textile industry (SIC 22), this ratio remained close to 100 percent between 1960 and 1990, meaning that US textile production remained approximately equally competitive with foreign production. For the apparel industry, however, the ratio declined from 98 percent in 1961 to 66 percent in 1990. [27]

It is important to note, however, that these measures do not take into account the impact quotas and tariffs have had in restraining imports. Therefore, as the full ramifications from NAFTA and the ten year phase out of textile quotas take effect, the challenges for the industry will be serious. This is in part because US duty reductions will be much greater for hosiery and underwear than

for most other types of clothing, and because knit apparel producers who move to lower labor cost regions will be more likely to buy foreign knit fabric from those same regions.

Also, even though knit production is less labor-intensive than many other sectors of the textile and apparel industry, labor content is still a significant component of production costs, putting high-wage countries such as the US at a disadvantage. In addition, the knitting process is technologically basic (as opposed to specialized) and overhead is relatively low (in the US, entrepreneurs have been known to start their companies with one or two knitting machines in a home garage). These low barriers to entry combine to give some significant competitive advantages to places such as Mexico or Asian nations where textile and apparel production is on the rise.

In response, many analysts forecast that in order to thrive US knit producers need to capitalize on their competitive advantages: proximity, quality and design. The market issues section below will discuss these in further detail.

Productivity increases in knitting mills have been fueled by new knitting machines that are much faster than previous machinery. According to the National Association of Hosiery Manufacturers, labor content for hosiery companies, for example, typically ranges between 18 to 24 percent of product value. While older knitting machinery was made in the US and Great Britain, today almost all machines come from Italy, Eastern Europe (particularly Czechoslovakia) and less often Japan. In fact, the last US manufacturer of knitting machinery—Crawford—went out of business last year. New machines are computerized and driven by electronics, requiring different skills from technicians used to maintaining mechanical equipment.

Many believe a byproduct of the overall rise of productivity among knitting mills has been overcapacity in the industry. This has led to intense competition and declining prices. Inefficient companies and those unwilling to adapt to changes in the market are struggling. For example, in the summer of 1995 three long-time hosiery companies in North Carolina—each employing more than 400 workers—were in the news: one closed, another filed for Chapter 11 bankruptcy, and the third announced it was unable to meets payroll.

Newer equipment is expensive—up to $50,000 for a single knitting machine. High investments inhibit the kind of entrepreneurism that existed for many years as enterprising operators and technicians purchased surplus equipment that cost a fraction of what it does today and set up their own shops. Today, the high costs of equipment necessary to compete make entrepreneurship much riskier and more difficult.

Despite new equipment that has been widely adopted by large and some smaller knitting manufacturers, many small knitting mills still successfully use older equipment, often times tweaking such machinery to enhance its capabilities and improve its efficiency. However, greater production capabilities across the board have driven prices down and changed the dynamics of the market.

Market Issues

As mentioned, the essential competitive advantages on which American knitting mills depend are proximity, quality and design. Proximity refers to the advantage producers have in the U.S. market, whereas, quality and design refer to advantages in both domestic and international markets.

Proximity: "Quick Response (QR)" manufacturing is being adopted by the most advanced apparel and textile companies as a way to build stronger relationships and better market positions with retailers. Succinctly, QR means the rapid translation of consumer purchasing information from retailers to manufacturers and their suppliers. Inventory is "pulled" rather than "pushed" through the production pipeline. For example, as soon as a shirt is purchased, data about size and style is passed down to manufacturers and suppliers so that popular choices are replenished quickly and unpopular styles are not over-produced. In addition to quickly replenishing stock, QR enables companies to offer a wider choice of styles, reduce inventory levels (and thereby costs), and better anticipate future demand (increasing markets).[28]

QR requires close cooperation and trust between retailers, manufacturers and their key suppliers (particularly yarn producers) because companies must exchange potentially sensitive information, such as pricing data, on an almost daily basis. It also requires sophisticated communication networking including, but not limited to, Electronic Data Interchange. U.S. firms are much better positioned to take part in QR networks than foreign competitors who are more distant (textiles shipped from Asia typically two to three months to arrive) and harder to connect to the U.S. market.

Quality and Design: U.S. knitting mills have the reputation for producing high quality products that have appeal to both domestic and international markets. While occasionally modifications in design are necessary for exporting, many customers in Japan, Canada and European countries seek the casual "American look" meaning firms need no more than change packaging to export. According to officials at the International Trade Administration, knit products that are high quality, are medium to high end products and exhibit a strong design component are the strongest performers in export markets. As the following export trend analysis shows, overall US textile exports have performed well since 1993.

Export Trends

In 1995, textile mill products accounted for 1.1 percent of the value of manufactured products exported from the United States and 2.7 percent of the value of manufactured exports from the ARC states. (SIC 22 data is used in this analysis. Unless otherwise noted, the textile industry analysis, like the export analysis in Chapter 1, uses the MISER export data, as provided in the National Trade Data Base, for the years 1993 through 1995.) The higher proportion for the region reflects the fact that Appalachian Regional Commission member states are a major source of United States textile exports. Between 1993 and 1995 US textile exports grew by just over a billion dollars, from $5.07 billion to $6.12 billion. At the same time, exports from ARC member states rose from $3.29 billion to $3.92 billion, an increase of some $630 million. The value of recent textile mill product exports are presented in Table 45. The increased sales represent a

20.6 percent increase for the United States, and a 19.2 percent increase for the combined ARC member states.

Table 45
Value of Textile Mill (SIC Code 22) Exports, 1993-1995 (millions of $)

Area	1993	1994	1995	1993-1995 Change
ARC States	$3,290.5	$3,591.5	$3,922.0	$631.5
United States	$5,071.7	$5,536.6	$6,115.1	$1,043.4

In 1993-95, the 13 ARC states accounted for almost two of every three dollars in export sales from US textile mills. Textiles is the only industry targeted by this project with export sales so dominated by ARC member states. The slower rate of growth in textile exports from the ARC states has not changed this dominance (see Figure 21).

Figure 21

Both the textile industry and textile exporting are most concentrated in the southeastern ARC states. The highest dollar value of textile exports in 1993 originated in Georgia and in 1994 and 1995, in North Carolina. Table 46 lists 1993 through 1995 values of textile exports attributed to each ARC member state, and the changes that occurred during that interval. Textile exports have been volatile. Changes range from an increase of over $400 million in North Carolina to decreases of $60 million and more in New York and Georgia.

Absolute numbers tell part of the story, but the impact of a given increase or decrease in export sales depends in part upon the amount of export activity. Calculating the rate of change helps put the movement in perspective. The rate of change in textile exports for the ARC states, depicted in Figure 22, reinforces the strong position of North Carolina and confirms the volatility suggested by the absolute numbers. It also shows the most dramatic textile export growth in Mississippi, which experienced a 95 percent increase. Textile exports from both Virginia and

West Virginia increased by 67 percent from 1993 to 1995. In contrast, New York, Georgia, and Ohio saw the value of their textile exports decline.

Figure 22

Percent Change in Textile Exports 1993-95

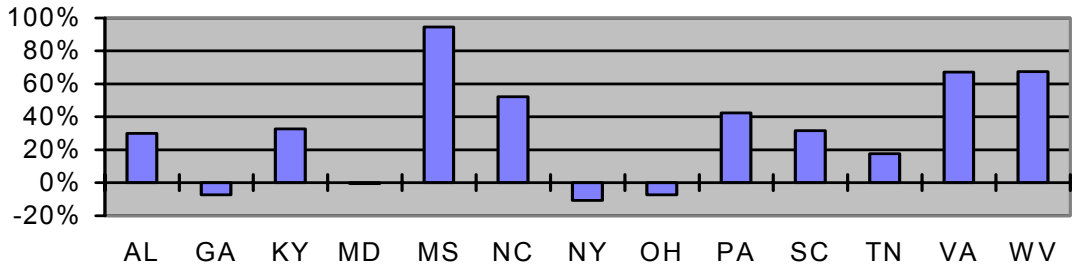


Table 46
Value of Textile Mill Exports by ARC State, 1993-1995 (millions of $)

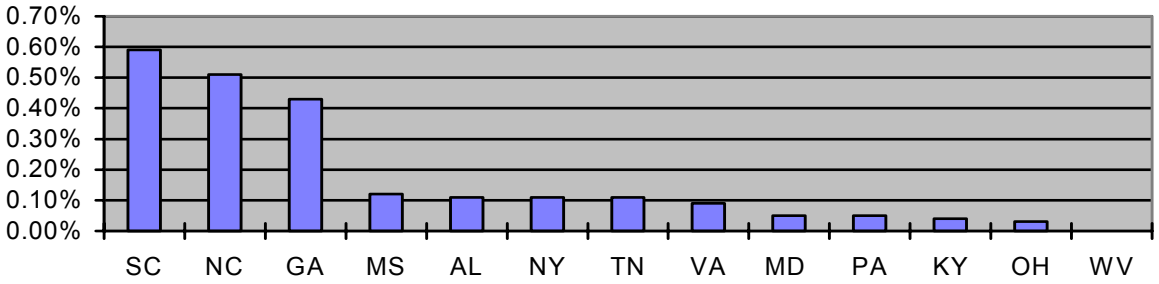
Area	1993	1994	1995	'93-'95 Change
Alabama	$84.6	$92.3	$109.9	$25.3
Georgia	$809.8	$774.8	$749.8	$(60.0)
Kentucky	$31.2	$41.4	$41.4	$10.2
Maryland	$63.9	$88.7	$63.6	$(0.3)
Mississippi	$40.3	$67.1	$78.3	$38.0
North Carolina	$768.7	$919.3	$1,170.2	$401.5
New York	$613.2	$587.2	$547.7	$(65.6)
Ohio	$96.8	$95.5	$89.9	$(7.0)
Pennsylvania	$120.9	$141.3	$172.2	$51.3
South Carolina	$416.1	$477.6	$547.8	$131.7
Tennessee	$118.2	$147.3	$139.0	$20.8
Virginia	$124.8	$156.9	$208.8	$84.0
West Virginia	$2.1	$2.1	$3.5	$1.4

Export Intensity

Another way to accommodate size differences and facilitate comparisons among the ARC states to calculate the value of textile exports as a percentage of the gross state product (GSP). That ratio measures the contribution that textile exports make to the state economy. It is the target industry counterpart of the state export intensity. Figure 23 ranks the ARC states by their 1993-95 textile export intensity.

Figure 23

Textile Export Intensity
1993-95



The textile export intensity for the combined Appalachian Region states is 0.16 percent, which twice the ratio for the nation as a whole, 0.08 percent. That difference describes the additional contribution that export sales of textile mill products are making to the regional economy compared to the contribution it would make if export performance was at the national average.

Within the region, textile export intensity varies widely. The variation by state shows a clear geographic concentration in three contiguous states, North and South Carolina and Georgia, which are the only ARC states with a textile intensity index above the multi-state average. The next highest state export intensity is less than one-fourth the ratio for any of those three. Mississippi, Alabama, New York, Tennessee, and Virginia all have textile export intensities that are below the ARC average but above the national average. The remaining five ARC states are below the national average.

To facilitate comparisons over time of ARC states' textile export performance with that of the nation, export intensity can be calculated as an index relative to the national average. The resulting number is the export intensity index (EII) for the target industry. The national EII is always one, and states where textile exports make an above average contribution to the economy have an textile EII greater than one. Conversely if textile exports make a relatively small contribution to the state economy, the EII is less than one. The textile EII reveals that textile exports make a relatively large contribution to the state economy in eight of the 13 ARC states (see Table 47).

Table 47
Textile Mill Products Export Intensity Index, 1993-1995

Area	1993	1994	1995
Alabama	1.27	1.27	1.38
Georgia	6.09	5.34	4.61
Kentucky	0.49	0.60	0.54
Maryland	0.66	0.84	0.55
Mississippi	1.03	1.58	1.67
North Carolina	5.61	6.14	7.01
New York	1.50	1.32	1.14
Ohio	0.47	0.43	0.37
Pennsylvania	0.55	0.59	0.65
South Carolina	7.00	7.36	7.62
Tennessee	1.26	1.44	1.22
Virginia	0.96	1.11	1.34
West Virginia	0.08	0.07	0.11

Changes over time in the textile EII reflect a change in the contribution of textile exports to the state economy that is greater (an increasing EII) or less (a decreasing EII) than the national trend. For the aggregated ARC states, the textile EII is essentially stable, just below two or almost twice the national average. However, most ARC member states increased their textile export intensity between 1993 and 1995, and it appears that textile exports represent a regional strength. In the Carolinas, the contribution of textile export sales to gross state product is more than seven times the national average and increasing. In Georgia, the third ARC state with a very high EII, however, the EII is dropping, reflecting the decline in textile exports from Georgia. Alabama, Mississippi, Virginia, and to a lesser extent Pennsylvania exhibit strong increases in their textile EII.

Appalachian Locational Patterns

Textile mills (SIC 22) exist in almost every state; however, the South employs by far the largest share of textile workers. The industry is largely rural: in more than 60 percent of nonmetro counties in Alabama, Georgia, North Carolina, South Carolina, and Tennessee, at least 10 percent of overall employment was in the textile or apparel industry in 1987. Of the five "core" states for apparel and textile production—Alabama, Georgia, North Carolina, South Carolina and Virginia—these industries employ eight percent of private non-farm employment and 30 percent of manufacturing employment. Knitting mills employ 15.6 percent of all textile and apparel workers in these same states.[29]

Within the ARC region, two significant knitting mill clusters emerged from analysis of employment, establishments and location quotients at the county level. The first cluster is on the eastern edge of the ARC region in North Carolina, spilling over to southwestern Virginia and northeastern Tennessee. The second cluster is in the area where the Alabama, Tennessee and Georgia borders meet. The hub of this cluster is Ft. Payne, Alabama. RTS chose to analyze the

North Carolina/Virginia /Tennessee area as the primary cluster for this project because it employs more people (19,920 versus 6,400), has a large number of SMEs (132), and plays a more important role in the regional economy.

The balance of knitting mills in Appalachia are scattered. Small concentrations are located in parts of New York (Schoharie county) and Pennsylvania (Schuylkill county).

The North Carolina/Virginia/Tennessee Knitting Mill Cluster

Within the ARC region's North Carolina (including adjacent counties in Southwestern Virginia and Eastern Tennessee) knitting mill cluster, there are 132 knitting establishments that employ almost 20,000 people, according to Dun and Bradstreet data. Table 48 classifies these establishments by size and Table 49 classifies them by their primary four-digit SIC code. As evident, knitting mills encompass both final product apparel producers and firms who produce fabric for use by other manufacturers.

The table 49 shows that the preponderance of knitting mill establishments in the cluster are hosiery firms. The hosiery sector (women's hosiery, except socks plus other hosiery) together represents 55 percent of the cluster's employment and 88 establishments. The second largest category is knit outerwear with 26 percent of the cluster's employment and 25 establishments. Knit underwear (primarily three large Sara Lee plants) follows with 9 percent of employment; knit fabrics combine for six percent, and knitting mills, not elsewhere classified, represent about four percent of employment.

Table 48
Companies in Primary Cluster, by Number of Employees

# of Employees	# of Companies
>500	17
250 - 499	12
85 - 249	15
45 - 84	13
15 - 44	33
<15	51

Table 49
ARC North Carolina/Virginia/Tennessee Knitting Mill Cluster

Primary SIC Classifications	Number of firms	Employees	Share of Cluster Employment	Average # of Employees per firm
Women's hosiery, except socks	22	4,921	25%	224
Other Hosiery	66	5,955	30%	90
Knit outerwear mills	25	5109	26%	204
Knit underwear mills	5	1,725	9%	345
Weft knit fabric mills	8	1,109	6%	139
Lace and warp knit fabrics mills	2	385	2%	193
Knitting mills, n.e.c.	4	723	4%	181
TOTAL	132	19,920	100%	151

Source: Dun and Bradstreet

It is not surprising that the hosiery industry figures so prominently in the cluster. In 1994, North Carolina's 360 producers produced 56 percent of the US output of hosiery, accounted for $1.8 billion in annual sales, and, together with their suppliers, employed 42,000 people. Nearly three in five of these firms employ fewer than 50 employees. About one-third of all hosiery manufacturers in the state are located in the Hickory metropolitan area (one county east of the ARC border in North Carolina), a significant number are near Mt. Airy, and the rest are concentrated near Greensboro, Burlington and Asheboro, areas of the state that are not in the ARC region.

This cluster also extends across state lines to southwestern Virginia where a concentration of knitting mills are found in Carroll , Pulaski, and Smyth counties, and to northeastern Tennessee where a small concentration exists in Washington county. As Figure 23 and Table 50 show the relative importance of knitting mills to the local economies of the cluster. The higher the location quotient (the ratio of the percentage of county employment within an industry compared to the percentage of total manufacturing employment in the county), the greater the impact of the industry on the county.

The cluster is characterized by significant autonomy—89 of the knitting mills in the cluster are single location establishments or headquarters compared to 43 which are branch plants or divisions of larger companies. And many of the branch plants in the cluster belong to corporations with a large number of establishments, and even division headquarters, in North Carolina (e.g., Sara-Lee, Kayser-Roth), meaning corporate actions are heavily influenced by decision makers located in or near the cluster.

Table 50
Establishments, Employment, and Location Quotients for Knitting Mills by County, 1993

County	State	Establishments	Employment	Location Quotient
Alexander	NC	135	5,687	148.2
Burke	NC	35	3,718	63.7
Caldwell	NC	17	679	13.0
Forsyth	NC	8	2,617	9.6
McDowell	NC	8	621	20.4
Rutherford	NC	3	843	20.6
Surry	NC	33	7,460	114.9
Wilkes	NC	9	2,656	60.9
Yadkin	NC	3	1,000	59.9
Carroll/Galax	VA	3	762	29.5
Pulaski	VA	2	1,396	64.9
Smyth	VA	3	310	12.5

Note: The loation quotient is the ratio of the fraction of all employment in that sector within the region divided by the fraction of that sector of all employment in the nation.

It is important to note that industrial clusters do not, of course, follow jurisdictional lines. Thus, although the specific companies under analysis for this research are mostly located in the ARC region, the cluster straddles the ARC border and extends much farther east in North Carolina. Many other knitting establishments, support organizations and suppliers that regularly interact with firms in the ARC region are located beyond the ARC "border." Because it would be arbitrary to ignore these firms and organizations that in many cases are closely linked to the ARC firms, their inclusion in this research where appropriate was imperative.

This cluster (including those nearby firms outside of the ARC region) exemplifies a regional production system because almost all of the elements of a production system, e.g., suppliers, associations, services and skilled labor, are located in a relatively small and rural geographic region. Those companies interviewed estimated that at least 25 and in some cases as much as 90 percent of inputs were purchased locally. Suppliers include the firms that produce the raw yarns, elastic, dyes, needles, labels and packaging materials that these firms need. The impact of suppliers and support organizations will be explored in more detail later.

History of the knitting cluster

The Catawba Valley Hosiery Association (now the Carolina Hosiery Association) was established by the chamber of commerce in 1958 as a "hosiery club" and was spun out as a full-fledged autonomous association in 1960. The 1960s and 1970s were good economic times for the "lifestyle entrepreneur," the independent owner/manager. At that time, according to long-time industry participants, there was little trust among firms and no collaboration among companies.

During the 1980s, however, retailers began to consolidate and 90% of new market growth stemmed from the top 10 retailers. Retailers decided they wanted to work directly with manufacturers and cut out the "middle men" distributors. Most hosiery firms found they couldn't depend on New York City-based distributors and brokers and had to learn how to market themselves. Smaller firms—particularly grey good producers that knit unfinished socks which finishers dye and package—in turn became more dependent on subcontracts from larger mills, although some continued to sell through brokers.

Cluster's Competitiveness and Technology Issues

Although the basic knitting process has become much more efficient since the 1960s (as described earlier), certain processes particular to the hosiery industry have not enjoyed the same advances. Seaming operations to close the toes of socks use the same technologies developed in the 1950s. And "boarding," the process that uses heat to give hosiery products a foot-shaped appearance, remains a labor-intensive, repetitive and uncomfortable job, much as it did thirty years ago. About two dozen hosiery firms—through the Carolina Hosiery Association—have joined forces with North Carolina State University to attempt to develop technology that will automate the boarding process. Finishing operations—folding, inspecting, labeling/packaging and boxing goods for shipment—are manual jobs where ergonomics is an issue and attracting workers is difficult when labor markets are tight. Finally, standardizing quality standards (such as color and wash fastness) is another technology area which the sector is trying to address through cooperative projects.

Because hosiery companies are typically small, there are few companies with R&D budgets sufficient to develop technologies to respond to these issues. As illustrated by the joint "boarding" research project; however, firms are beginning to work together to solve mutual problems. Much of this exchange takes places through the Catawba Valley Hosiery Technology Center (CVHTC), associated with the Catawba Valley Community College in Hickory.

The CVHTC began its operations in 1992 at Catawba Valley Community College on the strength of its association in the state legislature. Successful lobbying resulted in a special appropriation outside of the educational funding channels to create this unique Center. The bill gave the association authority to select the director—a person with extensive industry experience—and govern the Center. Soon after, the Southeastern Manufacturing Technology Center in Columbia, South Carolina—under a grant from the National Institute of Standards and Technology's Manufacturing Extension Partnership—assigned a field agent to the center to supplement the center's technology resources.

In 1995, the Center received a specific appropriation from the North Carolina General Assembly to continue its role in supporting the state's hosiery firms. And, the North Carolina Industrial Extension Service last year announced that it will host a full-time industrial engineer at the Center to offer further technical assistance to knitting mills. The Center demonstrates new equipment, offers work force and management training courses and carries out specific technology-related projects for the hosiery industry.

North Carolina State University's College of Textiles in Raleigh and TC2 (Textile and Clothing Technology Corp.) in nearby Cary, while not located in the cluster itself, are also sources of technology assistance for the textile and apparel industries, including knitwear companies.

Competitive Advantages of the Cluster

Before reporting findings from the interviews conducted for this project, it is important to note companies that participated were not randomly chosen due to budget limitations. Most of the companies contacted were referred to RTS by an industry trade association or a regional high technology center associated with a community college. Therefore, it is very likely that these firms are more likely to seek assistance and interact with other companies in the region than a random sample of the companies in the cluster.

The *exporting* companies interviewed for this report most often cited their strongest competitive advantages as product design, followed by on time delivery and company reputation. Non-exporters cited quality, followed by on time delivery and customer service. This should not necessarily be interpreted that quality does not matter to exporters: it could be considered a "given" by companies with exportable products.

Service providers that support knitting companies in the cluster interviewed for this project cited on time delivery, product quality, and knowledge of the products and processes as the cluster's competitive strengths.

Services

Despite the many public services in this part of the region, the companies surveyed overwhelmingly get assistance and their information about new technologies from other companies. Only one respondent frequently uses any public agency—a community college—for such assistance, while two others sited occasionally using a community college and one reported using a small business center. Respondents most common sources of information, in order of preference, are:

(1) other companies
(2) suppliers
(3) equipment vendors
(4) customers

Exporting companies report receiving general export leads most often from the US Department of Commerce's Export Assistance Center (EAC) in Greensboro, NC (cited three times). Distributors, agents and North Carolina's world trade center follow were each once as sources of general help. These companies reported receiving specific leads equally from the EAC, consultants/agents, distributors and customers (all once). Export consultants/agents and freight forwarders were cited most often as sources for technical assistance (each twice), followed by banks and distributors (each mentioned once).

Exporting companies reported most often self-financing these transactions. One company reported using a regional bank; one has used an Export/Import bank; one company said it requires foreign customers to pay up-front; and another reported purchasing insurance to cover any potential losses.

Exporting from the Cluster

According to export service providers, small to medium sized knitting mills in the cluster that directly export primarily ship goods to Japan and Europe. Some shipments also go to the Middle East and South America. High-end and specialized niche products can succeed in Japanese and European markets where "Made in the USA" labels on knit goods carry a certain caché and are valued for their design and quality. Some companies export under their own brand name while others profit from licensing agreements to make products under brand names such as "Keds" or "Wrangler." At least one knitting mill in the cluster exports medical apparel such as specialty bras and compression hosiery for cardiac patients. A hosiery company that is very close to the ARC "border," produces a broad range of very high quality sport specific socks that are successful in overseas markets. Another company produces made-to-order, high end knit fabric for other manufacturers such as automakers and the computer industry. Other knitting companies are indirectly exporting through subcontracts with larger companies and through brokers or agents, mostly in New York, who export.

Barriers to exporting

On the whole, however, most knitting mills in the cluster do not export. The obstacles *non-exporting* companies interviewed for this research most often rated high were, in order of importance:

(1) lack of information about markets
(2) unfamiliarity with export process
(3) lack of capital
(4) lack of time
(5) getting paid

The two obstacles *exporting* companies interviewed for this research most often rated high were:

(1) lack of information about markets
(2) marketing and sales costs
(3) getting paid
(4) tariffs or government trade barriers

Services working with the cluster agreed with the firms. Those interviewed that ranked barriers, in order of importance, as:

(1) lack of information about markets
(2) lack of time as the largest barriers, and
(3) product design specifications

According to organizations that provide export assistance, several factors impact the ability of knit producers to export. First, as mentioned earlier, knit outerwear products are high in labor content because parts must be cut and sewn. For example, the knit sweater industry now has significant import penetration from Asia and Central America and U.S. exports are low.

Meanwhile, for goods such as knit underwear and hosiery where labor content is fairly low (and thereby the U.S. is more competitive), demand for high quality, expensive U.S. products in other countries is finite. One industry analyst interviewed said that while he could envision exporting of hosiery goods, for example, rising from the current five percent of US production to ten percent, he does not think it would reach higher. "There's only so much demand for U.S.-

produced high end and niche products in foreign markets." The largest markets for underwear and hosiery are "commodity" basic products, a fact which holds true in U.S. and in other countries' markets. Transportation and labor costs make the U.S. uncompetitive in foreign markets for these basic goods.

Moving to issues pertaining to the firms, export assistance providers said they believe that of those firms that are "export ready" (have both the capacity and the appropriate products), a key to being successful at exporting is to make a concrete, strategic commitment to (and investment in) exporting. Small, isolated shipments to foreign markets are often inefficient. Another key element for success is a strong relationship with overseas distributors who can effectively serve foreign markets that tend to be much more fragmented than U.S. markets. This can be a problem, according to one industry analyst, because U.S. manufacturers have a reputation for turning to foreign customers during economic downturns in the U.S. and then retrenching to domestic markets when the economy recovers.

Non-exporting companies frequently rated lack of capital as a barrier to exporting, while exporters generally didn't report capital difficulties. Without a broader sample and more in-depth surveys, it is impossible to know exactly why. One reason could be that exporting, a relatively rare practice among SME knitwear producers, is a proxy for a strong financial position and market outlook which allows the company to either self-finance their exporting or use commercial financial services. Although exporters did not report serious capital difficulties, there was strong sentiment from many of the companies interviewed that few of the region's financial institutions have a good understanding of the knitting industry. One bank in Hickory—Bank of Granite—was frequently cited as the exception.

Dynamism and Linkages

The firms interviewed fall into two general categories—hosiery companies (which represent more than half of the cluster's employment and the majority of the SMEs) and other knit producers. Based on the interviews for this research (and prior RTS work with the hosiery industry in North Carolina), it quickly became apparent that the hosiery component of the knitting cluster is a more self-contained and self aware production system than the knitting cluster as a whole. Exhibiting what some call "friendly competition," these firms cooperate considerably in certain areas—both informally and through formal subcontracting relationships. These subcontracting practices (particularly between large and smaller producers) provide extra production capacity for companies and allow firms to offer more product lines through access to a broader range of knitting equipment than just what they have on their own factory floor.

In the interviews, most hosiery companies reported sharing equipment and supplies when necessary and, through the CVTC, undertaking some joint training and R&D. Joint marketing, however, is fairly rare because competition for customers is keen despite cooperation in production.

Based on our interviews, non-hosiery knit companies are more isolated from each other and less aware of belonging to a cluster other than there being a general concentration of apparel and textiles in the region. This is in part stems from the fact that the non-hosiery knitting companies in the cluster produce a wider variety of products ranging from industrial fabrics to gloves to underwear, despite the fact that the basic technology is similar.

They did not express having significant relationships with other knitting companies and described more "solitary" behaviors. One of these company executives stated that while his firm would not cooperate with direct competitors, he thought the company would be interested in closer relationships with non competing knit producers.

Several companies mentioned the abundance of local suppliers (the percentage of products purchased from within a 100 mile radius averaged more than 60 percent) as an advantage for the cluster. Others cited the availability of a labor force with knowledge of the industry as a competitive advantage, although the region's low unemployment rate in recent years makes labor scarcity a problem at times.

Considering both the longevity and magnitude of this cluster, knitting companies located in the region may take for granted some of the advantages that come from the large concentration of firms. In addition to the proximity of suppliers (with the exception of machinery firms) and a labor force knowledgeable in the industry, customers are willing to travel to the region to meet with companies. Yet while some firms capitalize on the concentration of firms to a greater degree than others through informal and formal information exchange and sharing, based on the interviews for these projects, there are opportunities for increased cooperation that would yield benefits to the cluster. Increased cooperation in expanding exports is one of those areas.

Future of Exporting from the Knitting Cluster

Small and medium-sized knitting companies can and are exporting. While it is unrealistic to expect a majority of knitting companies to export due to constraints described earlier, clearly, there are export markets for knit products made in the Appalachian region that are not being fully tapped.

Not every knit producer is export ready or appropriate (one industry analyst estimated fewer than 10 percent in the cluster currently are). For hosiery and underwear firms, there will likely continue to be a sizeable domestic market for companies that produce medium- to low-end "commodity" knitwear. These sectors are more import protected than other knit sectors due to the products' low labor content and high transportation costs (relative to product value). Successful firms in this category will continue to become more efficient, forge closer ties with U.S. retailers through "Quick Response" strategies, and engage in flexible production through subcontracting relationships. Nonetheless, more consolidation among domestic market firms is likely as less efficient companies fall to increasing demands from retailers and overcapacity.

Knit outerwear and fabric producers that make medium-to low-end goods, however, will likely face stiffer competition from imports and "QR" strategies will be even more important to retain market share.

We can, on the other hand, also characterize companies that are likely candidates to successfully enter export markets: firms that have considerable domestic markets for high-end or niche products with a strong design component, have efficient production processes, and those willing and able to make a strategic commitment to cultivating and sustaining export customers—a commitment which largely entails time and capital. To aid these companies, cluster-based

strategies that address non-exporters' lack of familiarity with how to find export customers and undertake export transactions would seem most beneficial.

One step in that direction already in place is a group of hosiery companies that, through the Carolina Hosiery Association, recently joined together to form a marketing network. The alliance plans to hire a marketing executive who will represent the firms in new markets, including foreign ones. By joining forces, the companies will achieve sufficient scale to more effectively find new customers than would be affordable on an individual company basis. This model is particularly attractive with respect to exporting since finding and sustaining international relationships is more time intensive and costly than establishing domestic contacts.

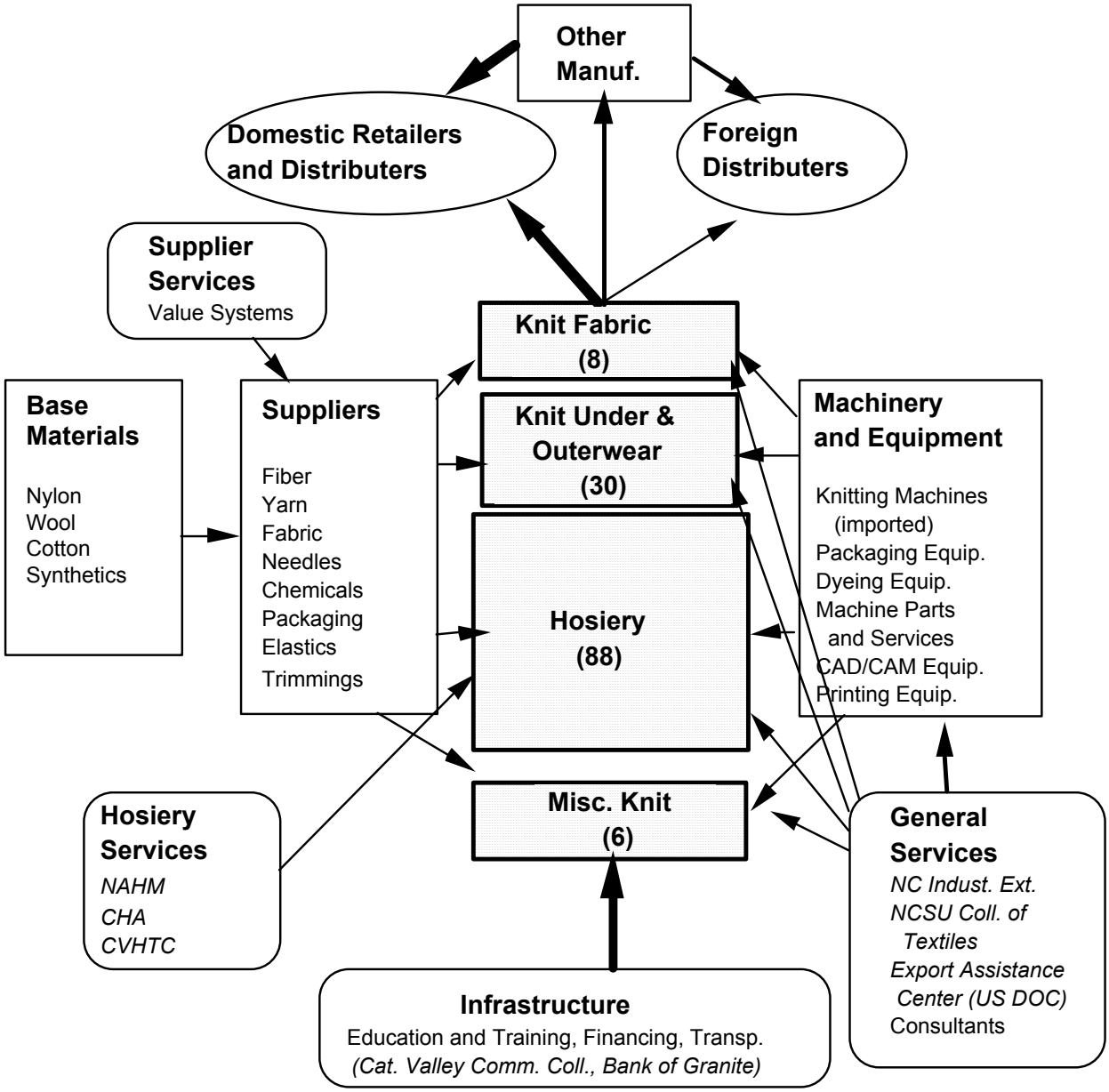
Interviews for this project revealed considerable interest among companies in exporting. A surge in exporting by those companies already "export ready" might encourage some non export ready companies to move into higher value-added and niche products in order to export. Because such goods have higher margins and are more resistant to foreign competition than low-end goods—particularly for non-hosiery producers—their increased production would benefit the overall health of the cluster and, consequently, the cluster's regional economy. Knitwear producers, many of which are in the Appalachian region, are not fully tapping foreign demand for U.S. knit products.

Exporting Isn't Just for the Big Boys

One small hosiery company interviewed for this project exports about 25 percent of its total sales, mostly to Europe. This firm, which has fewer than 50 employees, doesn't have the newest equipment. And, obviously its small size means it doesn't enjoy large economies of scale. But the firm was recently bought by a dynamic leader who has relentlessly, and successfully, pursued overseas markets. With initial assistance from the U.S. Department of Commerce's Export Assistance Center, today the owner maintains weekly contact with foreign distributors. Exported products are mostly durable exercise socks whose quality, the owner claims, largely stems from locally-produced yarn that exceeds the quality available in other nations. The result: the company reports significant increases in sales and wages over the past three years. Unfortunately, this company represents the exception, rather than the rule, among small knitting mills.

Figure 24

Knitting Mills in NC/VA/TN



** figures in parentheses indicate number of establishments*

Appendix D
Industry Analysis: Knitting Mill Products

The following analyses rely heavily on trade patterns in the general category of apparel, as there were insufficient data to examine knitwear exports as such. Industry experts suggested that knit products follow the trends of the apparel industry overall, perhaps being slightly more successful due to the high capital and low labor content of the products. Statistical accuracy and comparability to other sources are affected by a number of factors, including lack of published figures in certain markets, variances in data collection techniques, sources of data, and industry definitions.

The knitted products industry is characterized within the apparel industry as capital intensive and specialized. The companies in the United States that are most successful at exporting tend to be those that offer specialty or niche products.

Table D-1
SIC 225 1995 Industry Exports, F.A.S. $ millions

F Y 1995	NAFTA	JAPAN		ASIAN NICS	AMERICAS	REST OF WORLD	
Knit fabrics and hosiery	$246	$37	$67	$45	$298	$66	$759

U.S. Total Exports, 1995 by Area and Three-digit SIC Product Groups; (Census Basis; foreign and domestic Exports.

Tables D1-D6 examine the export performance of several sub-sectors of SIC 225. Industry experts suggest that these sub-sectors are the most heavily exported products in SIC 225, thus, in the absence of more composite data examining the performance of these sub-sectors will provide a good approximation of the entire sector. These numbers are distorted by maquiladora production, where goods partially produced in the United States are finished overseas, then re-imported for sale in the United States. This practice affects the numbers such that it is difficult to determine what the best country prospects are for knitwear exports.

Table D-2
Knit and Knit Pile Fabrics Exports, 1993-95, $thousands

	World	Canada	Mexico	Japan	UK
1993	$324,191	$117,615	$ 18,015	$ 9,288	$ 13,698
1994	$346,156	$132,811	$ 25,227	$ 10,272	$ 11,818
1995	$440,578	$152,270	$ 33,688	$ 16,206	$ 12,616
Absolute Change	$116,387	$ 34,655	$ 15,673	$ 6,918	$ (1,082)
% Change	36%	29%	87%	74%	-8%

Table D-3

Women's and Girls' Other Knit Shirts Exports, 1993-95, $ thousands

	World	Canada		Japan	
1993	$237,734	$ 15,191	$ 49,198	$ 83,330	$ 2,280
1994	$308,597	$ 14,606	$ 99,972	$ 85,729	$ 5,271
1995	$333,892	$ 18,320	$ 76,340	$103,131	$ 8,979
Absolute Change	$ 96,158	$ 3,129	$ 27,142	$ 19,801	$ 6,699
% Change	40%	21%	55%	24%	294%

Table D-4
Women's and Girls' T-shirts and Tank Tops Exports, 1993-95, $ thousands

	World	Canada	Mexico	Japan	UK
1993	$206,732	$ 31,130	$ 12,167	$ 79,041	$ 5,605
1994	$238,789	$ 43,364	$ 39,302	$ 85,003	$ 3,442
1995	$315,670	$ 49,845	$ 52,224	$106,855	$ 5,036
Absolute Change	$108,938	$ 18,715	$ 40,057	$ 27,814	$ (569)
% Change	53%	60%	329%	35%	-10%

Table D-5
Summary of Knit Shirts, Knit and Pile Fabrics, and T-shirt and Tank-Tops, $ thousand

	World	Canada	Mexico		UK
1993	$ 768,657	$163,936	$ 79,380	$171,659	$ 21,583
1994	$ 893,542	$190,781	$164,501	$181,004	$ 20,531
1995	$1,090,140	$220,435	$162,252	$226,192	$ 26,631
Absolute Change	$ 321,483	$ 56,499	$ 82,872	$ 54,533	$ 5,048
% Change	42%	34%	104%	32%	23%

Table D-6
Summary of Hosiery, $ thousand

Hosiery	World	Canada	Mexico		UK
1993	$ 207,583	$ 32,819	$ 11,478	$ 22,492	$ 5,120
1994	$ 220,222	$ 43,220	$ 13,585	$ 24,555	$ 5,600
1995	$ 256,880	$ 45,472	$ 5,782	$ 19,994	$ 5,571
Absolute Change	$ 49,297	$ 12,653	$ (5,696)	$ (2,498)	$ (451)
% Change	24%	28%	-50%	-12%	-9%

Apparel

Excluding maquiladora production, several strong markets are Canada, Mexico, Japan, and the United Kingdom.

Canada: The recession in Canada slowed purchase of apparel for several years. Now that consumer confidence is up and primary indicators announce the end of the recession, apparel markets are expected to grow. U.S. suppliers of high quality niche-market clothing have excellent opportunities to enter and succeed in this market. Competitive advantages of U.S. suppliers include elimination of tariffs on U.S. origin goods, relatively low costs of production, and market proximity. The best prospects in the Canadian market include cotton pullovers and cardigans, T-shirts, singlets and other vests, and cotton shirts.

Mexico: Mexican middle and upper economic class shoppers traditionally bought their designer clothing abroad. This trend has been changing as local department stores carry more international items. Design, quality, and price are the key sales factors in this market. Industry expectations are that the market for imported apparel will increase approximately 30%. Competitive advantages of U.S. suppliers include elimination of tariffs on U.S. origin goods, and market proximity. The best prospects in the Mexican market include cotton knitted undershirts, and knitted sweaters, pullovers, and vests.

Japan: The Japanese market is moving away from the European designer look and "American Casual" is becoming the new fashion. The newest fashions are brand names such as J. Crew, DKNY, and Calvin Klein. T-shirts, sweatsuits, and clothing with team logos are also very popular in this market. Unfortunately this trend does not translate into the more basic items such as U.S. manufactured women's or children's wear, or underclothing. The best prospects are those listed above, and generally fall into the categories of men's and women's outer garments.

United Kingdom: The United Kingdom has a strong market for U.S. designed and manufactured apparel. The market is expected to continue to grow, particularly in the fashion-oriented "over-fifties" market. The market for U.S. manufactured men's and women's apparel in the U.K. is fairly developed, but the children's market is a yet undeveloped market for U.S. manufacturers. The best prospects in the U.K. market are men's, women's and children's outerwear, particularly branded clothing.

Summary

The apparel industry has historically not been very export oriented. As U.S. markets become saturated and apparel manufacturers face stiff competition from countries with lower labor costs, they look to international markets. The U.S. enjoys success in these markets with niche products, including branded items, specialized products, medical knit products, and stylized products. Products that are more labor intensive, for example embroidered products, and standard products essentially the same as local production, are less competitive internationally. As less developed countries such as Korea and Mexico invest in the technology to make knitwear, it is likely that the market for un-branded, non-specialty knitwear will decline.

ELECTRONIC COMPONENTS IN NEW YORK (SIC 367)
A SELF AWARE CLUSTER

by Brian Bosworth
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Preface

The electronics industry cluster in the southern tier of New York is a classic small industry cluster of the variety that drive regional economies across the United States. Because of its scale and diversity, it is not as immediately apparent as other larger and more concentrated clusters but this region is clearly the dominant part of Appalachia for the production of electronics components. Moreover, the diversity of the southern New York electronics cluster suggests the potential for long-term growth through continuous innovation and new market applications.

The cluster has a long history in the Southern Tier; in fact, it used to be bigger than it is now. The roots of the electronic cluster in Binghamton and the surrounding region go back 30 and 40 years with the development of computer manufacturing and electronics for the defense aerospace industry. In more recent years there has been enormous change in these two industries. IBM now has one plant, not three, in the region. Several facilities have changed hands as the defense industry consolidates and retrenches.

From that historical perspective, what is going on now in the region might look like the "shrinking" of a mature cluster. But, if one were not aware of that background, the glass might look half full rather than half empty. This cluster of electronics firms has several important assets. It has history of technological capability in sophisticated packaging processes. There are several entrepreneurial firms in the region, there is a strong research and development base supported by higher education institutions, there is an apparently large and well skilled work force and there are important growth opportunities within the electronics industry.

Moreover, there is potential in this region for more explicit policies and programs to encourage inter-firm cooperation to promote export development. In this region of small cities and rural towns, the owners and managers of many firms are quite familiar with each other. Many have spun out from some to the larger electronics and computer firms which have downsized over the past several years. These larger firms are far less vertically integrated than they used to be. They are doing far more strategic outsourcing and they are involving their suppliers and contractors in design and engineering. These new relationships may be helping to build the foundation for new collaborations in export development.

Although there is no long-time and well-patterned "habits of cooperation" among electronics firms in this region, many see a potential for creating new mechanisms to allow firms to explore opportunities for joint export development. While many of these firms do compete with each other in regional markets to supply larger customers, a large number have differentiated themselves with their special capabilities over the past few years. Thus, they may find there is

now less direct competition and more opportunities for cooperation. In fact, virtually all of the firms surveyed for this project expressed interest in at least exploring new and closer forms of cooperation.

While many firms in the region now export, there appears to be significant opportunities to expand exports, especially among firms that up to now have been content to service domestic and regional markets. Among the larger firms (IBM, Universal Instruments, Amphenol Aerospace, Dovatron, CAE Electronics, Loral, Martin Marietta, and others), there is a great deal of expertise in export sales and in servicing foreign customers. They have the internal capacity to optimize export opportunities without relying on external assistance. A new program to boost exports logically would focus on smaller firms with fewer resources. A few of the small electronics firms in the Southern Tier export, demonstrating that it is possible, but most do not. Yet they do supply components and sub-assemblies to larger firms that then export fully assembled products. Therefore, these suppliers have already demonstrated that their products are exportable. There appears to be "generic" export assistance capability within the region and in the private sector there are services with specialized expertise in the industry.

The issue is not just a matter of aggregate demand and mastering the paperwork and logistics management complexities of foreign sales, although these can be daunting for small firms. Rather, successful exporting requires developing and supporting specialized products and gaining capacity to service customers who expect customized application support. Although firms in the region that do not export may be concerned about the paperwork and logistics management issues, the most important barrier seems to be their ability to build capacity in foreign markets to understand the precise needs of the buyers and service the application requirements.

Almost by definition, electronic components are part of larger products, incorporated into electronically powered and controlled devices. Companies supplying these components and sub-assemblies must be able to work with their customers in the application process. Unsophisticated, commodity-like components that require little support in application usually can be made more cheaply elsewhere. Those firms in this region of New York that provide basic coils, transformers, and printed circuit boards cannot expect to compete effectively with cheaper wage rate areas of the world where commodity products can be produced at lower costs than in the U. S. (although there may be some opportunities for very high volume, high speed manufacture of printed circuit boards and other components in the U. S. that would make export sales feasible). On the other end of the scale, the successful export of manufacturing and assembly machinery has a high and increasing entry cost. The best export opportunities apparently lie in technologically advanced capacitors, resistor chips, connectors, and printed circuit board assemblies. The sales have to be at the scale that support the development of specialized application support at the customer's site. If several firms were to work cooperatively in developing a shared capacity to play this role, it might lead to significant growth in export opportunity.

In light of this, it appears feasible to stimulate the export of electronics from this region through thoughtful public policy and creative program assistance. However, it may be that what the industry most needs is not just more of what is already available in the form of generic export assistance. Rather, it appears that the most rewarding strategy might be to develop a consortium of exporters and non-exporters who would seek to develop joint marketing and market servicing

capabilities in target countries.

General Industry Description

National Overview

The electronics components industry (SIC 367) consists of several related but distinct product groups. It includes the following.

electron tubes	SIC 3671
printed circuit boards	SIC 3672
semiconductors and diodes	SIC 3674
capacitors	SIC 3675
resisters	SIC 3676
coils and transformers	SIC 3677
connectors	SIC 3678
other components (switches, relays, assemblies, etc.)	SIC 3679

Long-term growth prospects appear strong and most forecasts see annual growth at the 6 to 8 percent level into the next century, below the non-recession year growth rates of the 1980s and 1970s, but still solid growth. However, the industry will face much higher performance expectations. Producers will be expected to add functionality and continue to miniaturize their products. Demand will continue to come from the computer industry (although the trends here will be for very application specific components), from telecommunications, instruments, medical equipment and transportation industries.

Job growth prospects are less positive. Employment has fallen in these industries reflected new production technologies. Because these components are now being manufactured in several relatively cheap wage rates nations, the trend here in the United States will be to continue to substitute technology for labor, so future job growth is unlikely in 367 per se although there may be growth in some of the industries producing the new assembly and manufacturing equipment.

These are fiercely competitive industries, where the U. S. faces an overall trade deficit, partially because of rising demand in the U. S. from goods producers recovering to the level of production of the 1980s. Most U. S. exports go to newly industrializing countries in East Asia and to Canada and Mexico. These same countries, plus Japan are the leading source of imports.

Semiconductors and related devices constitute over one-half the value of all electronic component shipments. American firms have invested heavily in new facilities for semiconductor production, contributing to a resurgence in competitiveness.

Electronics in the ARC Region

Almost 45 percent the ARC region's total employment in electronics components is concentrated in nine ARC counties in New York. Of just over 38,000 jobs in SIC 367, 16,500 are located in this region. Another 8,700 are in nearby counties in the northern tier of Pennsylvania. However, New York is home to only about 18 percent of the total number of establishments. Clearly, there are several very large employers in New York relative to the

other parts of the Appalachian region. There are a few other clusters of electronics firms in Appalachia but much smaller in total employment. There are 28 firms in northeastern Alabama employing only about 4,200 people and 17 in western South Carolina employing about 5,200.

The Electronics Cluster in Southern New York

Though small relative to other regions of the country (such as the huge agglomerations in northern California, Greater Boston, or the Phoenix area), the southern New York state cluster is clearly the dominant electronics concentration in Appalachia. It is also a "self aware" cluster. In 1995, DRI/McGraw Hill ranked this cluster as the second most 'powerful" electronics cluster in the United States (second to the San Francisco-Oakland-San Jose electronics cluster in California).

Electronics firms are cognizant of the importance of their industry to the entire region. Other economic institutions seem to share that perception. Specialized technology, marketing and work force training institutions have emerged that probably are not matched anywhere else in Appalachia.

On a small scale, this cluster may be a good illustration of what Michael Porter had in mind when he described how cooperation and competition among interdependent clusters of firms in a region shape the competitive advantage of that region. There are a number of larger customer firms in the region—many of them Original Equipment Manufacturers (OEMs)—that drive and shape demand. Smaller, specialized, supplier firms both cooperate and compete in meeting those customer needs. The region has a common market of specialized labor and underlying technological drivers—advanced ceramics and newer electronics "packaging" technology that optimize advances in the miniaturization of circuits and other components.

This nine-county area in New York is know as the Southern Tier. It is predominately rural, from the Catskills in the east to the farmlands of the Finger Lakes area in the west. The region is blessed by a particularly strong set of higher education resources including the public research institutions of Cornell University, Binghamton University, and Alfred University and several other two and four year institutions with strong technical education programs. The population of this nine county area is about 730,000 and has been generally stable for several years.

The Southern Tier electronics cluster is somewhat hard to analyze because it includes several SIC codes. Historically, the largest employer in the region has been IBM, which has made computers, peripherals, and computer equipment. These products are classified under SIC 357. Presently, several of the strongest companies in the region manufacture the equipment and machines used in manufacture of circuit board and other electronic components. This production is classified under other SIC codes. The picture is further complicated in that several of the largest customers in the region of the output of the electronics components are in such diverse industries automobiles and aerospace.

The region may be defined in very narrow or wider terms. Most narrowly, it is Broome County, New York and specifically a 15-mile sprawl of five cities along the Susquehanna River—Binghamton, Johnson City, Endwell, Endicott, and Vestal. Most of the electronics firms are in

Broome County and most of them in one of those four cities. Nearly 9,000 people work in the electronics industries (SIC 367) of Broome County alone. A wider definition of the region would include Delaware, Otsego and Chenango Counties to the north and east, and Tioga, Chemung, Tompkins, Schuler, and Steuben to the west. There are also significant employment in electronics to the south in the Pennsylvania counties of Susquehanna. In these other counties—not including Pennsylvania—there are another about 7,000 employees in electronics components (SIC 367). Employment in other related SIC industries linked to the electronics components employs over 10,000 people. This cluster this is very significant in an area where total manufacturing employment is less than 70,000.

There are at several component parts of the electronics industry cluster in the Southern Tier. Figure 25 shows a simplified representation of cluster relationships At the core, there are several dozen companies scattered through the region (and into northern Pennsylvania) who produce electronic components in the 367 SIC range. Only a few of them are semiconductor manufacturers; most produce printed circuit boards and passive components (capacitors, resisters, coils and transformers, connectors, switches, relays and assemblies). A few (including a large Toshiba plant in Horsehead, NY, employing over 1500) are engaged in the manufacture of electron tubes. Location quotient analysis reveals that each of these four digit level industries, except semiconductors, has a very strong concentration in this area. Most of the firms in the 367 SIC range are smaller firms and they mostly supply larger firms also in the region who sell sophisticated machines and systems often with defense applications (although most of these firms are seeking to diversify into commercial markets or have already managed that transition). There is apparently a fair amount of transactions among the firms in the 367 SIC range, within and among the four digit product classifications.

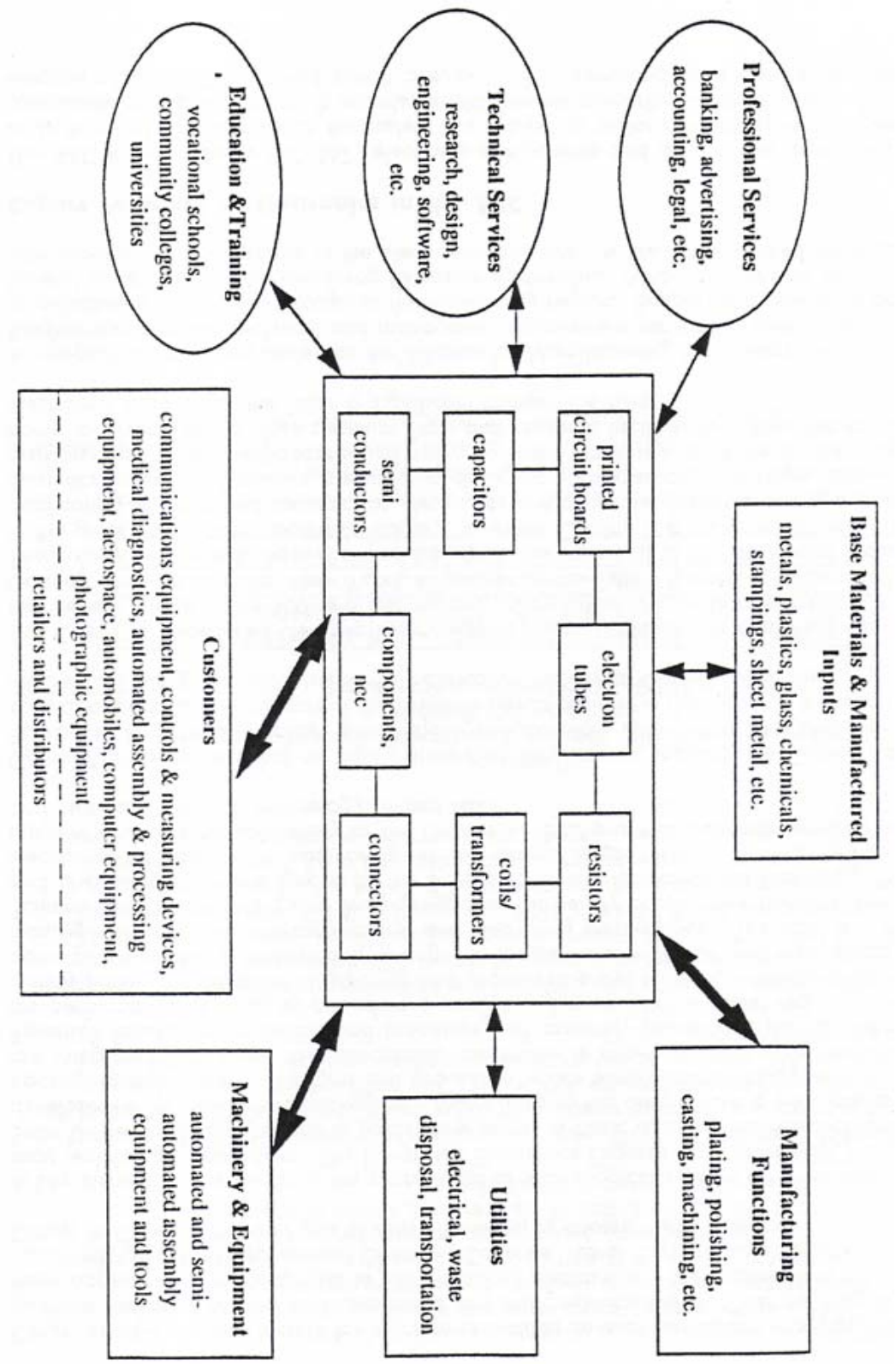
Several groups in the cluster consists of firms which sell materials and services as inputs to the electronics firms or which make the equipment used in the manufacture of the electronic components, especially the printed circuit boards. For example, Universal Instruments is a Binghamton-headquartered worldwide provider of electronic circuit assembly equipment for surface mount and throughhole assembly. Because this equipment itself incorporates sophisticated electronic systems, including circuit boards, Universal sometimes buys from and sells to the same companies—its suppliers frequently are also its customers. Although Universal is the dominant equipment manufacturer in the region, there are other firms which sell the specialized equipment and tools use in the manufacture of electronic components. Dover Electronics (which is owned by Dover Technologies which also owns Universal) makes micro-electronics circuit packaging. There also are a number of plastics firms and metalworking firms that provide producers and services.

Business service firms supply banking, advertising, accounting and legal services, often with relatively specialized capacity by people who have deep experience in the electronics sector. Technical service firms include specialized electronics design, engineering, and systems integration providers as well as research support and technical information and scanning services. There are a growing number of small software companies chiefly in Tompkins County who are focused primarily on supporting the electronics industry. Utilities are important service providers. For example, firms in the region are very concerned about what they see as relatively high costs of electricity.

A third significant part of the cluster consists of several companies in diverse fields who are

large customers of electronics component manufacturers. This includes a ‚mini-cluster" of companies that makes flight simulators (AAI Mircoflight, CAE Electronics, Binghamton Simulator, Lockheed Martin's Aircraft Control Systems [formerly GE] and Doron Precision). These companies started by serving the defense industry but some are now branching out into commercial markets. Several firms have been bought and sold, as larger defense-focused corporations seek to reposition themselves through acquisitions and divestitures. Several other firms produce computer hardware and peripherals (SIC 35). While many manufacture some of their own electronic components, they also outsource to other companies in the region. The largest employer is this category is IBM, which produces computer hardware in Endicott. Its has downsized its operations in Broome County significantly over the past several years from three plants to just one but continues to be a major employer in the region.

Figure 25
Electronic Components Cluster



Other major customer/sectors for electronics include several aerospace manufacturers (such as Lockheed Martin) and automotive and truck manufacturers. Over the long term, there appear to be opportunities to use advanced electronics in the manufacture of rail transit equipment in Steuben and Chemung Counties. Loral Corporation's Federal Systems Group in Owego (formerly one of IBM's facilities) is another large customer.

A key element in the cluster is the strong base of technological support for firms that are most technology dependent. The Integrated Electronics Engineering Center (IEEC) at the State University of Binghamton is particularly strong in basic and applied research and development for electronics packaging. Many firms in the cluster have a vital interest in packaging technology. The form and process in which semiconductor chips with circuitry are integrated into larger microelectronics assemblies is known as packaging technology. Research focuses on materials and processes and assembly procedures that can enhance the performance of chips by providing a smaller and more flexible scale; reducing weight; cutting power consumption; dissipating heat more efficiently; reducing environmental hazard; optimizing portability; withstanding changes in temperature, vibration and mechanical stress; making more effective interconnections; and measuring performance. The IEEC is a National Science Foundation (NSF) and State designated "university cooperative research center" and also designated and funded by the State as a Center for Advanced Technology (CAT) in electronics packaging. In addition to running several major research projects selected by industry and directed by faculty of the University, IEEC provides outreach services to small and mid-sized firms on technology related issues.

Cornell University, less than an hour's drive from Binghamton, supports the Cornell Advanced Packaging Fabrication Facility, a well-equipped laboratory able to fabricate chips for special applications in support of the research needs of firms in the region. A portion of IEEC's CAT budget is allocated to the Fabrication Facility at Cornell University.

The Center for Advanced Ceramic Technology at Alfred University (in Allegheny County at the western fringe of the Southern Tier region, tightly linked to private research facilities of Corning, Inc. (in Corning, New York), is another of the State's Centers for Advanced Technology. As noted, these facilities are almost as important to the electronics industry as to the glass and ceramic materials industry, in which Corning is a dominant player. The application of advanced ceramics to electronics constitutes the fastest growing part of the ceramics industry. Ceramics are used in electronic substrates and packages, capacitors, resistors, ignition elements, lasers and sensors. The western region of the Southern Tier is home to several world class ceramics firms and research facilities and their ties to the electronics area gives the latter a significant competitive asset.

A non-profit corporation known as the Alliance for Manufacturing Technology (AM&T) in Binghamton provides technical and managerial improvement services to small and mid-sized manufacturing companies throughout the nine-county region. Supported by the state and federal government's Manufacturing Extension Partnership, AM&T has several staff members with specialized background in the electronics industry. A few once worked for area firms.

Export Potential of Electronics in the ARC

The ARC target industry SIC 367, electronic components and accessories, comprises a wide array of products which themselves are subject to major differences in the level of complexity or sophistication. It includes establishments primarily engaged in manufacturing electron tubes (3671), printed circuit boards (3672), semiconductors and related devices (3674), electronic capacitors (3775), resistors (3676), coils and transformers (3677), connectors (3678), and electronic components not elsewhere classified such as electronic video and sound system components, rheostats and switches, quartz crystals, and microwave components (3679). It is part of SIC major industry 36, electronic and other electrical equipment and components, except computer equipment. *(Standard Industrial Classification Manual;* Executive Office of the President, Office of Management and Budget, 1987.) SIC 36 data is used in this analysis.

Recent Export Trends: In 1995, electronic equipment accounted for 17.4 percent of the value of manufactured products exported from the United States and 10.2 percent of the value of manufactured exports from the ARC states. The much lower share in the region indicates that the ARC member states contribute a relatively small share of United States electronic equipment exports.

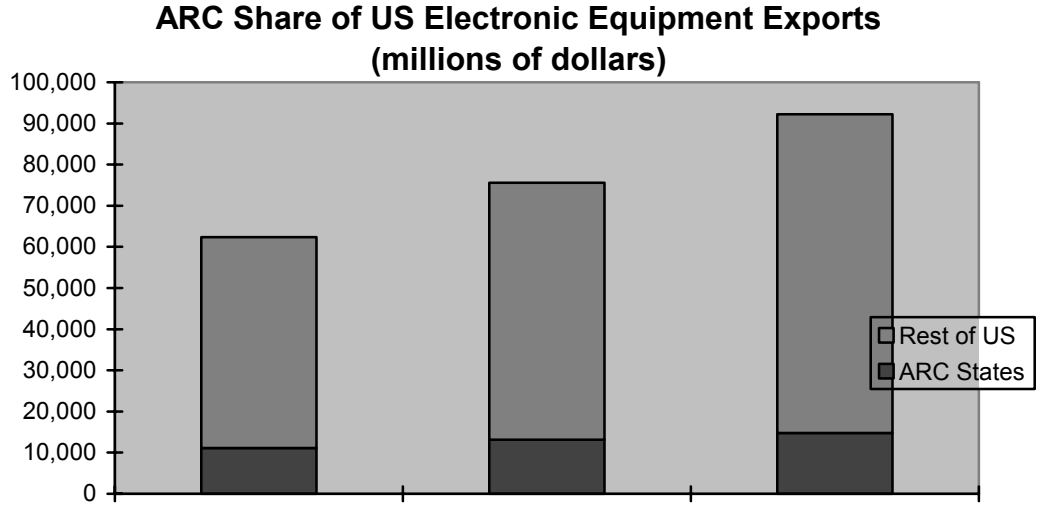
In 1995, United States producers sold $92.2 billion of electronic equipment to customers in other countries. This represented an increase of almost $30 billion over the 1993 export sales of $62.3 billion. the 1995 exports of electronic equipment from producers in ARC member states reached $14.8 billion in 1995, up from $11.2 billion in 1993. The value of recent electronic equipment exports are presented in Table 51. The increased sales represent a 47.9 percent increase for the United States, and a 32.7 percent increase for the combined ARC member states. The ARC states experienced strong growth, but it was well below the national average.

Table 51
Value of Electronic, Electric Equipment, Except Computer (sic code 36) Exports, 1993-1995 (millions of dollars)

Area	1993	1994		1993-1995 Change
ARC States	$11,151	$13,140	$14,792	$3,641
United States	$62,343	$75,557	$92,204	$29,860

Due to slower growth for the combined ARC states during this interval, the ARC states collective contribution to US electronic equipment exports dropped by almost two full percentage points, from 17.9 percent in 1993 to 16.0 percent in 1993. Figure 26 depicts the region's shrinking contribution to national electronic equipment export values.

Figure 26



Electronic and electrical equipment exporting activity is unevenly distributed across the Appalachian Region. Electronic and electrical equipment export activity is so concentrated that New York alone accounts for 40 percent, of the ARC states total 1995 electronic equipment exports. Overall, electronic equipment exports come predominantly from *the* northern ARC states, but North Carolina is also a major exporter. Table 52 lists the 1993 through 1995 value of electronic equipment exports attributed to each ARC member state, and the changes that occurred during that interval.

Table 52
Value of Electronic Equipment Exports by State, 1993-1995 (millions of dollars)

Area	1993		1995	1993-1995 Change
Alabama	$440.2	$561.3	$599.1	$158.9
Georgia	$622.2	$892.6	$956.0	$333.8
Kentucky	$292.7	$317.4	$335.1	$42.5
Maryland	$482.1	$517.1	$673.9	$191.8
Mississippi	$146.7	$191.5	$183.7	$37.0
N. Carolina	$1,110.5	$1,272.2	$1,383.4	$272.9
New York	$3,557.1	$3,863.2	$4,595.5	$1,038.4
Ohio	$1,197.2	$1,428.5	$1,649.8	$452.6
Pennsylvania	$1,668.3	$2,052.4	$2,235.9	$567.7
S. Carolina	$490.6	$550.5	$533.8	$43.3
Tennessee	$506.4	$702.7	$684.7	$178.3
Virginia	$630.5	$784.6	$951.6	$321.1
W. Virginia	$6.9	$6.3	$10.1	$3.2

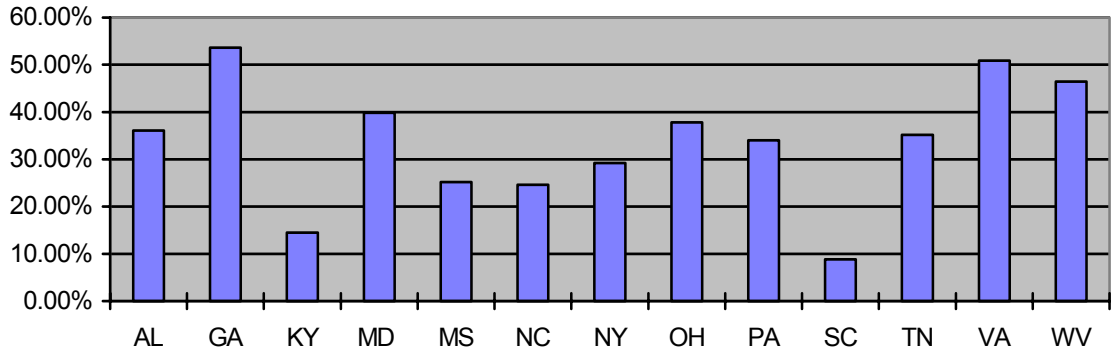
Every ARC state experienced an increase in the value of electronic equipment exported, but in several states, the dollar value of the increase was small. The 1993-1995 change data confirms

the dominant position of New York in electronic equipment exports. Only North Carolina, Pennsylvania, and Ohio had 1995 exports with a total value higher than the 1993 to 1995 increase in value for electronic equipment exports from New York.

Absolute numbers tell part of the story, but the impact of a given increase or decrease in export sales depends in part upon the amount of export activity. Calculating the rate of change helps put the movement in perspective. The rate of change in textile exports for the ARC states, depicted in Figure 27, reduces the interstate differential shown by the absolute numbers and highlights several states with a relatively low dollar value of exports but high growth rates.

Figure 27

Percent Change in Electronic Equipment Exports 1993-1995

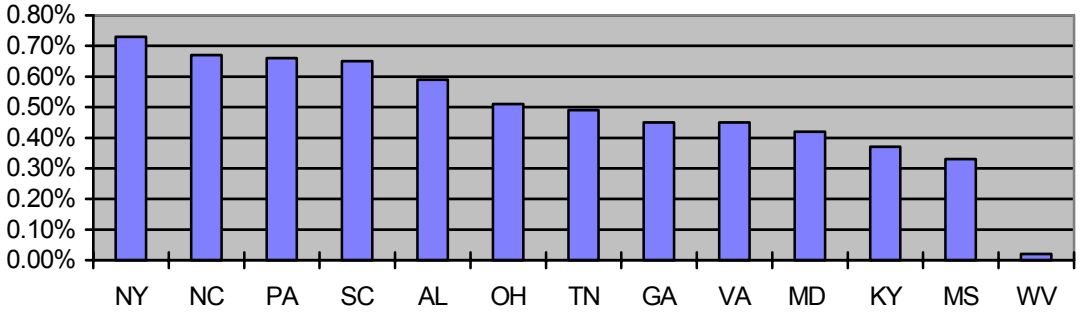


Between 1993 and 1995, Georgia and Virginia saw exports of electronic equipment from their producers increase more rapidly than the national average. West Virginia, which has the lowest amount by value of electronic equipment exports experienced a rate of growth just slightly below the national rate. Maryland, Ohio, Alabama, Tennessee, and Pennsylvania experienced 1993 to 1995 growth rates in electronic equipment exports that were below the national average but above the combined ARC state average.

Export Intensity: Another way to accommodate size differences among the ARC states so that comparisons can be made is to calculate the value of electronic equipment exports as a percentage of the gross state product (GSP). That ratio measures the contribution that electronic equipment exports make to the state economy. The US electronic equipment export intensity for 1993 through 1995 was 1.11 percent. The combined export intensity for the ARC states was only a little over half that, 0.57 percent. The difference describes the gap between the contribution economy and the contribution they would make if export performance was at the national average. The large discrepancy indicates that there is a lot of room for the ARC states as a group to increase their exports of electronic equipment. Figure 28 ranks the ARC states by their 1993-95 electronic equipment export intensity.

Figure 28

ARC States Ranked by Electronic Equipment Export Intensity



No ARC state approaches the national average in electronic equipment export intensity. New York, clearly the predominant state in the region, has the highest ratio, but it is still far below the national average. On this measure, New York does not stand far above the other ARC states, and there is no clear state or group of states leading the region. Except for West Virginia, which has an extremely low value, the other ARC states are more closely clustered in terms of export intensity for electronic equipment than for the other target industries

To facilitate comparisons over time of ARC states' electronic equipment export performance with that of the nation, export intensity can be calculated as an index relative to the national average. The resulting number is the export intensity index (EII). The national Ell is always 1.0, and states where electronic equipment exports make an above average contribution to the economy have an electronic equipment Ell greater than 1.0. Conversely if electronic equipment exports make a relatively small contribution to the state economy, the Ell is less than 1.0. The latter describes the situation in the ARC region where every state had an Ell well below 1.0 for every year in the analysis, 1993 through 1995.

Changes over time in the textile EII reflect a change in the contribution of textile exports to the state economy that is greater (an increasing EII) or less (a decreasing EHII) than the national trend. The electronic equipment Ell for ARC states combined fell from 0.54 in 1993 to 0.49 in 1995. Thus, electronic equipment exports make a contribution to the regional economy that is approximately half the national average and falling. The electronic equipment industry does not yet represent a regional exporting strength. Moreover, the 1995 electronic equipment Ell was lower than the 1993 index in every ARC state except Georgia, where it was 0.01 higher. Georgia and several other states saw an increase in the Ell from 1993 to 1994 that was followed by a larger decline from 1994 to 1995. Table 53 lists the electronic equipment Ell for each ARC state.

Table 53
Electronic Components Export Intensity Index, 1993-1995

Area	1993	1994	1995
Alabama	0.54	0.57	0.50
Georgia	0.38	0.45	0.39
Kentucky	0.38	0.34	0.29
Maryland	0.41	0.36	0.39
Mississippi	0.31	0.33	0.26
North Carolina	0.66	0.62	0.55
New York	0.71	0.64	0.63
Ohio	0.48	0.47	0.44
Pennsylvania	0.62	0.63	0.56
South Carolina	0.67	0.62	0.49
Tennessee	0.44	0.50	0.40
Virginia	0.40	0.41	0.40
West Virginia	0.02	0.02	0.02

The Survey of Firms

In this project, 17 firms in the Southern Tier electronics cluster were surveyed. Of these, 8 firms are exporters and 9 are non-exporters. Because the surveys focused chiefly on small and mid-sized firms, the majority who participated in the surveys are privately held establishments. The two large establishments with over 500 workers were both publicly held corporations.

Growth: Most of the companies reported modest increases in sales over the past three years. Five of the eight exporters reported sales growth of over 10% and one (the largest) reported sales growth of over 100%. Exporting firms reported slightly higher levels of growth than the non-exporters although a few of the non-exporters indicated substantial recent growth in sales.

Response to questions about changes in employment revealed no discernible pattern. About half the firms had increased employment and half have stayed the same or decreased. There was no significant difference between the exporters and non-exporters in this dimension, although one exporter reported big employment growth (over 500 new employees in the past four years).

All of the exporting firms indicated that they have increased average wages in the last three years—half between 0 and 10 percent and half between 10 and 20 percent. All but two of the non-exporters had increased wages, at about the same levels.

Importance of exports: Exporters with the highest percent of their sales or who reported that export sales are very important to their future are firms that make relatively sophisticated products for special application, such as special purpose connectors, assembly systems, or control devices. All of these companies accorded very high importance to distribution systems and customer service capability. Some reported that the time it took to complete federal government procedures for obtaining export approval frustrated them. They emphasized that customers have very specify applications of the products that usually are time sensitive and they

are not patient with slow delivery. A few companies indicated that they rely on the offices of their congressional representatives and senators to smooth the export approval process.

Competitive Advantage: Most of the firms—both exporters and non-exporters—were reluctant to single out one or two factors of competitive advantage. For almost all of them, design, price, quality, delivery and customer relationships were of equal import. Some of the firms were willing to discuss the advantage they derive from being part of a concentrated group of similar and complementary firms. They see the strength of the overall cluster as giving them individual competitive advantage.

Getting information and assistance: The survey indicated that respondents get most of their general and trade-specific information and assistance from the private sector, not from government related organizations or programs. Most important are their customers, followed by suppliers, equipment vendors, and other companies. Most responded that they use small business centers , government agencies and community colleges rarely or never. Despite the proximity of strong universities, few cited them as sources of assistance—although those that did leaned heavily on them and indicated that they were especially helpful. The firms responding to questions about specific and general trade leads indicated that they rely mostly on private sector sources, especially customers and sometimes distributors.

Barriers to export: For companies that do not now export, the most important barriers are lack of information about markets and customers and a concern about high costs of marketing and sales. Export success requires a strong ability to support the customer in the application of the component or subassembly. Developing this capability is a significant barrier for the small company which cannot afford to spend a great deal of time in pre-production design and engineering consultation, service and troubleshooting with companies located that far away.

Firms that do export generally view exports as very important to their future. Firms that do not export are generally willing to consider it in the future. However, some of the firms that do not export now seem to have a very realistic view of their
prospects within their current production capabilities and product mix. As revealed by this sample survey, many non-exporters are assembly "job shops" or contract manufacturing facilities who are too small and localized to have export capability. Their niche lies in their flexibility to quickly meet the requirements of larger local firms who outsource specialized components. Other firms, such as some in the coils and transformers business, see themselves as non-competitive in international markets where they would face enormous price competition from firms in low wage rate areas.

Work force issues: A few other issues emerged from the surveys. First, labor force skills and availability are viewed as a significant competitive advantage for exporters and non-exporters alike. At every opportunity, the firms interviewed (and the service organizations that work with them) cited the skilled work force as a significant asset to the electronics cluster in the Southern Tier. Electronics is a "traditional" industry in the Southern Tier that has long hosted large electronics manufacturers that have made a sizable human capital investment in the technical skills important needed by the industry. As larger firms downsized in the 1980s, the specialized labor pool became more available to the smaller, more entrepreneurial firms in the region. Community colleges and four-year schools are apparently continuing to produce skilled

technicians and engineers required by firms in the region, and none cited current shortages as an obstacle to exports.

A few firms, however, expressed concern about the aging of the work force. The work force in the Southern Tier is somewhat older than in the rest of New York. Much of the region is rural, and, although it has many physical attractions, lacks the excitement of larger metropolitan areas. This leads a few firms to worry about a current or potential "brain drain" from the area as younger people seek economic opportunity in bigger cities. Some of the firms are working closely with the educational institutions of the region to strengthen worker training programs and attract young people into the technical proficiencies demanded by this industry.

Potential for cooperation: A second important result of the surveys has to do with the potential for collaboration among firms in this industry. Every firm surveyed was receptive to the idea of greater collaboration within the electronics cluster in the Southern Tier. Many indicated that they are already involved in one or more collaborative activities with other firms and would be open to others. Even firms not now cooperating with other businesses registered an interest in exploring opportunities for joint programs. A few of the firms indicated that there did not appear to be mechanism or institutions which facilitated cooperation, but nonetheless were interested in seeing if they might be established. This level of support is quite surprising. It suggests that the firms are not as worried about direct competition or proprietary advantage as is frequently suspected. It further suggests that many of the firms are moving toward market niches where their competition is not local, but rather global.

The willingness to explore new forms of cooperation is also important in that it may help resolve some the key barriers to export market entry and expansion; i.e., the time and cost of building up a customer development and service presence in foreign markets. Strategies which help the smaller and mid-sized firms to better serve export customers in the on-site application of product purchases would be a significant contributor to boosting exports.

Typical of the comments from firms on this topic were the following observations:

- "currently loan equipment to another firm: would consider working together with others in the future"
- "would consider future cooperation"
- "now cooperating on a small scale and would be willing to look at future opportunities"
- "have collaborated with friendly competitors"
- "have cooperated in joint ventures with other local firms and would consider more"
- "absolutely interested in working together"

Most of the institutionalized inter-firm relationships apparently fail to convert this willingness to work together into specific activities or outcomes. Most of the firms report that they belong to trade and industry associations and their employees to professional engineering societies. However, it appears that most of these groups are external rather than internal to the cluster. There is no general association focused around the electronics cluster within the region. Electronics business-based association relationships tend to include a few firms in the region and several firms outside the region. As a result, firms may be missing the opportunity to explore complementary relationships and inter-dependencies of the sort most likely to lead to joint action in the pursuit of export opportunity.

The Capacity of Service Providers

As noted earlier, the Southern Tier is—by New York City standards at least—a thinly populated rural area. About 730,000 people live in the nine-county area. While the electronics cluster stands out, the rest of the economy is diversified with a greater reliance on agriculture than most of the rest of the state. Although there are many specialized technical support services very knowledgeable of the cluster, such as IEEC at Binghamton University and the Alliance for Manufacturing and Technology—as noted earlier—the local and regional economic development agencies display little of that specialization. With a few exceptions, they tend to be general purpose economic development agencies with no specialized competence in electronics or in export development. Instead, organizations provide general assistance and information about export development and, while they serve the electronics firms along with others, they lack any specialized experience. On the other hand, there is strong private sector consulting capability in the region very familiar with and experienced in the electronics industry.

Some Beginning Steps Toward an Export Development Strategy

It has not been feasible to design a strategy of export development for the electronics cluster in the Southern Tier as part of this initial study. However, some ideas have emerged from the interviews and surveys which suggest a starting point for the formulation of a strategy. Five key findings shape this approach.

1. *There seems to be clear potential to increase electronics exports from this region.* Several firms already are exporting and the larger ones have very specialized knowledge and market support capability. There business strategies seem to rely heavily on continuing and increasing exports. In other words, within the private sector community of this region, there is extensive and sophisticated knowledge of exports markets and marketing processes.

2. *Several of the smaller firms are providing components and sub-assemblies to these larger firms and therefore their products are meeting the test of foreign markets.* Many of these smaller firms have specialized product capability. There is extensive technical knowledge and technology assistance systems in the region to support the firms as they seek to meet the exacting standards of foreign markets.

3. *Mastering the paperwork logistics of export sales is daunting for the smaller nonexporting firms, but it is not the only problem and it may not be the most important.* Exporting in this industry frequently requires the ability to serve customers in foreign markets and to provide application support. Larger firms have this capability in place. Setting up this market service capability is an expensive proposition for smaller firms.

4. *According to the secondary data that is available, this is primarily a cluster of complementary firms rather than a cluster of competing firms.* Of course, some of the firms are in very direct and fierce competition in local markets. But there is evidence (even though more research would clearly be advisable) of substantial segmentation and "niching" among many of these firms. Many may have found specialized demand in the

region that has led to complementarity in their processes and product mixes.

5. *Electronics firms in the region display a willingness to work together. Even though there are no highly evolved trade or industry associations, the firms seem to know each other quite well.* They work together in discrete projects now and they are willing to explore new forms of cooperation.

These findings suggest that perhaps the many of the electronics firms in the area might be willing to work together on an export initiative that would contemplate a collaborative approach. For example, the firms might be willing to establish a joint market support capability in countries with especially attractive markets. They might be interested in a "buddy system" where the firm with export experience helps ones without it in return for other considerations. There may be a willingness to investigate a joint export development entity which might consolidate the burdensome logistic requirements while setting the basis for a cooperative approach to market support.

Appendix E
Electronic Components SIC 367

The following analysis uses information from the Department of Commerce's Country Commercial Guides for the listed countries, the International Trade Commissions document U.S. Trade Shifts in Selected Commodity Areas, and interviews with industry experts and U.S. manufacturers. Some of the export data, particularly statistics to Latin America may be distorted due to maquiladora produced electronic components. Statistical accuracy and comparability to other sources are affected by a number of factors, including lack of published figures in certain markets, variances in data collection techniques, sources of data, and industry definitions.

The United States is a net importer of electronic equipment. Expanding the category to include computers, computer peripherals, and parts, the U.S. had a trade deficit of $11.1 billion in 1995, exporting approximately $129.5 billion and importing $177.1 billion. These numbers are somewhat distorted by products that are exported for processing, then re-imported.

The global electronic equipment market is a highly competitive price-sensitive and for the most part commodity-type market. Competition in the electronics industry is fierce; to be successful a company must either have superior technology or be highly price competitive. With the relatively inexpensive labor costs in Asia and Latin America, the markets that the United States is successful in are those that are highly sophisticated and require a high level of technology, such as semi-conductors and LCDs.

The total exports of electronic components (SIC 367) in 1995 was $45.5 billion. These exports were broken down regionally by destination in Table E-1 as follows:

Table E-1
Foreign and Domestic Exports, F.A.S.; ($ in millions)

Electronic Components	NAFTA	Japan		Asian NICs	America	Rest of World	Total
1992	4,368	$1,190	$2,474	$6,491	$350	$1,319	$16,192
1995	$12,009	$4,867	$7,248	$17,131	$980	$3,279	$45,514
% Change	275%	408%	293%	264$	280%	248%	281%

U.S. Total Exports, 1995 by Area and Three-digit SIC Product Groups; (Census Basis; foreign and domestic Exports, F.A.S.; $ millions

The numbers above indicate that the electronic component industry has grown significantly in the last four years, and with the introduction and usage of increasing amounts of electronic equipment such as HDTV and computers, the market is expected to continue this growth pattern.

Country Analysis

Canada: Canada imports approximately 137 percent of its electronic components. Many of the electronic components are imported into Canada, incorporated into other products, then re-exported. The U.S. supplies 60 percent of total imports. The U.S. export market to Canada is thus closely linked to Canada's exports of products that contain electronics much of which returns to the United States. The Canadian export market in these products is expected to grow at approximately nine to eleven percent in the next three years. This growth, combined with the continuing effects of NAFTA, should make electronics components to Canada grow at approximately four to five percent per year for the next three years. The best prospects in the Canadian market are telecommunications and specialized advanced electronics subsectors.

Table E-2
Canada: Current and Projected Markets: 1995-1997

	1995	1996	1997
Total Market Size	$4,511	$4,804	$5,116
Total Local Production	$790	$918	$1,068
Total Exports	$2,451	$2,764	$3,117
Total Imports	$6,172	$6,650	$7,165
Imports from the U.S.	$3,682	$4,079	$4,519
U.S. Market Share	81.62%	84.91%	88.33%

Mexico: Mexico imports approximately 10% of its electronic components. The U.S. supplies 61% of those imports, thus having a market share of 6.29%. Much of the electronic equipment in Mexico is maquiladora-produced, and is not included in this analysis. The primary competitors in Mexico are the Japanese and the Europeans. The primary opportunities in the Mexican market are electronics for large international firms that are opening production plants in Mexico that use electronic components, and the privatization of the telecommunications industry in Mexico. This will lead to opportunities in the sale of electronic components for long distance and international service.

Table E-3
Mexico: Current and Projected Markets: 1995-1997

	1995	1996	1997
Total Market Size	$1,733	$1,657	$1,714
Total Local Production	$1,606	$1,654	$1,704
Total Exports	$51	$208	$214
Total Imports	$178	$211	$233
Imports from the U.S.	$109	$130	$136
U.S. Market Share	6.29%	7.85%	7.93%

Singapore: Singapore imports approximately 171% of its electronic components. Many of the electronic components are imported into Singapore, incorporated into other products, then re-exported. The U.S. supplies 15% of total imports. While a portion of the electronic components imported into Singapore are for assembly and re-export, the market for pure exports to Singapore is strong as international companies open and supply new facilities. The lead competitors in Singapore are the Japanese, Malaysians, Koreans, Taiwanese, and Thai. The best opportunities in the Singapore market are in integrated circuits, microprocessors, ASICS, DRAMs, and transistors.

Table E-4
Singapore: Current and Projected Markets: 1995-1997

	1995	1996	1997
Total Market Size	$12,665	$15,983	$20,175
Total Local Production	$9,642	$23,520	$15,066
Total Exports	$18,608	$23,713	$31,447
Total Imports	$21,631	$23,937	$36,556
Imports from the U.S.	$3,259	$4,236	$5,507
U.S. Market Share	25.73%	26.50%	27.30%

Japan: Japan imports approximately 50% of its electronic components. The U.S. supplies 35% of those imports, thus having a market share of 18%. The Japanese have a strong capability in this market, and are one of the U.S.'s major competitors in Japan and internationally. The most top opportunities in the Japanese market are in semi-conductors and flat panel displays. The semi-conductor market is expected to grow 18-19% annually, while the LCD display market will continue to grow at 20-25% annually.

Table E-5
Japan: Current and Projected Markets: 1995-1997

	1995	1996	
Total Market Size	$46,653	$56,800	$66,110
Total Local Production	$101,381	$112,100	$119,400
Total Exports	$78,129	$88,290	$97,300
Total Imports	$23,401	$32,900	$44,010
Imports from the U.S.	$8,300	$11,200	$14,700
U.S. Market Share	17.79%	19.72%	22.24%

Taiwan: Taiwan imports approximately 77% of its electronic components. The U.S. supplies 18% of those imports, thus having a market share of 14%. Taiwan, like the other major Asian electronics importing countries imports high quality electronic equipment from foreign suppliers to maintain the quality of its assembly operations. Additionally, international manufacturers operate facilities in Taiwan that need a steady supply of high quality electronic components.

Table E-6

Taiwan: Current and Projected Markets: 1995-1997

	1995	1996	1997
Total Market Size	$18,000	$20,700	$23,800
Total Local Production	$13,879	$15,900	$17,900
Total Exports	$9,849	$12,000	$14,200
Total Imports	$13,970	$16,800	$20,100
Imports from the U.S.	$2,566	$2,800	$3,100
U.S. Market Share	14.26%	13.53%	13.03%

Summary

The United States is fairly competitive in high quality, sophisticated electronic components such as semi-conductors and LCD displays. Several elements of the global market include:

- primary customers for electronic components are large international firms that establish facilities in countries with few regulations and relatively inexpensive labor costs.
- most suppliers to these firms are successful in large part through maintaining customer relationships.
- Components exported from the United States are placed in products and then reexported, either to the United States, or to other countries.

NOTE: The projected figures for 1996, 1997, and 1998 are all estimates selected by U.S. embassy officials in the respective countries. The country by country analysis may differ in exact composition from the selected SIC code. The general category contains approximately the same products.

PLASTIC PARTS IN PENNSYLVANIA AND OHIO:
Successful, Clustered, Ubiquitous

by Dan Broun
Regional Technology Strategies, Inc.

Preface

While it might be a little simplistic to sum up the future of the Appalachia region in terms of polymers, for portions of this diverse region, it is clear that plastics play a crucial role. Given the importance of plastics in heavy industries such as auto manufacturing, it is not surprising the Appalachian region's strongest concentration of plastics firms lie in areas long considered part of the "rust belt." Indeed, the area around Erie, Pennsylvania is one of the top plastics clusters in the entire nation, and even holds an important place in the industry's history as the location of the first company to use injection molding practices.

The industry, especially as it is constituted in the Pennsylvania and Ohio counties surrounding the city of Erie, primarily produces sub-assembly products for large original equipment manufacturers. As such, while the industry is very strong, it is not a particularly vibrant exporting sector. Finished products are more likely to be exported and the plastics companies in Erie, especially the small and medium sized firms that make up the target of this study, do not specialize in finished goods. Unlike some other industries, where the lack of exporting can and most likely will affect the growth potential of firms, for most plastics manufacturing firms exporting does not hold the key to their future success. Instead, improvements in technologies and in worker skills would seem to offer the best chances for sectoral growth.

General Industry Description

Industry Composition

There are two broad industries in what might traditionally be thought of as "plastics." The first is Plastics Materials and Resins (SIC 2821), the major input needed for plastics processing. The second is miscellaneous plastics products (SIC 308), which is the focus of this particular study. The miscellaneous plastics sector comprises several sub-sectors covering completed plastic shapes. The major sub-sectors in SIC Code 308 are: Unsupported Plastics Film and Sheet (SIC 3081), Unsupported Plastics Profile shapes (SIC 3082), Laminated Plastics Plate and Sheet, Plastics Pipe (SIC 3084), Plastics Bottles (SIC 3085), Plastics Foam Products (SIC 3086) ' Custom Compound Purchased Resins (SIC 3087), Plastics Plumbing Fixtures (SIC 3088), and Plastics Products not elsewhere classified, (SIC 3089). This final catch-all category is by far the largest sub-sector with both 63 percent of the sector's employment and its establishments nationwide. In fact, only one other sub-sector, plastics foam products, has over 1,000 establishments, still well short of the miscellaneous plastics products total of over 8,000 firms. All told, miscellaneous plastics products is the fifth largest manufacturing sector in the United

States, trailing only motor vehicle and car bodies, petroleum refining, automotive parts and accessories, and computers and peripherals in terms of value of industry shipments.

Industry Growth

The plastics industry has not experienced dramatic industry growth over the past ten years. As Table 54 shows, from 1986 to 1994 shipments grew at a rate of 13.2 percent, while employment grew at a rate of 1.8 percent, and average production wages (per hour) grew at a rate of 22.9 percent.

Table 54
Industry Growth

	1988	1990	1992	1994	Percent Growth
Value of shipments (millions)	$59,036	$62,390	$62,308	$68,040	13.2%
Employees (000)	584	595	574	595*	1.8%
Average production wage (per hour)	8.56	9.22	9.97	11.06*	22.9%

*estimated *U.S. Industrial Outlook, 1994.*

These relatively anemic growth patterns are forecaster to continue with about 15 percent growth in shipments forecast from 1994 to 1998. More than most industries, the plastics products sector is dependent on the performance of other manufacturing sectors. An economic downturn, similar to the one experienced in the early years of this decade will have a particular effect on the plastics industry. Plastics products are used extensively by the electronics , health care, construction, transportation, automotive and food packaging industries.

Industry Trends

While the amount of total shipments of plastics is not expected to grow extensively in the next years, there may be more opportunity for smaller firms. The trend towards corporate downsizing should have a beneficial effect on the smaller and medium sized firms that predominate in this sector. In many large OEMs, smaller injection molding jobs are done even if the firm's primary sector is not plastics processing. Pressure to reduce costs has and should continue to force these firms to outsource jobs.

Another trend expected to affect the plastics industry in the coming years is larger plastics firms sending their production to low-wage country overseas. The wage gains made by building a product in nations such as Mexico or China offset the shipping costs of getting the products to their final destination.

Locational Patterns

Every state has some plastics manufacturing with the greatest regional concentrations located in the Far West, the Northeast and the Midwest. The top six states in terms of plastics employment- California, Ohio, Michigan, Illinois, Texas and Pennsylvania- largely reflect that regional trend. The top twelve states have 70% of the nation's plastics employees. In addition to Ohio and Pennsylvania, North Carolina, Georgia, Tennessee and

Kentucky are other ARC states with significant plastics employment. Georgia, Alabama and Tennessee have experienced significant growth in the past few years, with all three of the states increasing employment in plastics processing by over 30% in the years 1991 to 1994.

Within the ARC region, the area with the most significant plastics concentration was extremely clear. Erie, Pennsylvania, a city of 108,000 inhabitants sitting on the northwest edge of the ARC's territory, has both a historical and present day claim to being the region's center for the plastics industry. Although Erie County is clearly the center of this industry, the cluster extends southward towards Pittsburgh and westward into Ohio. The cluster analyzed here includes 12 counties.

The only other geographic area with a significant concentration of plastics firms in the ARC Region was the Spartanburg/Greenville area of South Carolina. However, it has nowhere near the concentration on a scale that the Erie area possesses.

Export Trends

The ARC target industry SIC 308 is part of SIC major industry 30, rubber and miscellaneous plastics products. SIC 30 data is used in this analysis. In 1995, rubber and miscellaneous plastics products accounted for 2.2 percent of the value of manufactured products exported from the United States and 3.0 percent of the value of manufactured exports from the ARC states. The slightly higher ratio for the ARC member states indicates that these states contribute a relatively high share by value of US rubber and miscellaneous plastics products exports.

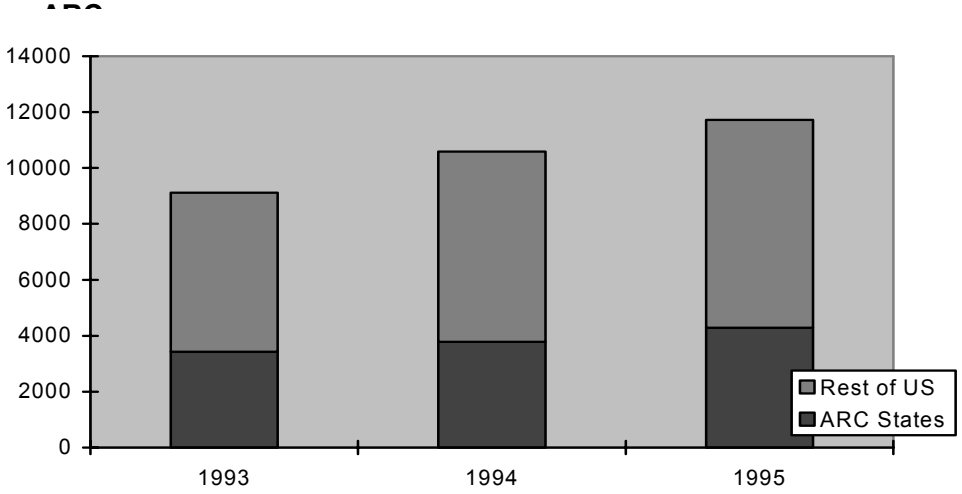
The US 1995 rubber and miscellaneous plastics products export total increased from $9.1 billion in 1991 to $11.7 billion in 1995, an increase of just over $2.6 billion dollars. During the same interval, rubber and miscellaneous plastics products manufacturers in the ARC states increased their export sales from $3.4 billion to $4.3 billion, a 1993-1995 increase just under $ 1 billion. This growth in export sales represents an increase of 28.6 percent for the United States and 25.0 percent for the combined ARC member states. Table 55 lists the national and 13-state total values of rubber and miscellaneous plastic product exports for 1993 through 1995.

Table 55
VALUE OF RUBBER AND MISCELLANEOUS PLASTIC PRODUCT EXPORTS, 1993-1995 (millions of dollars)

Area	1993	1994	1995	1993-1995 Change
ARC States	$3,432.2	$3,785.6	$4,290.2	$858.0
United States	$9,114.7	$10,595.0	$11,725.1	$2,610.4

The ARC member states combined contribute well over a third of US export sales in rubber and miscellaneous plastics products. Due to the slightly slower 1993-1995 growth in exports from ARC states, the multi-state contribution slipped from 38 percent in 1993 to 37 percent in 1995. Figure 29 illustrates the ARC contribution to US exports.

Figure 29



Ohio and New York lead the ARC states in the value of rubber and miscellaneous plastics products exporting. These two states account for one of every four dollars earned in exports during 1995. However, every ARC state experienced growth in the value of this industry's exports between 1993-1995. Table 56 lists the 1993 through 1995 value of rubber and miscellaneous plastics products exports attributed to each ARC member state, and the changes in the value of those exports over the three years. The gains ranged from over $231 million for South Carolina to $11 million for West Virginia.

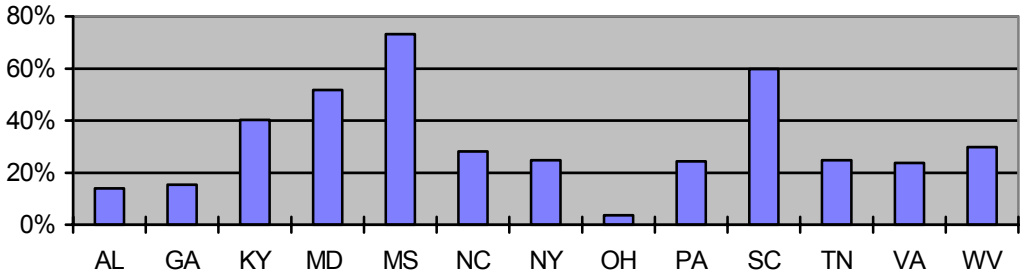
Table 56
VALUE OF RUBBER AND MISCELLANEOUS PLASTIC PRODUCT EXPORTS BY STATE, 1993-1995
(millions of dollars)

Area	1993		1995	1993-1995 Change
Alabama	$135.9	$127.8	$155.0	$19.1
Georgia	$223.5	$248.9	$257.8	$34.3
Kentucky	$94.8	$111.3	$132.9	$38.2
Maryland	$66.2	$90.2	$100.4	$34.2
Mississippi	$38.6	$51.9	$66.8	$28.2
N. Carolina	$332.0	$369.5	$425.2	$93.2
New York	$541.5	$561.0	$675.3	$133.8
Ohio	$718.3	$715.0	$744.3	$26.0
Pennsylvania	$332.5	$373.1	$413.7	$81.3
S. Carolina	$386.3	$517.6	$617.3	$231.0
Tennessee	$269.4	$312.4	$336.2	$66.8
Virginia	$254.3	$264.9	$314.5	$60.2
W. Virginia	$39.1	$42.0	$50.8	$11.7

Absolute numbers tell part of the story, but the impact of a given increase or decrease in export sales depends in part upon the amount of export activity. Calculating the rate of change helps put the movement in perspective. Figure 30 shows the rate of change in rubber and miscellaneous plastic product exports among the ARC states.

Figure 30

Percent Change in Rubber & Misc. Plastic Product Exports, 1993-1995



Mississippi, which had relatively low dollar values for rubber and miscellaneous plastic product exports, had an export growth rate of 73 percent. South Carolina, and Maryland also experienced growth rates in excess of 50 percent between 1993 and 1995, while Kentucky export values increased by 40 percent, and West Virginia increased by 30 percent. All other ARC states grew more slowly than the regional average of 25 percent. New York, which with South Carolina led the increase in dollar value of exports, had a relatively slow rate of growth. Ohio, the largest exporter, had the slowest rate of increase among all ARC states.

Export Intensity

Another technique for accommodating size differences among the ARC states so that export performance can be compared across the states and with the national average is to calculate the value of rubber and miscellaneous plastic product exports as a percentage of the gross state product (GSP). That ratio measures the contribution that rubber and miscellaneous plastic product exports make to the overall state economy.

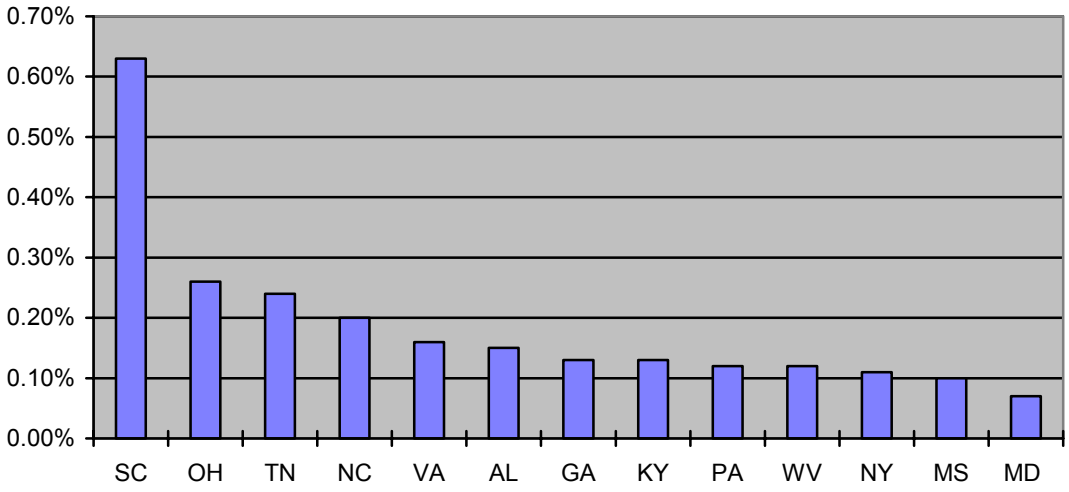
The 1993-1995 rubber and miscellaneous plastics products export intensity for the Appalachian region states of .17% is just above the national rate of .15%. The difference describes the additional contribution that export sales of rubber and miscellaneous plastic products are making to the regional economy above the contribution they would be making if export performance was at the national average. However, the experience varies among states within the ARC region. Figure 31 ranks the ARC member states by their 1993-1995 rubber and miscellaneous plastics products export intensity.

South Carolina stands out among the ARC member states as having an exceptionally high export intensity that more than twice as high as any other ARC state. Ohio, Tennessee, and North Carolina also have export intensities that are well above both the regional and national averages, while Virginia and Alabama are above the national average but below the regional ratio.

To facilitate comparisons of export performance over time, the ARC states' export intensity can be calculated as an index relative to the national average. The resulting number is the target industry counterpart of the overall export intensity index calculated in Chapter 1. The national EII is always one, and states where rubber and miscellaneous plastics products exports make an above average contribution to the economy have a rubber and miscellaneous plastics products EII greater than one. Conversely, if rubber and miscellaneous plastics products exports make a relatively small contribution to the state economy, the EII is less than one.

Figure 31

ARC States Rubber & Misc. Plastic Product Export Intensity



The ARC states combined rubber and miscellaneous plastic product EII was 1.11 in 1995, down from 1.14 in 1993 but still above the national average. Changes over time in the EII reflect a change in the contribution the industry's exports to the state economy that is greater (an increasing EII) or less (a decreasing EII) than the national trend. Trend data confirms South Carolina leadership in plastics exporting. South Carolina recorded the largest EII gain for any state in the region, while Ohio, the state with the second highest EII in 1993, experienced the largest decline. Other states with a rising EII for rubber and miscellaneous plastics include Mississippi, Kentucky and Maryland. Alabama and Georgia had falling EIIs, and the remaining states were essentially stable. Table 57 lists the rubber and miscellaneous plastics products export intensity index for the ARC states.

Table 57
RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS EXPORT INTENSITY INDEX, 1993-1995

Area	1993	1994	1995
AL	1.14	0.92	1.01
GA	0.94	0.90	0.83
KY	0.83	0.84	0.91
MD	0.38	0.45	0.45
MS	0.55	0.64	0.74
NC	1.35	1.29	1.33
NY	0.74	0.66	0.73
OH	1.96	1.68	1.58
PA	0.84	0.81	0.82
SC	3.62	4.17	4.48
TN	1.60	1.59	1.54
VA	1.09	0.98	1.05
WV	0.83	0.77	0.85

ARC Erie Plastics Cluster

The ARC's region's Erie plastics cluster (which, as mentioned, includes counties in Ohio as well as Pittsburgh) has a total of 163 firms with 13,945 employees in 1993. Table 57 classifies these establishments by primary product according to their four-digit SIC code.

Table 58
Cluster by Subsector

Primary SIC Classifications	Number of firms	Employees	% Share of Cluster Employment	Average # of employees per firm
Unsupported film and sheet	6	692	5.0	115
Unsupported plastics profiles	2	161	1.2	81
Laminated Plastics	8	792	5.7	99
Plastics Pipe	4	284	2.o	71
Plastics Bottles	2	220	1.6	110
Plastic Foam Products	10	358	2.6	36
Plastics plumbing fixtures	2	195	1.4	98
Plastics Products, NEC	129	11,243	80.6	87

Source: *County Business Patterns, 1993.*

As in the case with the plastics industry in the rest of the nation, the "catch all" sub-sector of plastics products, NEC dominates the Erie cluster. In fact the percentage of employment in Erie

in sector is 17 percent higher than the national average for the plastics industry. As will be discussed, this is primarily due to the large number of injection molding firms in the region, companies that usually fall under the NEC sub-sector.

It is also interesting to note that the firm size of the plastics products, NEC sector tends to be smaller than that of other sub-sectors. This, in part, reflects the presence of some extremely small companies in this sub-sector. Many firms in SIC 3089 are simply job shops, performing as - needed tasks for larger companies who contract out their plastics processing.

Concentration within the cluster

The Erie plastics cluster is strongest in Erie County, the country which, not surprisingly, includes the city of Erie. Other counties in the cluster with high concentrations of plastics industry include Guernsey and Tuscarawas Counties in Ohio. Table 58 shows the relative importance of plastics firms to the local economies of the duster. he location quotient was calculated by measuring the percentage of the county's total employment in plastics, compared to (divided by) the same ratio for the nation as a whole. The relatively low location quotient for Allegheny County, the county containing Pittsburgh is mainly due the heavily industrialized nature of that county.

Table 59
Number of Establishments and Employment and Location Quotient by County

County	State	Employment	Establishments	Loc. Quotient
Allegheny	PA	2,368	40	0.57
Beaver	PA	272	8	0.65
Crawford	PA	529	12	3.02
Erie	PA	4,570	57	6.24
Lawrence	PA	595	12	3.19
Mercer	PA	510	7	1.91
Warren	PA	738	4	6.86
Washington	PA	644	11	1.58
Columbiana	OH	807	4	4.12
Geurnsey	OH	680	12	8.08
Holmes	OH	331	4	4.49
Tuscarawas	OH	821	16	4.25

Source: *County Business Patterns*, 1993.

An argument could be made that the Erie plastics cluster extends into southwestern New York State and into additional counties in northeastern Ohio. In fact several of the service providers interviewed for this report worked with firms beyond the borders of the ARC region. An example of this phenomenon is the Plastics Program at Penn State Erie-Behrend College. The college considers counties in northeast Ohio, northwest Pennsylvania and southern New York to be a part of its service area.

The plastics cluster is overwhelmingly autonomous—with almost 81 percent of the firms being either single location establishments or headquarters. The independent nature of the industry again reflects the preponderance of "job shop' injection molders.

Importance of the tool and die industry and other suppliers

A major reason for the Erie region's strength as a plastics duster cannot be found simply by analyzing the numbers and concentrations of firms within SIC 308. The plastics industry has flourished in and around Erie in large part due to the presence of a large and dynamic tool and die industry. Over 100 tool and die companies are located in the area--one of the highest concentrations in the nation. This industry is responsible for building the molds used in much of the plastics processing work done in the region.

The relationships between the plastics firms and the tool and die manufacturers is another reason why analysts view Erie as an industrial cluster. However, most of the companies interviewed for this study did not report purchasing a high percentage of their products locally. Few said they purchased more than 15 percent from firms within an 150 mile radius and only two purchased more than 50 percent from local firms. However, the relative lack of local purchasing should not be overemphasized. First, since most of these firms are second or third tier suppliers they require few inputs beyond the industrial machinery required to mold the plastics and the resin from which the plastic is actually made. The former is made by only a handful of companies (Conair Inc., one of the largest is located within this cluster) and tends to be a long-term purchase rather than an annual one. Resins are supplied by large multi-national petroleum companies which are not located within the region. Secondly, while products may not be purchased in great numbers from local suppliers, most firms' main customers are within a 150 to 300 mile radius. While this certainly creates a vibrant internal market it definitely makes the firms less likely to export-most firms are resolute in their belief that they cannot compete in markets located more than 300 miles away from their facility. An example of this attitude comes from one mid-sized company which just opened up a new facility in Massachusetts. The company wanted to be closer to one of its most important customers Gillette, which is located in Boston.

History of the plastics cluster

The history of the Erie plastics cluster can be traced back 25 years before plastics processing became a viable industry. In 1913, the Hookless Fastener Company started a manufacturing facility in Meadville, a small town south of Erie. The company, later remained the Talon Zipper Corporation used a number of precision machining and tooling operations which would eventually lead to the production of precision molds for compression, transfer and injection molding. A number of the tool and die companies that exist in Erie were direct spin-offs of the larger company and the most important "sister" industry of the plastics sector became firmly entrenched in the region.

Plastics manufacturing began in the region in 1935 when Erie Resistor began making plastics. Erie Resistor is important for the local industry for two reasons besides being the first in the area to manufacture plastics. First, Erie Resistor became the first company in the Untied States to use injection molding, the key to making plastics processing a rapid automation industry. Second, many of the workers on the Erie Resistor presses, like their counterparts at Talon Zipper, eventually left the larger firm to start their own companies. Five of the most prominent plastics

companies in the region owe their origins to Erie Resistor. The industry continued to grow and by 1953, 14 million pounds of plastic material were shipped into the Erie region, leaving the area as toys, buttons and automobile parts.

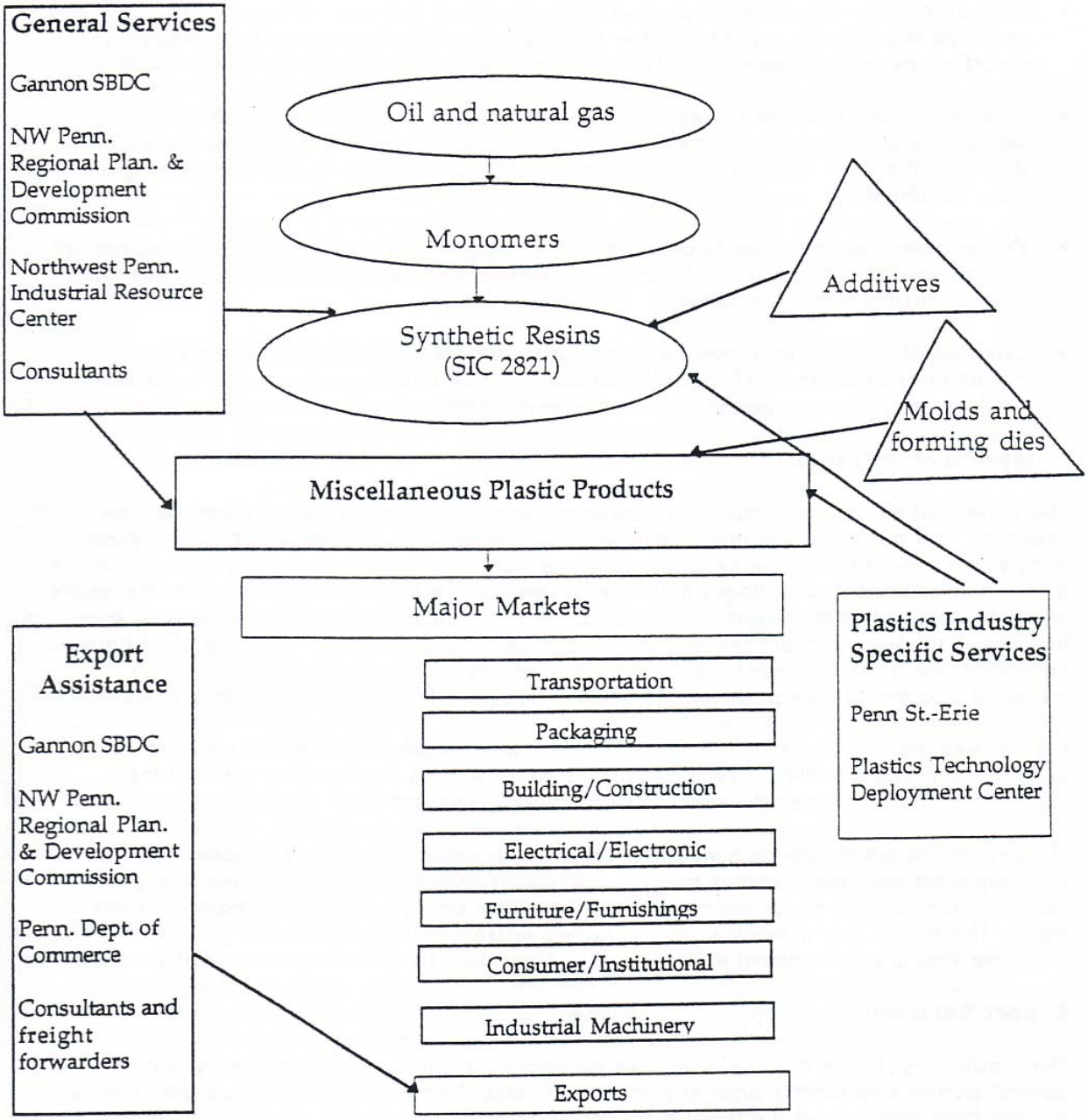
The region as a whole has followed closely the economic trends of the rest of what is often called the "rust belt." The hey-day of manufacturing in the 1950s and early 1960s began to lag in the 1970s and 1980s as plastics, an industry heavily dependent on other sectors, faced significant downturns. In the 1980s, as the industry and region emerged from the worst recession since the 1930s, several of the larger plastics firms decided to band together to address one of the industry's problems: a shortage of highly skilled workers. Working with faculty and administration at Penn State-Erie, the firms succeeded in opening a plastics laboratory at the college and creating a baccalaureate program in plastics engineering technology. Much of the original lab's machinery and equipment were donated by local plastics companies who also helped create a $1.2 million equipment endowment fund. Presently 750 students in the 3,200 college are enrolled in engineering or engineering technology with many of these in plastics engineering. The college recently instituted an associate degree program in plastics technology.

Another program started in 1993 with the cooperation of Cleveland Advanced Manufacturing Program (CAMP). The college and CAMP received a $2.8 million Technology Reinvestment project award for the purposes of starting the Plastics Technology Deployment Center (PTDC). This center, affiliated with the National Institute of Standards and Technology's (NIST) Manufacturing Extension Program, helps small and medium-sized plastics firms become more competitive. The establishment of the center is itself a statement of the recognition of the industry's importance to the Erie area and to the area's prominence as a national center of plastics products. PTDC is one of the very few centers in the national system of NIST extension centers which focuses on a particular industry.

The Cluster Today

While the statistics pertaining to the Erie plastics cluster tell part of the picture, firms' attitudes towards a variety of issues impacting their exporting potential can only be obtained by talking directly to the firms themselves. To that end, the project team interviewed twenty companies—10 exporters and 10 non-exporters. The companies were selected by a variety of means. First using a database from Dun & Bradstreet's Direct Access Service, researchers identified firms producing goods in SIC 308. This list was then shared with staff at the Plastics Technology Deployment Center in Erie which pointed out good candidates for the survey. In addition to the suggestions made by the PTDC, the D&B list was cross listed with the journal of Commerce's Directory of United States Exporters, which lists firms which export. Cold calls were made to fill in the remaining holes. Figure 32 depicts the relationship between plastics firms, and their raw material suppliers, industrial supplies, general and specialized services, export assistance, and the domestic and foreign market penetration.

Figure 32 ARC Erie Plastics Cluster


General Services
Gannon SBDC
NW Penn. Regional Plan. & Development Commission
Northwest Penn. Industrial Resource Center
Consultants
Oil and natural gas
Monomers
Synthetic Resins (SIC 2821)
Additives
Molds and forming dies
Miscellaneous Plastic Products
Major Markets
Transportation
Packaging
Building/Construction
Electrical/Electronic
Furniture/Furnishings
Consumer/Institutional
Industrial Machinery
Exports
Export Assistance
Gannon SBDC
NW Penn. Regional Plan. & Development Commission
Penn. Dept. of Commerce
Consultants and freight forwarders
Plastics Industry Specific Services
Penn St.-Erie
Plastics Technology Deployment Center

Several broad characteristics about the firms emerged:

- All but two of the firms interviewed are locally owned.
- The majority of the non-exporting firms were small with all but two having fewer than 100 employees.
- Most of the exporting firms interviewed were larger with six having more than 100 employees and four of those having between 250 and 500 employees.

Economic Status

The firms interviewed appear to be doing quite well, with increasing sales, wages, and employment in the last three years. Firms appear to be performing at slightly above the national industry level. Among the trends gleaned from the survey

- 75% of the firms interviewed reported sales growth of between 10% and 50%. The non-exporters actually reported higher sales growth, with three of the firms interviewed reporting growth of greater than 50% and none with sales growth of less than 10%.
- Employment remained fairly steady for the exporters, with most firms reporting an increase of less than 10 percent over the past three years. Non-exporters grew at a slightly higher rate with about half the firms reporting increases in employment of greater than 10 percent.
- Wage growth remained fairly constant for the exporters, with all reporting an increase at a level less than 10 percent. Most of the non-exporters reported similar increases with a few increasing wages by between 10 and 20 percent.
- Exporters showed rapid increases in their exports with most showing an increase in export sales of between 10 and 50 percent over the past three years. Still only one of the firms employ a person whose sole responsibility is exports.

Competitive Situation

The survey revealed some important differences in competitive advantages between the exporting and non-exporting firms, or at least in how the firms themselves perceived those competitive advantages. The exporting firms mentioned both price and their company's reputation as the most important advantages their firm possessed. This is not surprising given the nature of the plastics exporting business. If a firm is to compete effectively overseas, it must be able to supply a product cheaper than it can be produced locally. In terms of a company's reputation, the just-in-time nature of much of this industry means that a product must be delivered in a timely fashion or run the risk of holding up the entire production process.

For non-exporters, the competitive advantages most commonly mentioned were product design and product quality. These companies must meet the rigid project specifications of their customer if they want to continue as a primary supplier to that firm.

The strength of the region as a whole in plastics was emphasized by the relative importance both exporters and non-exporters put on worker skills. Both sets of firms stated that good labor markets were a major region for the competitive strength of the Erie region in plastics parts. The region has a ready supply of skilled workers, and the continued growth of Penn State-Erie should only augment that.

Export Behavior

The plastics industry in the Erie area, like the sector nationally, does not heavily export. Several studies and reports prior to this one indicated the low emphasis on exports given by plastics firms and indeed, by firms in the region generally.

- In 1989 over 1,000 tons of plastics were shipped to South America-not one ton came from Northwest Pennsylvania.
- A 1993 Harris survey indicated that about half of employees in Erie worked at firms that exported, however when these companies were surveyed separately, about a third did not export on an on-going basis.
- For a Pennsylvania meeting of plastics firms, a survey was sent out to determine the topics for breakout sessions. Firms were asked to rank whether they had high, medium, low or no interest 10 possible subject areas. International trade finished second to last of all the subjects mentioned. Forty four percent of firms answering the survey had low or no interest and only 23 percent had high interest in learning more about international trade.

The survey work for this project would seem to back up these findings. Of the firms interviewed who exported, none exported above 15 percent of their product and most exported less than 10 percent. These exporters believed that foreign markets were important for the future of the industry—but less than half of the firms classified exports as very important.

Despite the professed importance of exporting, the firms did not devote a great deal of resources to selling goods overseas. Only three of the companies interviewed assigned specific employees to be responsible for exporting and only in one of those cases did that individual devote more than 10 percent of his or her time to the endeavor (in that case, exporting was the individual's sole responsibility).

According to the surveyed firms, a diverse set of obstacles discourage plastics firms from becoming more active exporters. The most prominently mentioned were:

- **Cost of shipping:** The expense required to get products to market, especially the freight costs, often eliminate any competitive advantage the firm might have had in terms of cost.
- **Marketing difficulties:** The small size of most of these companies means that they can not afford a large marketing staff that can scout out new foreign markets or shepherd products from manufacture to final delivery.
- **Foreign regulations and taxes:** Although there are not as many in the plastics products industry, foreign regulation of imports presents difficulties. A firm mentioned the V.A.T. tax applied on their goods as an impediment and another theorized that foreign firms are much more likely to use their local suppliers whom they are sure meet the complex local country regulations than risk an American supplier.
- **Lack of information/cultural barriers:** Although not mentioned nearly as often as compared to some others, some firms found that they were not equipped with enough information to adequately negotiate through the export maze. Included in that dearth of information is a lack of language skills that sometimes makes shipping difficult.

Since exporting is clearly not a common activity in the Erie region, it makes more sense to talk to the firms which do not export to find out why they don't sell their products overseas.

The three biggest barriers to entering foreign markets mentioned by non-exporters were the following:

- **Unfamiliarity with the export process:** Firms that identified this barrier simply do not know how to go about starting to export.
- **Transportation costs:** Firms do not think they can compete effectively with the costs of shipping added on to their product.
- **Lack of information:** about markets and customers: Some firms do not know where they might export their products even if they made a commitment to enter foreign markets.

Service Providers' Perspectives

In addition to interviewing firms, researchers for this project talked to service providers about the plastics industry in general and its export potential in particular. The Erie area has agencies which are specifically charged with assisting the plastics industry as well as assistance geared more generally to small business providers.

Opinions relating to several issues emerged in talking with the service providers:

- There is recognition that this is strong region for the plastics industry. Two strengths of the industry are the large presence of the tool and die industry and location near major markets.
- The biggest barrier to firms entering foreign markets is not those mentioned by the firms, according to most service providers interviewed, it is simply a lack of interest. Most firms, including those interviewed in this survey, are doing quite well selling their products to other firms within a 300 mile radius. New markets, especially those with the added complication of being foreign, seem unnecessary.
- Most of the non-exporting firms interviewed manufacture sub-assembly parts, products that tend not to be heavily exported. Fully assembled products stand a much better chance of ending up overseas than do those which are meant to be part of a larger product. Almost all the firms interviewed for this project which did not export produce custom-made injection molded parts for OEMs or second tier suppliers. While they may identify such things as lack of information and costs as barriers to exporting, a more likely explanation may be the products they manufacture.
- Service providers also suggest that firm owners simply do not have the time to make the investment in foreign trade. Most of the plastics firms are very small shops where the firm owner serves as everything from company president to chief marketer and the amount that he or she can devote to exports is minimal.
- Service providers believe that that there is adequate support for exporting. However, there is no specific plastics industry initiative aimed at exporting. The agencies geared towards the industry tend to focus more on technical rather than market issues. The broader-based service providers have opted to put what cluster focus they have into other industries. For instance, the Northwest Pennsylvania Regional Planning Development District has a program aimed at the food products industry.

Despite the presence of substantial resources in the region for exporting and general business assistance, firms interviewed tended to get information about improving their competitiveness elsewhere. Few of the exporting firms indicated that they used publicly-supported service providers as sources of information on exporting. In addition the vast majority of exporters indicated that they never used community colleges, government technology assistance or small business centers as sources of information or assistance on any business problem. Instead, most relied on private sources of information such as other companies, equipment vendors, and suppliers.

Non-exporters also tended to shy away from using public sources of assistance. Most used suppliers, trade journals and equipment vendors for sources of information and assistance. Government sources were rarely or never used by these firms.

Yet, on a somewhat ironic note, four of the firms interviewed cited government support as an advantage of doing business in the geographic location. Frequently mentioned as a plus, is the offered, if not taken advantage of, Pennsylvania Department of Commerce's trade show assistance program. In this program, firms are given up to $2,000 to attend a trade show in a foreign country. The Penn St.-Erie plastics program was also mentioned by some as a general resource for the area. Exporters generally tended to use the service more than non-exporters. This is not surprising given that the exporting firms tended to be larger and more likely to use engineering services more the types provided by the Penn St. college.

Dynamic Factors and Linkages

There was not a lot of agreement among firms on what makes the Erie region a good place to do business. Proximity to customers, government support and general quality of life were all mentioned as pluses of doing business in the area. Again the presence of the tool and die industry was mentioned as a plus by several interviewed firms.

In terms of cooperation, most firms do not engage in formal ways with their peers.
While most firms are members of either the Society of Plastics Engineers, the Society for the Plastics Industry or both, these trade associations are seen as more lobbying organizations at the national level rather than chances to get to know their own community.

Some of the larger companies have engaged in some forms of cooperation, the most notable being the banding together to help build the Penn St.-Erie plastics center. That center, along with the Plastics Technology Deployment Center, has sponsored a number of what they term "consortia," geared to particular elements of the plastics industry. For example, the "blow molding consortium" supplies specific training and technical assistance to firms specializing in that method of plastics processing. The college and PTDC purchased three blow-molding machines molds and computer software to help train industry personnel in their use and to help firms develop new products using the technology.

For the smaller companies, most of the collaboration has been on specific orders. If an order is too large they might contract out with another company. Many of the firms seemed willing to explore more formal ways in which such collaboration could manifest itself.

There seems to be an adequate level of trust and cooperation in the region with most exporting firms rating trust as average in the region. In addition, several of the service providers interviewed indicated that the atmosphere as fairly conducive to trust since many companies-especially those exporting—were not in direct competition with each other.

Conclusions about Exporting in the Erie Region

Through the interviews and surveys conducted with both firms and service providers in the Erie region, several findings emerge:

1. Any efforts at export development in the Erie region must take into account the primary barrier to foreign market entry: lack of an appropriate product. Plastics firms in Erie, especially the smaller firms on which this study focuses, are overwhelmingly sub-assembly manufacturers. Exported products are almost exclusively finished products. Thus, unless firms in the area radically change their product line, exports will probably remain fairly limited.
2. There seems to be a general lack of interest in exporting in the region. Most of the firms believe they are competitive within a 300 mile radius and see little reason to struggle to expand that market. This attitude seems fairly prevalent among plastics parts manufacturers throughout the state, where international trade is generally not viewed as a crucial industry concern.
3. If firms do decide to export, there exists a good network of assistance providers in the Erie region. From the Small Business Center at Gannon University, to the Local Development District Office to the State Department of Commerce, resources exist for firms to get started in exporting. The State's program is perhaps the most impressive because it funds companies to attend foreign trade shows. Not only does this attendance encourage exporting, it allows companies to interact, leading to future collaboration.
4. Collaboration in the Erie region among plastics firms seems fairly strong. Several of the larger firms worked together to start the Penn St. plastics program. In addition, there is a great deal of informal cooperation between firms and the large presence of tool and die firms in the area reinforces the symbiotic relationships between many of the firms. Indeed, if there is to be an export development strategy in the region it will most like be a collaborative approach. Firms might join together to jointly market Erie as an international center of plastics processing.

The World and Erie: One Plastics Firm and the Challenge of Exporting

Huron Plastics[30] is one of the most successful small plastics companies located in the Erie, Pennsylvania region. It's experience with exporting also can be seen as fairly representative of other mid-sized firms.

Although the company has sent some products in foreign markets, its experience is fairly limited. While small companies in other industries might not want to export because of the cost or the time involved, for Huron Plastics it is a problem inherent in the product they produce.

Like most plastics firms in the Erie region, Huron Plastics almost exclusively manufactures sub-assembly parts. These types of parts are simply not in great demand overseas. A foreign company will more likely use a local supplier who will be cheaper and just as important deliver the product in a very timely fashion. Indeed, most of Huron's customers are located within a 300 mile radius—to deliver products beyond that mile threshold might create a whole different set of problems.

While Huron Plastics is not making any future plans to export, the CEO realizes that there may come a time when in order to be competitive, they may have to change their philosophy.

"We may be on borrowed time in terms of exporting," he says. "For instance, one of our largest customers is a multi-national corporation. Eventually they will want one plastic canister for a product. They will not want to have to use a different supplier in every country in which they operate."

That time, however, appears to be well in the future. The owner also believes that smaller companies who often have a great number of customers will find even less need to export. If one of their customers were to demand that their suppliers conform to a particular standard, many firms could afford to stop supplying that customer and have other companies pick up the slack. For companies like Huron Plastics that rely on fewer companies with larger orders, dropping a customer is rarely an option.

Appendix F
Industry Analysis: SIC 308 Plastics

The following analyses and data are in reference both to SIC 308*, and the general category of semi-fabricated plastics products, as there was insufficient data to examine SIC 308 alone. Additionally, many items that fit into this category are, indirect exports; exported as a part of another product. Statistical accuracy and comparability to other sources are affected by a number of factors, including lack of published figures in certain markets, variances in data collection techniques, sources of data, and industry definitions.

The United States continues to benefit from a trade surplus of approximately $1.5 billion in semi-fabricated plastic products. The major plastic products producers are large, international, and often vertically integrated companies. The major industries leading in the use of plastics are electronics, health care, construction, transportation, automotive, and food packaging.

Table F-1
US Plastics Exports by Destination Region: 1992-1995

SIC 308, Plastics	NAFTA	Japan	EU-15	Asian NICs	Other Americas	Rest of World	Total
1992	$2,180	$248	$913	$423	$196	$511	$4,471
1995	$3,292	$438	$1,286	$650	$619	$489	$6,774
Absolute Change	$1,112	$190	$373	$227	$423	$(22)	$2,303
Percent Change	51%	77%	41%	54%	216%	-4%	52%

U.S. Total Exports, 1995 by Area and Three-digit SIC Product Groups; (Census Basis; foreign and domestic Exports, F.A.S.; $ millions.)

The data in Table F-1 indicate that the plastics market grew rapidly between 1992 and 1995, with a total growth of 52% in U.S. exports. The market growing most rapidly in value is the NAFTA market, with a growth of $1.1 billion dollars in this time period. The fastest growing market is represented by NAFTA, with a growth of $1.1 billion dollars. In terms of percentage change, sales to Latin American export markets have grown by 216%, moving from the smallest market at $196 million in 1992, to the second largest market at $423 million in 1995.

* Including unsupported plastics film and sheet (SIC3081), unsupported plastics profiles, rods, tubes, and other shapes (SIC3082), Laminated plastics plate, sheet, profiles, rods, and tubes (SIC3083), plastic pipe (SIC 3094), plastic foam products (SIC3086), custom compounding of purchased plastic resins (SIC 3087), and miscellaneous plastic products, not elsewhere classified.

Table F-2
Plastics in Semi-fabricated form

	World	Canada	Mexico	Japan	Netherlands	
1993	$ 3,370,868	$ 904,904	$512,663	$185,780	$ 204,833	$172,157
1994	$ 3,810,245	$1,017,471	$693,492	$217,472	$ 239,534	$179,576
1995	$ 4,270,697	$1,137,867	$644,688	$244,324	$243,259	$201,139
Absolute Change	$899,829	$232,963	$132,025	$58,544	$38,426	$28,982
% Change	27%	26%	26%	32%	19%	17%
% of World	100%	27%	15%	6%	6%	5%

U.S. Chemical Trade with Selected Countries, Groups and World, U.S. Exports for Selected Countries and Groups, Domestic Exports, F.A.S. $ thousands

As Table F-2 indicates, for the entire category of plastics in semi-fabricated form, Canada and Mexico constitute the primary trading partners of the U.S. The NAFTA countries account for 42% of exports, primarily due to close proximity and interrelated markets with the United States. The dramatic increase of plastics sales resulted from both increased production of products using plastic parts, and replacement of other materials by plastic parts. Plastics are replacing metals and other raw materials in production to improve design, cut costs, reduce weight and for corrosion resistance.

Country Analysis

The research team examined this sectors' export performance and potential using information from the Department of Commerce's Country Commercial Guides for the listed countries, the International Trade Commissions' U.S. Trade Shifts in Selected Commodity Areas, and interviews with industry experts and U.S. manufacturers.

Canada: U.S. plastics sales to Canada grew 12 % in 1993-1995 and are expected to increase at the same rate over the next three years. This growth is attributable to the interrelationships between U.S. and Canadian companies, the similarity of processes of the two countries that allows for ease of use of U.S. products, and the benefits of tariff reductions in the U.S. - Canada Free Trade Agreement (FTA), and NA.FTA. One issue that U.S. exporters will have to consider when exporting to Canada is the increase in environmental concern and regulations, particularly in relation to recycling.

Table F-3
Annual Domestic Exports to Canada, F.A.S. ($ thousands): 1993-1995

1993	1994	1995	% growth, '93-'94	% growth, '94-'95
$904,904	$1,017,471	$1,137,867	12.44%	11.83%

U.S. Chemical Trade with Selected Countries, Groups and World, U.S. Exports for Selected Countries and Groups, Domestic Exports.

Mexico: The growth of the Mexico's plastics industry is projected at approximately 10% per year over the next three years. The market is still recovering from the Peso crisis, but industry experts predict an increase of expenditure due to the improvement of economic conditions, population growth, and increased per capita consumption. Since much of the plastic producing machinery in Mexico is old and only slowly being upgraded or replaced, importation of semi-fabricated plastics will be necessary to supply this increase in consumption. The benefits of NA.FTA, and the relatively inexpensive shipping costs to Mexico, will boost semi-fabricated plastics industry to success in Mexico.

Table F-4
Annual Domestic Exports to Mexico, F.A.S. ($ thousands): 1993-1995

1993	1994	1995	% growth, '93-'94	% growth, '94-'95
$512,663	$693,492	$644,688	35.27%	-7.04%

U.S. Chemical Trade with Selected Countries, Groups and World, U.S. Exports for Selected Countries and Groups, Domestic Exports.

Japan: The Japanese plastics (by SIC 308 code) export market grew at a compound growth rate of approximately 20% between 1992 and 1995. Further data on Japan's plastics market was not available to the study team.

Table F-5
SIC 308, Total Foreign and Domestic Exports to Japan, F.A.S. ($ millions): 1992-1995

1992	1995	Compound Growth
$248	$438	20.87%

U.S. Total Exports, 1995 by Area and Three-digit SIC Product Groups; (Census Basis; foreign and domestic Exports.

The Netherlands: Exports of semi-fabricated plastics to the Netherlands grew strongly in 1993-1994, but in 1994-1995 sales growth was down significantly. The Netherlands is a major importer and re-exporter of products in Europe, thus many of the products shipped to the Netherlands have other European destinations. The primary competitors in the European market are Belgium/Luxembourg, France, and Italy.

Table F-6
Annual Domestic Exports to Netherlands, F.A.S. ($ thousands): 1993-1995

1993	1994	1995	% growth, '93-'94	% growth, '94-'95
$204,833	$239,534	$243,259	16.94%	1.56%

U.S. Chemical Trade with Selected Countries, Groups and World, U.S. Exports for Selected Countries and Groups, Domestic Exports.

United Kingdom: Plastics exports to the LTK continue to grow, but future exports are increasingly threatened by European Union packaging directives for pollution control and

recycling. Some of the modifications necessary to meet these requirements are expensive to implement.

Table F-7
Annual Domestic Exports to the United Kingdom, F.A.S. ($ thousands)

1993	1994	1995	% growth, '93-'94	% growth, '94-'95
$172,157	$179,576	$201,139	4.31%	12.01%

U.S. Chemical Trade with Selected Countries, Groups and World, U.S. Exports for Selected Countries and Groups, Domestic Exports, F.A.S. $ thousands

The worldwide plastics industry growth is being threatened by the increase of environmental awareness and regulations, but is expected to continue to grow strongly due to its advantages of being cheap, versatile, and convenient. As plastics are used in many, if not most products, the continuing market expansion in all major product areas will lead to increased exports.

MEDICAL DEVICES IN PENNSYLVANIA
STILL UNDEVELOPED POTENTIAL

by Dan Broun
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General Industry Overview

The Medical Devices and Surgical Instruments sector is one of the nation's strongest manufacturing sectors. Indeed, the 1994 U.S. Global Trade Outlook, a publication released by the U.S. Department of Commerce's International Trade Administration, listed the sector as one of the ten fastest growing sectors with high export potential. The high export potential of the industry can certainly not be argued. Fully 23 percent of all medical devices manufactured in the United States are sold to foreign markets. This large level of exporting accounts for an almost $5 billion trade surplus. Table 60 shows the growth in the medical supplies industry from 1987-1993.

Table 60
Medical Devices in the United States: 1987-1993

	1987	1988	1989	1990	1991	1992	1993
Value of Shipments (millions)	7,780	8,259	8,553	9,546	9,817	10,318	10,999
Employees (thousands)	73.1	75.7	83.9	88.9	87.7	87.4	89.4
Average Production Wage (per hour)	8.91	9.57	9.58	9.81	10.59	N/A	N/A

Source: Annual Survey of Manufacturers

Components of the Medical Device Industry

The following is a brief discussion of the primary sectors that comprise the medical supplies industry and recent trends affecting their growth and competitiveness. Because the SIC Code classification of 384 covers so many diverse industries, trends differ from sub-sector to sub-sector.

Surgical and Medical Instruments (SIC Code 3841): The surgical and medical instruments sub-sector of the medical device industry is the second largest sector in the industry with about 89,000 employees nationwide. The sector includes such products as syringes, clamps, hypodermic needles, catheters and blood pressure measuring devices. This sector primarily consists of non-electric diagnostic and therapeutic devices.

Like the sector as a whole, surgical and medical instruments are growing at a rapid rate especially when measured by exporting. In 1993, the sub-sector reached a record high of $2.6 billion in exports, which led to a $1.6 billion trade surplus.

Surgical and medical instruments would appear to be headed for continued healthy growth. The U.S. Department of Commerce forecasts average annual growth in shipments to range between 6 to 7 percent through 1998. This growth should offset any sluggishness in the domestic market. A major factor in the high growth of this sector is cost containment practices being implemented by health care facilities around the world. This particular sub-sector keeps its prices lower than other sub-sectors in the industry and its production costs have grown at a rate lower than other sectors both within and outside the overall medical device industry. The actual type of products contained in the sub-sector also should show strong growth. Many of the products are non-invasive, are used for procedures that do not require hospital stays, and greatly reduce fears of complications. Thus, devices such as internal stapling devices and laparascopic and endoscopic devices should be in great demand.

The primary international competitors in this sub-sector are Germany and Singapore. Along with the United States, the two countries were the only major trading partners that showed trade surpluses for 1993. Indeed, Germany accounts for over 21 percent of all imported surgical and medical instruments in the United States, while Singapore accounts for 10 percent. Japan, Canada and Germany are the leading markets for U.S. products.

Surgical Appliances and Supplies (SIC Code 3842): The surgical appliances and supplies sub-sector is the largest sub-sector in the medical devices industry. This industry encompasses a broad range of products including prosthetics, wheelchairs, bandages and sutures.

The sub-sector's employment is growing at a slightly slower rate than the surgical and medical instruments sub-sector. In 1993, employment increased by slightly less than one percent. However, the relatively slow growth in employment was countered by an impressive 11 percent increase in exports, the highest figure in the medical devices industry. In all, the surgical appliances and supplies sub-sector produced a more than $1 billion trade surplus for 1993, including surplus increases of more than a third with major trading partners the European Community and Japan. Those two markets, along with Canada and Mexico, are the biggest markets for the sub-sector.

In terms of international competition, Mexico and Germany are the two biggest exporters of surgical appliances and supplies to the U.S., accounting for 39 percent of all imports in 1992.

The prospects for continued growth in the sub-sector are extremely strong. Shipments are expected to grow at an annual rate of between 8 and 9 percent per year through 1998. A major reason for this growth is the aging of world populations especially in the U.S., Western European and Japanese markets. In addition, the same cost concerns that help the surgical and medical instruments sub-sector will also assist the surgical appliances and supplies sub-sector. Hospitals will look for products that will enable patients to more adequately take care of themselves. Thus, devices such as wheelchairs and prosthetics which allow for self-mobility will be in demand.

Dental Equipment and Supplies Industry (SIC 3843): The smallest sub-sector of the medical devices industry is the dental equipment and supplies industry. It accounts for about 5 percent of the total industry's sales. As the name suggests the sub-sector is made up of manufacturers of equipment, instruments and supplies used by dentists and dental labs, including such products as drills, sterilizers and dental chairs.

Growth has slowed somewhat in the industry, with shipments increasing only by two percent in 1993 compared with an annual growth rate of 5 percent between 1991 and 1993. Exports, however, remain extremely strong. Indeed, 35 percent of all shipments go to foreign markets translating into $258 million trade surplus in 1993. Canada, Germany and Japan are the biggest markets for the products. In terms of international competitors, Germany, Japan and Switzerland are the three biggest importers in of products into the U.S. market. Indeed, the first two nations account for over 60 percent of all dental equipment and supplies introduced into the United States. However, the U.S. still controls over 50 percent of the world market

The industry, more so than most of the other sub-sectors in the medical device industry, is made up of primarily small and medium-sized firms. Block Drug, 3M and Kerr Manufacturing, are some of the larger firms that do manufacture products for this sector.

The sub-sector is expected to continue its growth as new technologies such as laser treatment create increased demand for new products. One possible concern for sub-sectoral growth is the increased emphasis on ISO 9000 standards needed for export. Since most of the firms in this sub-sector are small and medium-sized firms, these firms will face a cost-burden trying to get up to speed with the new standards.

X-Ray Apparatus and Tubes (SIC Code 3844): The X-Ray Apparatus and Tubes sub-sector is one of the smaller sub-sectors in the overall medical devices industry. Unlike the rest of the industry, its growth has not been particularly robust. This primarily due to the great expense of the machines produced. The move towards cost-containment in the health industry has caused more used and refurbished equipment to be bought. Indeed the National Electrical Manufactures Association reported a 150 percent increase in shipments of used equipment from 1988 to 1991.

Despite the slow overall growth of the industry, the exporting of X-Ray apparatus and tubes is steadily growing. In 1993, the last year measured, exports of the product increased by eight percent while imports only increased four percent. Japan, Canada and Germany are the most common destination for the sub-sector's products while Germany, Japan and the Netherlands were the most common source of U.S. imports.

The recent trends of slow growth in general shipments and increase in exports are expected to continue for the rest of the decade. Concerns about cost will continue to dominate this industry dominated by relatively expensive products.

Electromedical Equipment (SIC 3845): The electromedical equipment sub-sector is the third largest in the medical devices industry with 18 percent of the market share. This sub-sector includes such products as pacemakers, ultrasonic scanning devices, and magnetic resonance imaging equipment (MRIs). The market for these products has suffered for many of the same reasons affecting the X-Ray sub-sector: increasing cost-consciousness of hospitals. The equipment making up this sector tends to be extremely capital intensive, especially MRIs.

The export trends in the sub-sector reflect the growing price sensitivity. While products such as pacemakers and ultrasonic scanning devices increased by over three percent, MRI shipments have declined almost 20 percent. The drop in number of shipments has caused manufacturers to substantially lower the price of their products in some cases by as much as 50 percent. Despite

these trends, the U.S. is forecast to be able to keep its dominance in the world's market well into the next century.

Overall exports of electromedical equipment have been increasing over the past years, giving the Untied States a healthy $1.1 billion trade surplus. Germany, Japan and the Netherlands are the major markets for products while Germany and Japan export almost 60 percent of the total amount brought into the U.S.

Surgical, Medical and Dental Instruments in the ARC Region

The surgical medical, and dental instruments and supplies industries are part of SIC major industry 38, which includes measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks. (*Standard Industrial Classification Manual*; Executive Office of the President, Office of Management and Budget, 1987.) SIC 38 data is used in this analysis of recent export trends. Unless otherwise noted, the SIC 38 industry analysis, like the export analysis in Chapter 1, uses the MISER export data, as provided in the National Trade Data Base, for the years 1993 through 1995.

Recent Export Trends

In 1995, SIC 38, instruments and related products, accounted for 6.1 percent of the value of manufactured products exported from the United States and 5.4 percent of the value of manufactured exports from the ARC states. The slightly lower share indicates that the Appalachian Regional Commission member states provide a relatively small share of United States instrument and related product exports.

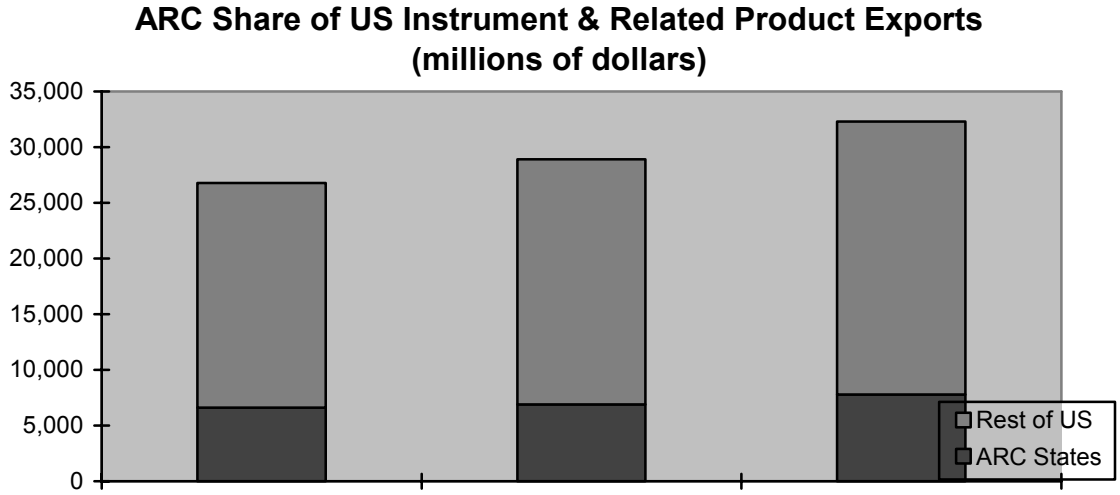
The total value of US instrument and related product exports was $32.3 billion in 1995, an increase of $5.5 billion over the $26.8 billion sold abroad in 1993. The 1995 exports of instruments and related products from establishments in the ARC member states reached $7.8 billion, an increase of $1.2 billion from the 1993 total of $6.6 billion. The value of recent instruments and related products export sales are shown in Table 61. The increased sales represent a 20.6 percent increase for the United States, and a 17.6 percent increase for the combined ARC member states.

Table 61
VALUE OF INSTRUMENT AND RELATED PRODUCT EXPORTS, 1993-1995
(millions of dollars)

Area	1993	1994		1993-1995 Change
ARC States	$6,620.9	$6,898.3	$7,784.5	$1,163.6
United States	$26,785.3	$28,906.2	$32,312.3	$5,526.9

In 1993-95, the 13 ARC states accounted for approximately one of every four dollars in export sales from US manufacturers of instruments and related products. Figure 33 depicts the region's contribution to national export totals. It shows that the region is experiencing relatively slow growth in its export sales from this industry.

Figure 33



Among the seven target industries selected by the ARC, instrument and related product exports show the greatest concentration in a single state. New York alone supplies some 45 percent of the region's exports by value. Table 62 lists recent export values for instruments and related products from the ARC states.

Table 62
VALUE OF INSTRUMENT & RELATED PRODUCT EXPORTS BY STATE, 1993-1995
(millions of dollars)

Area	1993	1994	1995	1993-1995 Change
Alabama	$59.8	$75.2	$74.2	$14.4
Georgia	$517.5	$602.6	$809.2	$291.7
Kentucky	$64.2	$96.4	$119.9	$55.7
Maryland	$280.4	$277.1	$293.7	$13.3
Mississippi	$14.2	$13.6	$13.3	$(0.8)
N. Carolina	$323.8	$402.2	$527.6	$203.8
New York	$3,172.8	$3,140.7	$3,549.6	$376.8
Ohio	$707.5	$750.7	$781.0	$73.6
Pennsylvania	$771.3	$803.7	$809.6	$38.3
S. Carolina	$96.8	$124.5	$138.2	$41.4
Tennessee	$315.8	$322.7	$351.0	$35.2
Virginia	$274.5	$268.0	$296.6	$22.1
W. Virginia	$22.4	$20.7	$20.4	$(2.0)

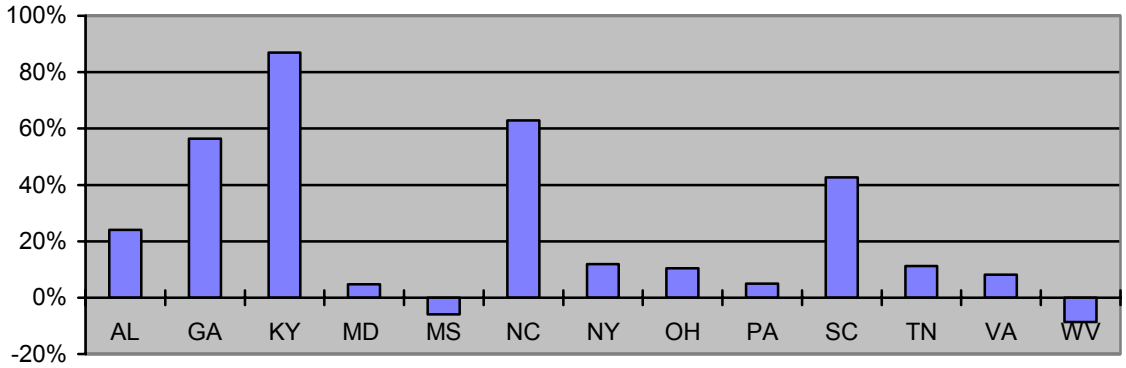
In 1995, the New York total of $3.5 billion in export sales of instruments and related products was more than four times the amount of export sales from any other ARC state. The next highest instruments and related products export sales were recorded for Pennsylvania and Georgia, with just over $800 million each. New York also had the largest 1993 to 1995 increase in the dollar value of sales, but it did not dominate in this measure. Georgia and North Carolina both posted

large increases in export values. However, no other ARC state experienced an increase in the value of exports close to these leaders. Mississippi and West Virginia experienced small declines.

Absolute numbers tell part of the story, but the impact of a given increase or decrease in export sales depends in part upon the amount of export activity. Calculating the rate of change helps put the movement in perspective. The rate of change in instrument and related product exports for the ARC states is depicted in Figure 34

Figure 34

Percent Change in Instrument & Related Product Exports 1993-1995



The rate of export growth reveals that several of the states with much smaller export totals are experiencing rapid increases in instrument and related product exports. Kentucky leads the region with an increase rate of 87 percent. North Carolina and Georgia posted gains of 63 and 56 percent respectively, while South Carolina saw a 43 percent increase in the value of exports from its instrument and related product producers. Alabama also had an export growth rate above the national average. No other ARC state, including New York, reached either the national or the regional growth rates for the value of instrument and related product exports.

Export Intensity

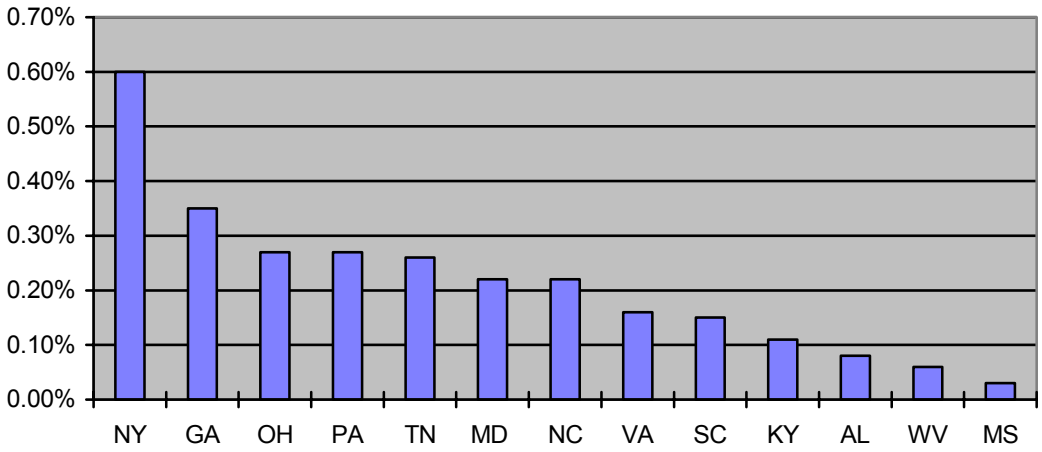
Another way to accommodate size differences among the ARC states so that comparisons can be made is to calculate the value of instrument and related product exports as a percentage of the gross state product (GSP). That ratio measures the contribution that instrument and related product exports make to the state economy.

The instrument and related product export intensity for the Appalachian Region states is .31%, which is less than the .42% ratio for the nation as a whole. The difference describes the gap between the contribution that export sales of instruments and related products are making to the regional economy and the contribution they would make if export performance was at the national average.

Despite recent slow growth New York leads the region in instrument and related product performance by a large margin. It is the only ARC state with an export intensity above the national average. The second ranked state, Georgia, is a distant second and the only other ARC state with an export intensity above the regional average. Clearly, the volume of exports from New York and that State's high export intensity skew the regional statistics to make ARC export performance appear stronger. Figure 35 ranks the individual ARC states by their 1993-95 instrument and related product export intensity.

Figure 35

ARC States Instrument & Related Product Export Intensity



To facilitate comparisons over time of ARC states' instrument and related product export performance with that of the nation, export intensity can be calculated as an index relative to the national average. The resulting number is the export intensity index (EII) for the target industry. The national EII is always 1.00, and states and regions where instrument and related product exports make an above average contribution to the economy have an instrument and related product EII greater than 1.00. Conversely if instrument and related product exports make a relatively small contribution to the state or regional economy, the EII is less than 1.00. The instrument and related product EII for the combined ARC states was 0.73 in 1995, down from 0.75 in 1993.

Changes over time in the instrument and related product EII reflect a change in the contribution of instrument and related product exports to the state economy that is greater (an increasing EII) or less (a decreasing EII) than the national trend. Thus, the EII reveals that the ARC region is under-performing the nation. Calculating the EII for individual states allows a state-by-state assessment of export performance. Table 63 lists the instrument and related product EII for each ARC state.

Table 63
INSTRUMENTS AND RELATED PRODUCTS SIC CODE 38, EXPORT INTENSITY INDEX, 1993-1995

Area	1993	1994	1995
Alabama	0.17	0.20	0.18
Georgia	0.74	0.80	0.94
Kentucky	0.19	0.27	0.30
Maryland	0.55	0.50	0.48
Mississippi	0.07	0.06	0.05
North Carolina	0.45	0.51	0.60
New York	1.47	1.35	1.39
Ohio	0.66	0.64	0.60
Pennsylvania	0.66	0.64	0.58
South Carolina	0.31	0.37	0.36
Tennessee	0.64	0.60	0.58
Virginia	0.40	0.36	0.36
West Virginia	0.16	0.14	0.12

Both the absolute values and the trends in instrument and related product EII indicate that increasing export sales from this industry represents a challenge for the ARC states. Not only is New York the only state with an EII over one, it also shows a downward trend in the value of its EII. Similarly four of the five ARC states with an EII between 0.50 and 1.00 experienced declines in their EII between 1993 and 1995. The only exception is Georgia, which experienced a strong increase, from 0.74 in 1993 to 0.94 in 1995. Kentucky, North and South Carolina had a clear rising trend in their instrument and related product EII, and North Carolina moved above 0.50 during the 1993-1995 interval.

Locational Patterns in Appalachia

As might be expected, the medical devices industry tends to cluster around metropolitan areas with large hospitals and significant research universities. Nationally, the largest clusters of medical devices can be found in Boston, San Jose and the Silicon Valley, the Twin Cities and in Los Angeles—all areas where there is a significant medical, research and perhaps, most importantly, a significant technological capability. Given that the ARC is primarily a rural region, it is not surprising that there are relatively few medical devices firms in the region, and few if any,, areas of major firm concentration. The Pittsburgh, Pennsylvania metropolitan area is the largest urban area within the ARC region and not-surprisingly has the largest concentration of medical devices firms in the region. The Pittsburgh cluster has 23 percent of the firm in the ARC region and 32 percent of the sectoral employment.

There are two other portions of the ARC region that might be thought of as small medical devices clusters. The first is located in northeast Georgia and the western Carolinas. The cluster has just over 16 percent of the regions sectoral employment. The other cluster is centered around Knoxville, Tennessee and crosses over into southwestern Virginia. This cluster has just under 16 percent of the region's ARC's devices employment. As can be seen these totals are far less than the Pittsburgh area's concentration. The Pittsburgh area is also much more geographically focused with the other two clusters covering a wide area somewhat hindering the chances for inter-firm collaboration.

The Pittsburgh medical devices cluster stretches across eight counties in Western Pennsylvania. Allegheny County, which contains Pittsburgh, has the largest number of firms. However, the county actually has a location quotient lower than one at .93, indicating a lower concentration of sector firms than the nation as a whole. The low location quotient is indicative of the fact that although the Pittsburgh metropolitan area is clearly the leader in medical devices in the ARC region it is not considered a national leader in industry concentration. In fact, the metro Pittsburgh area ranked 21st of all urban areas in the number of medical devices manufacturers.

Given the relatively small number of medical devices firms in Pittsburgh, an explanation is in order for why the area was chosen as the cluster to be analyzed. First, medical devices, as has been mentioned, is one of the fastest growing and most heavily exported manufacturing sectors. Almost any company that is to succeed in this sector must be adept at entering foreign markets. Second, there is recognition in the Pittsburgh business and business-support community, that although it may not be a prominent sector yet, it is one that should be concentrated on in the future. A recent report published by the Southwestern Industrial Resource Center and the Pittsburgh High Technology Council identified the "biomedical cluster" as one of the five most important industry clusters in the region. For purposes of analysis, the Council's report included health care information systems and molecular biology and genetic engineering but the major driver was the medical devices sector. The report stated that while "Pittsburgh has emerged as a world class health care and health care and health-related research, development, and clinical center, the region's biomedical manufacturing and commercial technology capability has been slower to develop." The final reason why Pittsburgh makes sense to study is that most of the external elements necessary for the success of the medical devices industry are present, even if the concentration of firms is not. Pittsburgh has two large research universities, Carnegie Mellon and the University of Pittsburgh both with excellent engineering programs, a prime component of success in this industry. The University of Pittsburgh's Medical Center is also world renowned, for among other activities, transplantation. Hospitals, especially those with strong research capabilities, are often sources of innovation for existing medical devices firms and many of the entrepreneurs come from hospitals. There is also a network of high-tech research facilities many of which could assist in the industry. Among these entities are the Pittsburgh Supercomputing Center/Meta Center, the Ben Franklin Center and the Carnegie-Mellon University Center of Light Microscopy Imaging and Biotechnology.

The Pittsburgh Area Medical Devices Cluster

The Pittsburgh area's medical devices cluster has a total of 25 firms with more than ten employees, and over 50 total establishments. Firms with fewer than ten employees tend to be almost exclusively in the prosthetic appliances sub-sector, and were therefore not included in the overall analysis of the cluster. These firms take orders for prosthetic devices from local hospitals and therefore have no real export potential.

Table 64
ARC Pittsburgh Area Medical Devices Cluster

SIC Classifications	Number of firms	Employees	Share of Cluster Employment	Average # of Employees per firm

Surgical and Medical instruments	9	555	20.2%	51
Surgical Appliances and Supplies	11	1,897	69.1%	172
Electromedical	5	292	10.6%	58
Total	25	2,744	100%	110

Source: Dunn and Bradstreet, 1996

As Table 64 shows, establishments in the sector are divided about evenly between surgical and medical instruments and surgical appliances and supplies. There are no firms in the region who specialize in either dental instruments or X-Ray apparatus. However in terms of actual number of employees, Surgical Appliances and Supplies is clearly the dominant sub-sector. This is problematic for this study for two primary reasons. First, the surgical supplies sub-sector tends to be less suited to export. Most of these devices are fairly low-tech and some like orthopedic appliances, which accounts for 20 percent of the employment in this sub-sector, serve a local market that asks for products designed to fit a particular patient. The second reason for concern is the fact that the employment in this sub-sector is made up almost entirely of two companies, a manufacturer of personal safety devices for the mining industry, and a manufacturer of respiratory and patient ventilation products. The two companies together have 1330 employees or just over 70 percent of the total sub-sectoral employment. These two companies have little in common with the other firms in the sector which primarily custom manufacture prosthetic devices for local hospitals. The two companies also bring up the problem inherent in any analysis of the medical devices industry: the products each company make often bear little relation to those made by other firms. A hard hat manufactured by one company bears little relation to a respiratory device manufactured by another, yet both are classified as medical devices. Indeed, when interviewed for this report, a representative from the mine supply company was bewildered as why his company was included in a survey of *medical* devices!

Despite this heterogeneity, there are some positive attributes about this concentration. The medical devices industry in Pittsburgh is fairly autonomous with only 32 percent of the firms being headquartered outside the region. This autonomy is encouraging in some substantial ways. First, branch plant managers and even more importantly, headquarters' executives, tend to be less tied to a region, making them more likely to move their operations than firms owned by local owners. Second, branch plants use fewer inputs from local suppliers, because buying decisions are often made at corporate headquarters.

However there are economic development assets associated with branch plants, including their rate of technology adoption. Studies show that large branch plants, regardless of the industrial sector in which they operate, use new technologies much faster and more completely than do smaller, independently owned firms. An economy with large number of firms adopting high technologies should drive other firms in the area to incorporate more advanced technologies as a means of staying more competitive.

In terms of the geographical concentration of the medical devices industry within the Pittsburgh area, Allegheny County has by far the largest number of firms. However, when measured by location quotient it actually has a smaller number than the national average. (The location quotient was calculated by measuring the percentage of the county's total employment in

medical devices, compared to (divided by) the same ratio for the nation as a whole) Other counties such as Armstrong and Somerset actually have higher location quotients. However, these counties tend to have small numbers of manufacturing firms that account for the large location quotients in the medical devices industry. For instance, although Somerset has a very high location quotient of 6.55, it actually has only one firm. The location quotient is driven up by the small number of manufacturing employees in that county. Table 65 shows the concentration of firms in the region by county.

Table 65
Concentration of Firms within Cluster

County	State	Employment	Establishments	Loc. Quotient
Allegheny	PA	1,550	25	0.93
Armstrong	PA	127	2	2.65
Butler	PA	194	3	1.40
Cambria	PA	131	3	0.97
Fayette	PA	156	2	1.62
Mercer	PA	132	4	1.23
Somerset	PA	399	1	6.55
Westmoreland	PA	700	5	2.38

Profile of Cluster Firms

In order to get a better sense of what affects the competitiveness of the region's medical devices firms, telephone and personal interviews were conducted with firms in the sector as well as those governmental and non-governmental entities that provide service to the industry. Unfortunately, firms in the medical devices industry proved to be quite difficult to interview primarily because there is no organization in the Pittsburgh area that offers specific assistance to the sector. In addition, the various medical device industry associations that exist, do so primarily as a national lobbying organization and therefore have little if any activities at the local level. In order to get in touch with the firms, RTS made what were essentially "cold calls" based on a database accessed through Dun and Bradstreet's Direct Access service. Through this method the project team contacted all medical devices firms in the region although not all agreed to participate in the interview process. In addition, several service providers were contacted to learn about what types of services they offer to the medical devices industry, their thoughts on the industry in the region and its potential for exporting.

Cluster's Competitiveness Issues

Labor Market Skill Issues

In general, firms interviewed in the area seem to happy with the labor skills present in the Pittsburgh area. The labor skills needed for the industry fall into two general categories. First, are the general assembly workers needed for production work and second are the engineers who design the new technologies necessary to remain competitive in the readily changing markets of the industry. On both counts, the Pittsburgh area appears to be faring well, with none of the

companies citing labor as a major barrier to their competitiveness. Indeed, the presence of universities, particularly Carnegie-Mellon, means that the firms are able to secure able engineers. One area where there appears to be a skill shortage is not in the technical area but rather in attracting entrepreneurs with enough business savvy to start and successfully operate new medical devices firms. Indeed the Pittsburgh High Technology Report on industrial clusters stated that the "limited number of entrepreneurs/managers experienced in biomedical business" as a key issue retarding the growth of the medical devices cluster.

Economic Status

Like the rest of the nation's medical devices industry, the small cluster in Pittsburgh seems to be doing well. Only one of the firms interviewed reported a decrease in employment and sales, and several of the firms reported increases in sales of more than fifty percent over the last five years. In general, the firms that appeared to be doing the best were those who exported their products. They also tended to be larger companies. This may be attributed to the types of products manufactured by the smaller companies—products in the prosthetic industry which tends not to be as high growth as other sub-sectors in the industry. Again it must be stated the it is difficult to draw conclusions about such a diverse industry through conversations with firms that make products ranging from pacemakers, to artificial limbs, to baths, to respiratory equipment. While some of the markets may be the same (e.g. hospitals), the processes that go into manufacturing are often be vastly different.

Competitive Situation

It is not surprising that an industry in which a faulty product can literally be a life and death situation, that *product quality* is of utmost importance to firms. Product quality is also crucial to meet the rigid regulatory requirements of both the Federal Drug Administration (FDA) and foreign governments. Indeed, only one company surveyed did not mention product quality as a competitive advantage of their firm. The other major competitive advantage cited by the companies, primarily those involved in exporting, was *company reputation*. This advantage relates closely to product quality—customers want to purchase a product that they can trust and medical devices firms in the United States are generally considered to be the world's best. The third competitive advantage cited by surveyed firms was product design. This highlights the importance of attracting quality engineers to the industry and therefore, would seem to offer a competitive advantage to the Pittsburgh region. As has been mentioned, Carnegie-Mellon is one of the finest engineering universities in the nation.

Export Behavior

Exporters: Without a doubt, exports are crucial to the long term success of the medical devices industry. However, their importance to individual firms in the Pittsburgh depends largely on what product they manufacture. As has been stated, the manufacturers of prosthetic devices generally do not export for the most part and probably never will ship their products beyond the immediate area. In contrast, the larger manufacturers of more technologically intensive products that fall in the sub-sectors of medical instruments or electro-medical devices are much more

export dependent. Most of those interviewed stated that exports were 'very important" to their industry's future.

Most of the barriers facing firms in the region that already export tend to be those that would affect any medical device firm in the U.S. While all firms tend to complain about governmental regulation of their products, medical device firms tend to have even more cause for complaint. According to the Health Industry Manufacturers Association, the largest trade association representing medical device manufacturers, medical device products designed in the United States take three times as along to get to market than those designed in other nations. In addition, the FDA until recently had stringent requirements about what products could be shipped overseas.

However, it is not only the United States government which causes problems for firms when it comes to regulations. Other nations have stringent requirements about what products can enter their markets. Therefore it is not surprising that the most commonly cited barrier to exports mentioned by the surveyed firms was "meeting product design standards." One company stated that the best way to improve the exporting of area firms was "to standardize world regulations on medical devices."

One barrier not mentioned often was a "lack of time." This is primarily due to the fact that the exporting firms in the Pittsburgh area tend to be larger than many other firms which try to sell their products to foreign markets. Most of the companies surveyed which do export have someone whose main responsibility is exporting. The one firm which exported and had a small number of employees did cite time as a major barrier. In that case the woman who owns the company was in essence the export representative, spending an estimated 25 percent of her time dealing with export issues.

A wide range of reasons were given as advantages of doing business in the Pittsburgh region. Among those mentioned were the skilled labor force, the good distribution of channels and the quality of life in the region. Two attributes that would indicate a high level of cluster activity were not stressed by the exporting firms, however. Proximity to other similar firms as rated was an average advantage of the region by one company, the rest did not mention it at all. Another advantage not mentioned often by firms was "access to research and development and technical services." This again reflects the dearth of service providers with services expressly geared to the medical device industries.

Non-exporters: As has been mentioned, exporting is vital to the success of most medical devices firms. Therefore, firms that are not exporting probably will never export-it is just not necessary for their business success. Small prosthetic parts manufacturers will never have call to send artificial limbs to far reaching places. This lack of interest in exporting was reflected in the survey in which firms cited no barriers to getting involved in the exporting-in reality the only barriers were internal, lack of interest or lack of product appropriateness.

Service Providers and Sources of Information

The low profile of the medical devices industry in Pittsburgh is evidenced by the absence of any one public or private service provider with staff specifically focused on the medical devices industry. Firms use a wide range of information sources and assistance including:

- Equipment vendors;
- Suppliers;
- Trade journals; and,
- Customers.

Some firms indicated that they used universities for assistance on technical matters. Given the highly specialized technical nature of the field and given the strong university presence in the area, it is not surprising that this resource was used. However, it appears that these consultations were on an ad-hoc basis and none of the universities have a program aimed specifically at assisting medical devices firms.

This, of course, is not to say that small medical devices firms cannot receive adequate general assistance. The Southwest Pennsylvania Industrial Resource Center provides a range of technical assistance to small manufacturers under the auspices of the federally-supported Manufacturing Extension Partnership. In addition, Dusquene University's Small Business Center and the World Trade Center of Pittsburgh, to name two, offer information on how to get a product to market. In addition, some small medical device manufacturers have participated in the Pennsylvania Department of Commerce's program to support attendance at foreign trade shows.

Dynamic Factors and Linkages

The medical device industry in Pittsburgh is characterized by extremely little collaboration. They do not benefit from any synergies or economies of scale associated with other similar firms being located nearby. The foremost reason for this lack of collaboration is the lack of any sort of what might be termed "cluster self-awareness"—firms do not believe that they are in a cluster. As one manufacturer put it "If I had wanted to locate my firm in an area with a lot of medical device firms, I would have gone to some place like Philadelphia."

This lack of awareness of each other's existence is reflected in the absence of any real trade association in the area focusing on the specific needs of the local industry. Some firms belong to the Pittsburgh Area High Technology Consortium that does discuss issues related to the biomedical industry, but this tends (1) to focus on subjects beyond just the scope of the medical device industry, issues such as biological and genetic research, for example; and (2) meet infrequently.

It is not clear that firms are resistant to collaboration—indeed exporting firms rated the level of trust and collaboration between firms in the region as average—rather there simply are not many opportunities for that trust to be put to use. One area in which it has been put to use is through the Pennsylvania Department of Commerce's trade show program. In that program, companies are given up to $2,000 to attend trade shows in foreign countries. In most of these cases the firms share booth space with other similar firms—an arrangement at least one company found useful. However, even this company has not continued the relationships it forged when overseas.

Although the numbers of horizontal relationships appear to be very limited, a significant number of the firms purchase their products locally and have local customers. Interestingly, the exporting

firms interviewed tend to purchase their products much more locally than do those firms who sell their products to only domestic markets. In terms of the products sold, the smaller companies tend to serve smaller markets. Again these smaller companies tend to be in the prosthetic devices services that serve local hospitals.

Companies outside the cluster

As mentioned the medical device cluster tends to be tightly concentrated around Pittsburgh proper. This is especially important given both the presence of the region's major hospitals and the location of the airport. The airport provides frequent international flights to take company employees to the trade shows that make up the heart of the marketing of medical devices. Indeed, if the few companies located outside Pittsburgh have a complaint about doing business within the cluster, it is difficult access to that airport.

Conclusions about the Medical Devices Industry

Through the interviews and surveys conducted with both firms and service providers in the Pittsburgh region, three important findings emerge:

1. As it stands now, there is not a large enough of a concentration of medical devices firms in the region to justify a large scale investment in improving their exporting abilities. The majority of the small firms in the area concentrate on providing prosthetic devices, which by its nature is a business that only serves a local market. The lack of a significant medical devices cluster is reflected by the fact that there is no service provider that provides specialized assistance to meet the needs of the medical devices firms.
2. There is very little collaboration between existing firms. Rather than reflecting inherent distrust among firms, it probably reflects simply the lack of concentration of firms and the significant diversity of the existing firms. Medical devices includes firms which make products which may have little in common beyond being grouped in the same SIC code. Therefore, they have little to talk about beyond the problems inherent to running any small manufacturing firm.
3. Despite the small number of firms, Pittsburgh has many of the necessary foundations to support a medical devices industry. There are two large research universities with excellent engineering programs. The area is also home to a world-class medical facility, a major source of innovation in the industry. There is also a network of high-tech research facilities many of which could assist medical devices firms.

Foreign Affairs: One Medical Devices Firm and Exports

Lifemed Enterprises[31]‘ is a small, medical devices firm company located in Pittsburgh. Operating at the higher end of the industry, Lifemed manufactures two main products. One is a component part sold to large OEMs most of whom are overseas; the other is a finished product of which about a third is exported.

“We have survived on exports,” the owner of the company says.

However, she also says that exporting creates another entire set of problems. The biggest challenge are the new regulations established in Europe for medical devices. And even within the rigid standards established by the European community, individual countries, such as France, create even further barriers to foreign products. In part in response to these regulations, Lifemed is in the process of getting ISO 9000 certified.

One of the reasons that Lifemed has been able to be so successful in the export market is the specific product they manufacture.

“We don’t really have competitors,” the owner says. “We have developed a very interesting market niche and we market ourselves mainly on our product uniqueness.”

In terms of actual marketing, the owner of the company is the one who must travel to the trade shows that make up the heart of any medical devices export strategy. She estimates that about 25% of her time is spent handling export issues. To assist her in this job, Lifemed received support from the Pennsylvania Department of Commerce to attend trade shows as well as assistance from the Dusquene University Small Business Development Center on general export issues and the Ben Franklin Technology Center on product development.

While these support services do make doing business in the Pittsburgh area easier, the owner doesn’t see the area as being strong for medical devices specifically.

“I am here because I like it in Pittsburgh,” the owner says. “There really aren’t that many medical supply firms here. Certainly, I could associate with more firms if I was in another city.”

Appendix G
Industry Analysis: SIC 384, Surgical, medical & dental instruments

The U.S. medical equipment and supplies industry constitutes one of the United States' strongest exporting industries, having a 59% market share in the $88 billion global market. Three reasons for this success include the United States' reputation for high quality, its' cutting edge technologies, and service. The U.S. is seen as the leading source of technological discoveries in this field, a primary competitive advantage.

The medical equipment and supplies industry has historically performed most strongly in highly industrialized nations that have the incomes to support advanced health care services. As Table G-1 shows, this market trend is shifting as rapidly industrializing countries in Asia and Latin America recognize the need to expand their health care systems, and acquire the income to support such systems.

Table G-1
Foreign and Domestic Exports, F.A.S.; ($ millions)

	NAFTA	Japan	EU-15	Asian NICs	Other Americas	Rest of World	Total
1992	$1,335	$998	$3,110	$599	$337	$1,263	$7,632
1995	$1,303	$1,729	$4,291	$873	$875	$1,210	$10,281
% Total	13%	17%	42%	8%	8%	12%	100%
% Change	-2.3%	73%	38%	46%	260%	-4.3%	74%

U.S. Total Exports, 1995 by Area and Three-digit SIC Product Groups; (Census Basis; foreign and domestic Exports.

These data indicate that the growth of the surgical, medical and dental instruments market has been primarily in Latin America, Japan, Asian countries and the European Union. Sales to the NAFTA countries, Africa, and the rest of the world are declining. In value, 42% of exports are sold to ELJ-15 countries, 17% to Japan, and 12% to NAFTA countries (low growth in NA-FTA sales may reflect slowdowns in Mexican buying because of the Peso crisis).

European Union: The medical equipment market continues to be strong and growing in the European Union owing to aging populations, continuing availability of sufficient income to spend on health care, and access to public health care services. Health care industries in the EU are under increasing pressure to increase their cost efficiency for medical care delivery though, which is shifting medical spending from hospital to home care products and services.

Asia: As Asia continues to develop rapidly, there has been increasing public pressure to expand health care services, and revamp old and outdated equipment. This has led to rapid growth in this sector, particularly in high technology medical devices.

The following data in Table G-2 combine growth and value figures to identify the best long-term export markets:

Table G-2
Medical Equipment, and Instrumentation Exports by Regional Destination: 1993-1995
($ thousand)

	Japan	Canada	France	W. Germany	Netherlands
1993	$1,137,235	$946,581	$467,351	$833,188	$431,462
1994	$1,366,353	$947,209	$566,091	$912,898	$489,158
1995	$1,690,867	$994,342	$669,267	$ 1,050,281	$622,291
$ Change from '93'95	$ 1,553632	$ 47,761	$201,916	$ 217,093	$190,829
% change	48%	5%	43%	26%	44%

	Brazil	NIS	Hong Kong	S. Korea	Australia	India	S. Africa
	$136,469	$ 56,105	$ 131,207	$182,988	$281,909	$ 38,111	$50,885
1993	$144,361	$82,205	$ 141,151	$256,825	$309,911	$ 47,827	$ 52,395
1994	$232,712	$ 90,941	$ 164,577	$252,184	$346,260	$ 56,247	$ 65,589
1995	96,243	$ 34,836	$ 33,37	$ 69,196	$ 64,351	$ 18,1361	$ 14,704
$ Change from '93'95	71%	62%	25%	38%	23%	48%	29%
% change							

Department of Commerce, Office of Microelectronics, Medical Equipment, and Instrumentation; $ thousand.

This information shows that the best potential markets for U. S. exporters are Japan, Canada, and France. Countries with high potential for future growth are Brazil and South Korea.

Country Analysis

The following sections rely on information from the Department of Commerce's Country Commercial Guides for the listed countries, the International Trade Commissions document U.S. Trade Shifts in Selected Commodity Areas, and interviews with industry experts and U.S. manufacturers. Some of the export data, particularly statistics to Latin America may be distorted because of direct sales and shipments to customers that are not counted in the statistical data. Statistical accuracy and comparability to other sources are affected by a number of factors, including lack of published figures in certain markets, variances in data collection techniques, sources of data, and industry definitions.

Japan: Japan imports approximately 40% of its medical equipment. As Table G-3 shows, the U. S. supplies 63% of those imports, or 21% of Japan's total market share. Domestic producers are the primary competition for the United States in Japan as its industry is heavily supported by the government. The United States government and Japan continue to dialogue about limiting tariff and non-tariff trade barriers, with increasing success. The U.S. embassy of Japan expects the market for medical equipment in Japan to grow at between five and eight percent for the next five years. U. S. suppliers are particularly competitive in the areas of implants including pacemakers, artificial heart valves and artificial joints; other therapeutic devices including anesthesia equipment and laparascopic surgery devices; catheters; and diagnostic imaging

devices including high quality ultrasound, CT and MRI equipment. (Japan: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, DOC)

Table G-3
Annual Domestic Exports to Japan, F.A.S. ($ thousands)

Japan	1995	1996	1997
Total Market Size	$16,868	$17,300	$17,650
Total Local Production	$14,340	$1,500	$15,300
Total Exports	$3,032	$3,500	$ 3,600
Total Imports	$5,560	$5,800	$ 5,950
Imports from the U.S.	$3,515	$3,800	$ 4,100
U. S. Market Share	21%	22%	23%

Source: Japan: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, DOC.

Canada: As Table G-4 shows, Canada imports approximately 80% of its medical equipment. The U. S. supplies 78% of those imports, or 62% of Canada's total market share. The primary reasons for the LT.S. dominance in this market are the excellent reputation for quality, extensive distribution networks, and good after-sales service. 'Primary competition in the medical equipment sector include Canadian, German, and Japanese firms.

Table G-4
Annual Domestic Exports to Canada, F.A.S. ($ thousands)

Canada	1995	1996	1997
Total Market Size	$1,205	$1,250	$1,068
Total Local Production	$485	$503	$438
Total Exports	$242	$251	$238
Total Imports	$962	$998	$868
Imports from the U.S.	$751	$778	$677
U. S. Market Share	62%	62%	63%

Source: Canada: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, DOC.

Canada's market for medical equipment is expected to shrink due to legislation decreasing the usage of the public health care system and hospitals, and increasing the emphasis on home health care. The shrinkage will decrease demand for medical equipment used in hospitals and increase demand for home care equipment. Additionally, demand for clinical laboratory equipment will continue to grow, due to Canada's aging population. In summary, while there may be some shifts in the demand patterns of the Canadian health care sector, Canada continues to be an excellent export prospect for U.S. firms in the medical equipment sector.

France: As Table G-5 shows, France imports approximately 77% of its medical equipment. The U.S. supplies 25% of those imports, or 19% of France's total market share. U.S. market share in France is growing gradually due to the good reputation and high technology of the products.

France continues to have a rapidly expanding market for medical equipment due to three factors: overall population increases, increased life expectancy, and a strong national health care system leading to over-consumption. Demand for home health care products is growing particularly strongly in France due to an increased life expectancy, and an increase in usage of same day surgery procedures.

Table G-5
Annual Domestic Exports to France, F.A.S. ($ thousands)

France	1995		1997
Total Market Size	$2,142	$2,235	$2,325
Total Local Production	$1,031	$1,046	$1,052
Total Exports	$541	$577	$605
Total Imports	$1,652	$1,766	$1,878
Imports from the U.S.	$417	$440	$466
U. S. Market Share	19%	20%	20%

Source: France: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, DOC.

Brazil: As Table G-6 shows, Brazil imports approximately 47% of its medical equipment. The U.S. supplies 42% of those imports, or 20% of Brazil's total market share. Primary competition in the medical equipment sector includes European and Japanese firms. Other Asian firms are gaining market share through competitive pricing.

The Brazilian health care market is growing rapidly due to the rapid development of the country, and internal and external funding increases in the health care field. The Brazilian government is introducing a special tax on financial transactions which may increase the Health Ministry's budget by $6 billion, and the World Bank and International Development Bank are funding expansions of health care facilities. Both of these influxes of money will boost the Brazilian market. The United States enjoys an excellent reputation in Brazil, although there is strong competition in high technology medical equipment from the Europeans and Japanese, and in the commodity medical market from low cost producers in Asia.

The most promising markets in Brazil are high tech medical equipment which is not locally produced, such as digital angiographers and magnetic nuclear resonance tomographers.

Table G-6
Annual Domestic Exports to Brazil, F.A.S. ($ thousands)

Brazil	1995	1996	1997
Total Market Size	$1,130	$1,233	$1,277
Total Local Production	$750	$847	$957
Total Exports	$150	$154	$231
Total Imports	$530	$540	$551
Imports from the U.S.	225	$267	$315
U. S. Market Share	20%	22%	25%

Source: Brazil: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, DOC.

Korea: As Table G-7 shows, Korea imports approximately 75% of its medical equipment. The U.S. supplies 40% of those imports, or 29% of Korea's total market share. Primary competition in the medical equipment sector include European and Japanese firms.

Strong economic growth and a rising standard of living have spurred an increase in health care delivery systems. In response, local health care providers are very interested in upgrading their service quality. Accordingly, Korean demand for sophisticated medical technology has been on the upswing and is expected to continue to increase at a rate of 8-10 percent for the next three years.

The most promising subsectors are: Medical sterilizers, rehabilitation equipment, respiration equipment orthopedic joint implants, diagnostic ultrasound scanners, magnetic resonance imaging systems, patient monitors, computer tomography scanners, catheters, artificial kidneys, syringes, suture needles, general surgical instruments, and operation tables.

Table G-7
Annual Domestic Exports to Korea, F.A.S. ($ thousands)

Korea	1995	1996	1997
Total Market Size	$811	$850	$890
Total Local Production	$376	$380	$387
Total Exports	$175	$190	$210
Total Imports	$611	$660	$713
Imports from the U.S.	$232	$255	$275
U. S. Market Share	29%	30%	31%

Korea: Leading Sectors for U.S. Exports and Investments, Country Commercial Guides, DOC.

Summary

The United States performs very strongly in international markets in the medical equipment sector, primarily due to its advanced technology and good reputation. The best international markets are ones that allow the U. S. to leverage its high-technology advantages. The primary competition in these markets is Japan and Europe.

NOTE: The projected figures for 1996, 1997, and 1998 are all estimates selected by U.S. embassy officials in the respective countries. Additionally, the country by country industry analysis may differ in exact composition from the selected SIC code, but the general category contains approximately the same products

Endnotes

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[15] Jeffrey C. Fuher and Jane Sneddon Little, "Technology and Growth: An Overview," in *New England Economic Review* (November/December 1996) pp. 3-25.
[16] Because the lines differentiating these categories and other SIC 35 industries are difficult to draw at the firm, or even regional level, the scope of the inquiry was broadened to include other industrial machinery, such as farm equipment (352) and construction equipment (353). Industries excluded from the analysis include 351 (engines and turbines), 357 (computers and office equipment), and 358 (refrigeration and heating equipment). Despite this exclusion, SIC 35 data are used in the analysis of recent export trends (unless otherwise noted), because neither industrial outlook nor state-level data are generally available at the three-digit level.
[17] *Standard Industrial Classification Manual*; Executive Office of the President, Office of Management and Budget (Washington, DC: Government Printing Office, 1987).
[18] The statistics in this section are drawn from *Selected Characteristics of Manufacturing and Wholesale Establishments that Export: 1992,* published by the Census Department.
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[22] Exports exceed output
[23] Much of this information was collected and reported by Mississippi State University graduate student Albert Nylander. It is supplemented by this author's interviews with business leaders in Tupelo.
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