CLEMSON UNIVERSITY

UCED Research Report
05-2008-01

EDA UNIVERSITY CENTER
FOR ECONOMIC DEVELOPMENT

BIOMEDICAL DEVICES CLUSTERS IN SOUTH CAROLINA AND THE UNITED STATES

by

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May 2008

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EXECUTIVE SUMMARY

Three South Carolina biomedical devices clusters were identified in the Charleston, Columbia, and Greenville-Anderson-Spartanburg metropolitan statistical areas (MSAs). The three established clusters are in a fledging stage compared with other regions of the U.S., and Battelle (2007) identified only Charleston and Greenville as emerging clusters on the national scene. These two MSAs have the infrastructure, resources, and employment necessary to develop potentially vibrant biomedical devices industry cultures.

A review of biomedical devices clusters throughout the U.S. showed that proximity to first-class hospitals and research facilities, such as universities, is important to cluster success. Biomedical devices clusters often are found in regions with reputations for technology and innovation, such as Silicon Valley, California; Minneapolis, Minnesota; and Boulder, Colorado. Biomedical devices clusters also tend to form in cities at the center of major transportation routes to take advantage of lower transportation costs between the clusters and their suppliers and consumers.

Many types of industry clusters exist, but all develop similarly. Clusters are formed as a result of a region's competitive advantage in an industry. That advantage may be due to factors such as proximity to resources, the existence of supporting industries, or the presence of government programs. Firms gain additional benefits by locating in the cluster, including external economies of scale, networking, pools of skilled labor, facilitation of industrial reorganization, and targeting of public resources.

A clustering strategy is not without drawbacks. It can be difficult to pick industries and firms that will be successful. A cluster that develops late relative to other clusters may be at a disadvantage because newer clusters offer fewer opportunities for networking and inter-firm cooperation. It can also be challenging to garner public support for new industries and institutes, especially if they are seen as threatening the status quo. A region considering promotion of a biomedical devices cluster should consider whether the region has a competitive advantage in offering the infrastructure and the skilled labor necessary to support the industry.

TABLE OF CONTENTS

1. OVERVIEW

In 2005, Michael Porter and Monitor Group conducted a study of South Carolina's economy and identified growth strategies for the state (Dassel and Dunn, 2005). The group recommended that economic development policy focus on core industrial competencies, education, and innovation. The eight core clusters originally identified by Porter evolved over the past two years into 14 cluster initiatives (South Carolina Council on Competitiveness, 2007). The focus of this paper is the biomedical devices cluster.[1] Experiences in the textiles and other manufacturing industries indicate that South Carolina's advantage is not as the low-cost producer in a global market. Consequently, South Carolina is striving to become a leader in innovative, high-tech biomedical devices development and production.

The biomedical devices sector is arranged in several clusters throughout the state. Almost all establishments are located in metropolitan areas, with hubs in the Charleston, Columbia, and Greenville metropolitan statistical areas (MSAs). The Greenville cluster is supported by activity in the broader Greenville-Anderson-Spartanburg combined statistical area (CSA). The counties included in each of these areas are provided in Table 1. Universities, hospitals, and research and development facilities in these areas provide the skilled labor, innovation, and infrastructure needed to attract innovators and entrepreneurs and to grow high-tech, innovative firms.

Table 1. MSA and CSA County Inclusion.

Area	Counties
Charleston-North Charleston MSA	Berkeley, Charleston, Dorchester
Columbia MSA	Calhoun, Fairfield, Kershaw, Lexington, Richland, Saluda
Greenville MSA	Greenville, Laurens, Pickens
Greenville-Anderson-Spartanburg CSA*	Anderson, Greenville, Laurens, Pickens, Spartanburg

*For this report, the CSA is defined as above. Some definitions also include the surrounding counties of Cherokee, Oconee, and Union.

Source: Office of Management and Budget, 2006.

2. DEFINITIONS OF BIOMEDICAL DEVICES CLUSTERS

A regional industry cluster is a geographically-bounded group of similar and/or related firms and organizations that enhance competitive advantages for the members and the host economy (Barkley and Henry, 1997; Bergman and Feser, 1999; Porter, 2000). Clusters promote external economies of scale, and

these agglomeration economies provide cost savings and networking opportunities that can lead to the attraction of new firms, further increasing the region's competitive advantage (Barkley and Henry, 1997; Porter, 2000).

Medical devices are defined by the FDA as "instruments, apparatus, and contrivances, including their components, parts, and accessories, intended (1) for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in man or other animals; or (2) to affect the structure of any function of the body of man or other animals" (U.S. Department of Health and Human Services, Food and Drug Administration [USDHHS-FDA], 1999, p.87). Two primary means of identifying biomedical devices clusters are the Food and Drug Administration (FDA) establishment and product registrations (USDHHS-FDA, 2007) and the North American Industry Classification System (NAICS) codes (U.S. Department of Commerce, Census Bureau [USDC-CB], 2007a). The two approaches provide different pieces of information about establishments and clusters and are complementary.

2.1 FDA Classifications

The FDA maintains a registry of medical devices and establishments producing or intending to produce medical devices (USDHHS-FDA, 2007). It also provides a registry of devices. Each device is classified by approval process and medical category. The registries are linked so that each device is matched to those establishments that manufacture it. The Code of Federal Regulations provides the classification, intended use, and information about marketing requirements for over 1,700 biomedical devices.

There are three device classifications as determined by intended use, indication for use, and risk associated with use. Class I products are subject only to general controls and have the lowest risk in use. Class II products are subject to both general and special controls. They include devices with somewhat greater risk than Class I devices. Class III devices are subject to general and special controls and must also receive pre-market approval. These devices carry the greatest risk to the patient and/or user. Some basic devices that were common prior to FDA standards and new products that are very similar to these basic devices are considered unclassified. In addition to a device classification, each product is assigned

to one of 16 medical specialty panels. Table 2 lists the panels and provides examples of class I, II, and III devices within each panel.

2.2 NAICS Classifications

Biomedical devices' production and distribution also are classified by the North American Industry Classification System (NAICS, USDC-CB, 2007). This system identifies business products by sector. Because sales and employment figures are reported by NAICS codes, matching NAICS codes to FDA classifications is the first step in analyzing the economic impact of the biomedical devices cluster. The NAICS codes, as identified in 2002, are two-digit to six-digit industrial codes. Additional specificity is provided by each digit. For example, code 33 represents manufacturing activity while sub-sector code 3391 stands for medical equipment and supplies manufacturing. Code 339114 indicates the specific manufacture of dental equipment and supplies. For this study, information about employment and establishments for medical devices was available at the six-digit level. The NAICS is much broader than the FDA classifications, and NAICS codes match more than one FDA panel. For example, 12 of the 16 FDA panels have products classified under surgical and medical instrument manufacturing (339113).

Most activity in the biomedical devices cluster is in the manufacturing sector. Table 3 shows the six-digit NAICS classifications associated with biomedical devices manufacturing. These NAICS codes were identified based on comparisons of NAICS product tables to FDA product lists. Within the manufacturing sector, most production of biomedical devices occurs in the medical equipment and supplies sub-sector (33911) and in the navigational, measuring, medical, and control instruments manufacturing sector (33451). Additional production occurs in four other six-digit sectors (322291, 325413, 325620, and 325699). All firms report their NAICS codes to the Bureau of Economic Analysis (BEA) along with their sales and employment data, thus a cluster size in a region can be compared with the sizes of clusters in other regions or states.[2]

Table 2. FDA Panels with Examples of Biomedical Devices by Device Classification.

Panel	Class I Device	Class II Device	Class III Device
Anesthesiology	Anesthetic gas mask, nose clip	Portable oxygen generator, bronchial tube	Lung water monitor, electroanesthesia apparatus
Cardiovascular	Pacemaker charger, stethoscope	Electrocardiograph, catheter, stethoscope	Pacemaker pulse generator, replacement heart valve
Clinical Chemistry and Clinical Toxicology	Breath-alcohol test system	Acetaminophen test system	HCG test system
Dental	Toothbrush, teething ring not containing fluid	Porcelain tooth, teething ring with fluid	Endodontic dry heat sterilizer, mandibular condyle prosthesis
Ear, Nose, and Throat	Air-conduction hearing aid, splint	Bone-conduction hearing aid	Antichoke device
Gastroenterology and Urology	Ostomy pouch, hernia support	Colostomy rod, lithotriptor	Implanted blood access device, urinary continence device
General and Plastic Surgery	Surgeon's glove, eye pad, manual surgical instrument for general use	Surgical mesh, ear prosthesis, surgical lamp	Absorbable powder for lubricating a surgeon's glove, breast prosthesis
General Hospital and Personal Use	Hospital bed, suction snake bite kit	Neonatal incubator, intravascular catheter	Chemical cold pack snakebite kit
Hematology and Pathology	Dye and chemical solution stains, cell and tissue culture supplies and equipment	Automated cell counter, occult blood test, automated blood cell separator operating by filtration separation principle	Automated blood cell separator operating by centrifugal separation principle
Immunology and Microbiology	Culture medium, colony counter, microbiological incubator, some reagents and test systems	Antimicrobial susceptibility test disc, some reagents and test sytems	Herpes simplex virus serological reagents, oxidase screening test for gonorrhea
Neurology	Tuning fork, percussor, clip forming/cutting instrument	Human dura matter, electric cranial drill motor, evoked response mechanical stimulator	Implanted neuromuscular stimulator, cranial electrotheraphy stimulator, intravascular occluding catheter
Obstrical and Gynecological	Nonpowered breast pump, unscented menstrual pad	Assisted reproduction microtools, unscented menstrual tampon	Abdominal decompression chamber, contraceptive intrauterine device (IUD) and introducer
Ophthalmic	Steroscope, artificial eye	Soft (hydrophilic) contact lens for daily wear, eye sphere implant	Intraocular lens, soft (hydrophilic) contact lens for extended wear
Orthopedic	Bone cap, calipers for clinical use, cast component	Single/multiple component metallic bone fixation appliances and accessories, knee joint femorotibial metal/composite cemented prosthesis	Hip joint metal/metal semi-constrained prosthesis with an uncemented acetabular component
Physical Medicine	Cane, mechanical walker, cold pack	Powered muscle stimulator, powered wheelchair, powered heating pad	Stair-climbing wheelchair
Radiology	Personnel protective shield, radiographic film	Mobile x-ray system, bone densitometer	Transilluminator for breast evaluation

Table 3. Six-Digit NAICS Codes Identified as Representing Biomedical Devices Manufacturing Activity.

Code	2002 NAICS Code Title	Examples
322291	Sanitary paper product manufacturing	Menstrual pad, tampon
325413*	In-vitro diagnostic substance manufacturing	Blood glucose test kits
325620	Toilet preparation manufacturing	Toothbrush, dental floss
326299	All other rubber product manufacturing	Teething ring, condom
334510*	Electromedical and electrotherapeutic apparatus manufacturing	Cardiograph, electronic hearing aid
334514	Totalizing fluid meter and counting device manufacturing	Counter, flow meter
334516	Analytical laboratory instrument manufacturing	Microscope, spectrometer
334517*	Irradiation apparatus manufacturing	X-ray apparatus, medical radiation therapy equipment
339111	Laboratory apparatus and furniture manufacturing	Hospital bed, laboratory scale
339112*	Surgical and medical instrument manufacturing	Anesthetic device, surgical clamp
339113*	Surgical appliance and supplies manufacturing	Artificial limb, surgical dressing
339114*	Dental equipment and supplies manufacturing	Dental cement, dental drill
339115*	Ophthalmic goods manufacturing	Contact lenses, goggles

* Represents primary NAICS codes for biomedical device manufaturing. These codes occur with significantly more frequency than do other codes.

2.3 Related Industries

As explained in the preceding section, several manufacturing sub-sectors produce biomedical devices. There are also industry linkages between firms in each of these sub-sectors and their input suppliers, service providers, and distributors. These linkages form the basis for cluster activity in the region and enhance the cluster's multiplier effects. The presence of industries related to the manufacture of biomedical devices helps to ensure the availability of scale economies and to enhance the stability of the region's clusters. Proximity to input suppliers, service providers, and distributors decreases transportation costs and delivery times and increases the exchange of ideas and information (Barkley and Henry, 1997). This in turn increases cluster profitability and responsiveness to consumer demands. The presence of local suppliers also decreases economic leakages resulting from imported components, thus boosting the income and employment multiplier effects of medical devices production. Larger multipliers increase the economic impact provided by a shock to the biomedical devices sector. A list of industries linked to the medical devices sector is provided Table 4.

Table 4. Industries Related to Biomedical Devices Manufacturing.

Stage of Production/Distribution	Related Industries
Inputs	Raw materials, plastics, energy, sub-compenents
Post manufacturing	Packaging, marketing
Distribution and sales	Wholesalers, transportation, hospitals, pharmacies and other retail stores
Services	Clinical trials, educational and research institutions, financing, legal services, test facilities

Input suppliers to biomedical devices production include a variety of other manufacturers (Walcott, 1999). Consequently, there are many opportunities to create inter-industry linkages. Many biomedical devices contain chemicals, pharmaceuticals, and adhesives. Other devices are made of metal, rubber, or composite materials. Paper and textile plants supply material required for wound dressings and coverings, and high-tech devices rely on electronic equipment and components. Devices must be packaged for shipment, and many are packaged for individual use. These packages may be produced by paper, paperboard, or plastics manufacturers. Finally, transportation services are needed to move products to consumers.

Most firms in the medical devices industry also require professional services. Accounting, legal, and marketing firms provide services to the biomedical devices establishments, as do office supply and cleaning businesses. In addition, the scientific and innovative nature of a biomedical devices cluster encourages relationships between firms and research facilities such as universities and hospitals.

Wholesale activity associated with medical devices has the NAICS codes 42345 and 42346. Wholesaling of electrical apparatus and equipment is included in code 42361. Retail of biomedical devices purchased outside of medical clinics and hospitals is included in the broader code 4461. Although the importance of these sectors is recognized, the focus of this analysis is on the manufacturing sector. This is justified because the focus of the South Carolina biomedical devices cluster initiative is on developing and commercializing innovative biomedical products.

3. SOUTH CAROLINA BIOMEDICAL DEVICES ESTABLISHMENTS

3.1 Existing Establishments by FDA Classification

Figure 1 shows the locations of the 146 establishments registered with the FDA to produce biomedical devices. A list of South Carolina biomedical device manufacturing establishments and their locations is provided in the appendix. Establishments rather than firms are identified because a firm may have more than one establishment or plant location. Figures 2, 3, and 4 map the locations of biomedical manufacturing establishments by device classes I, II, and III, respectively. The highest classification of a product registered to the firm determines the firm's classification. There was one establishment specialized in unclassified products. That establishment is included in the FDA class I map. Note that the number of South Carolina establishments registered with the FDA (146) is higher than the sum of the establishments with registered devices (74). Almost half of the South Carolina establishments registered with the FDA do not have any devices registered with the agency. Some of these establishments are start-ups or spin-offs, and some may never emerge as full-fledged companies.

Industry establishments are scattered throughout the state; however, the three main areas of activity are the state's principal metropolitan areas: Charleston in the Southeast Coastal region, Columbia in the Midlands, and the Greenville-Anderson-Spartanburg CSA in the Upstate. These areas appear as the red dots in Figure 1. These three MSAs are identified as the state's biomedical devices clusters. Rock Hill in York County is considered part of the Charlotte, North Carolina, MSA and is therefore not considered part of the Greenville-Anderson-Spartanburg cluster.

Biomedical devices production is more spatially diffused at lower levels of technology. Class I establishments are located in 16 of the 46 South Carolina counties. Class II establishments are found in 15 counties; however, approximately 50 percent of the Class II establishments are in Greenville or Richland counties. Class III establishments appear in only three counties: Charleston County, Beaufort County, and Lexington County. The Upstate has no Class III establishments, but it has a higher density of Class II establishments than does Charleston.

South Carolina's biomedical devices manufacturers are not the only firms to benefit from the state's innovation clusters. The state is home to several establishments that serve as U.S. agents for international firms that manufacture biomedical devices. Agents act as correspondents between foreign manufacturers and the FDA. The establishments registered with the FDA as U.S. agents are shown in Figure 5. Nineteen establishments are registered as agents for class I devices, 18 for class II devices, and one for unclassified devices. No establishments are agents for firms with class III devices.

South Carolina is also home to four firm headquarters with branch plants out of state. Figure 6 maps the headquarters registered with the FDA by class. There is one class I and three class II headquarter firms in the state. Three of these firms are located in the Upstate, and the fourth is in Charleston. Three of the headquarter firms registered with the FDA do not have registered devices and therefore cannot be assigned a class. Two of these establishments are in Charleston County, and one is in Greenville. Cultivation of these companies may increase the likelihood of their establishing branch plants within South Carolina in the future.

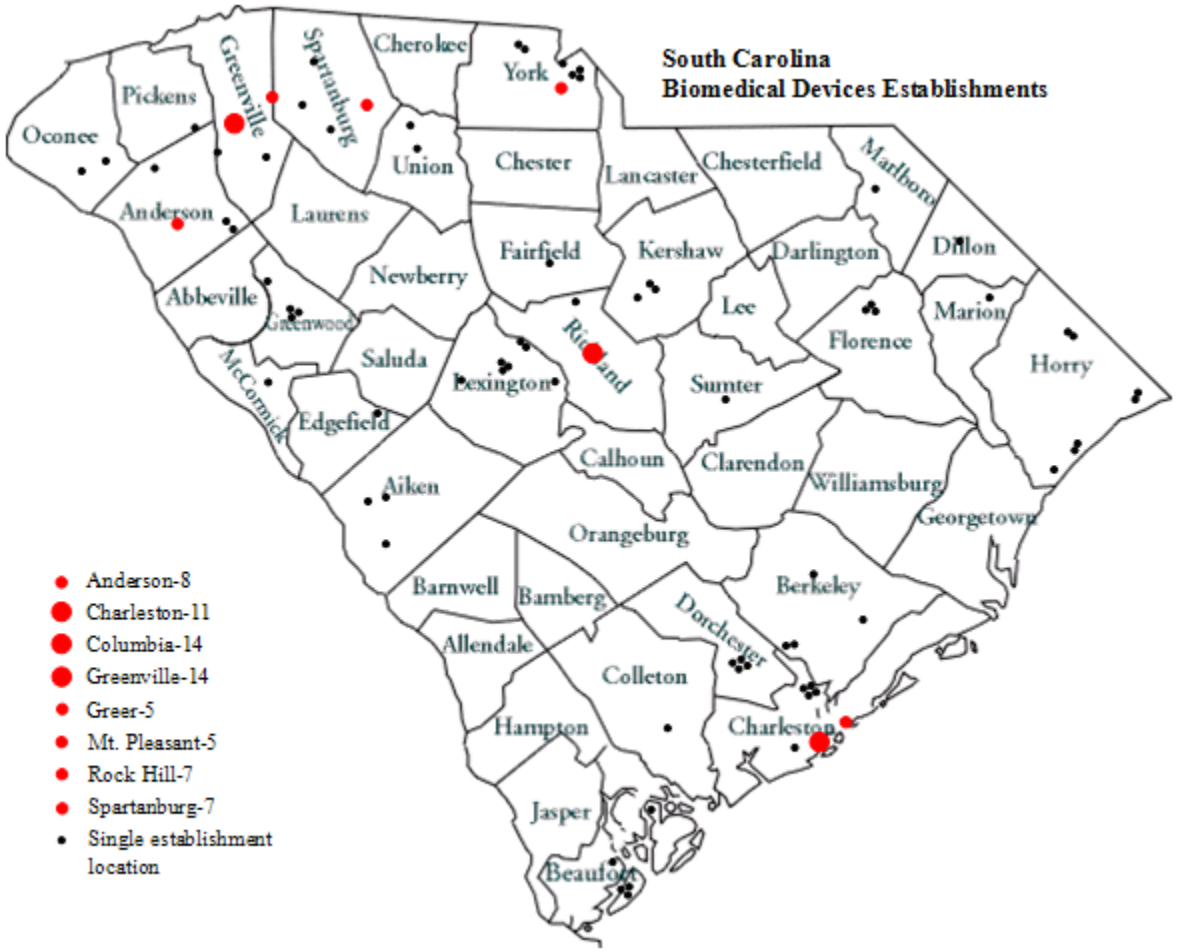

Figure 1. Locations of the 146 South Carolina establishments registered with the FDA as manufacturers of biomedical devices.

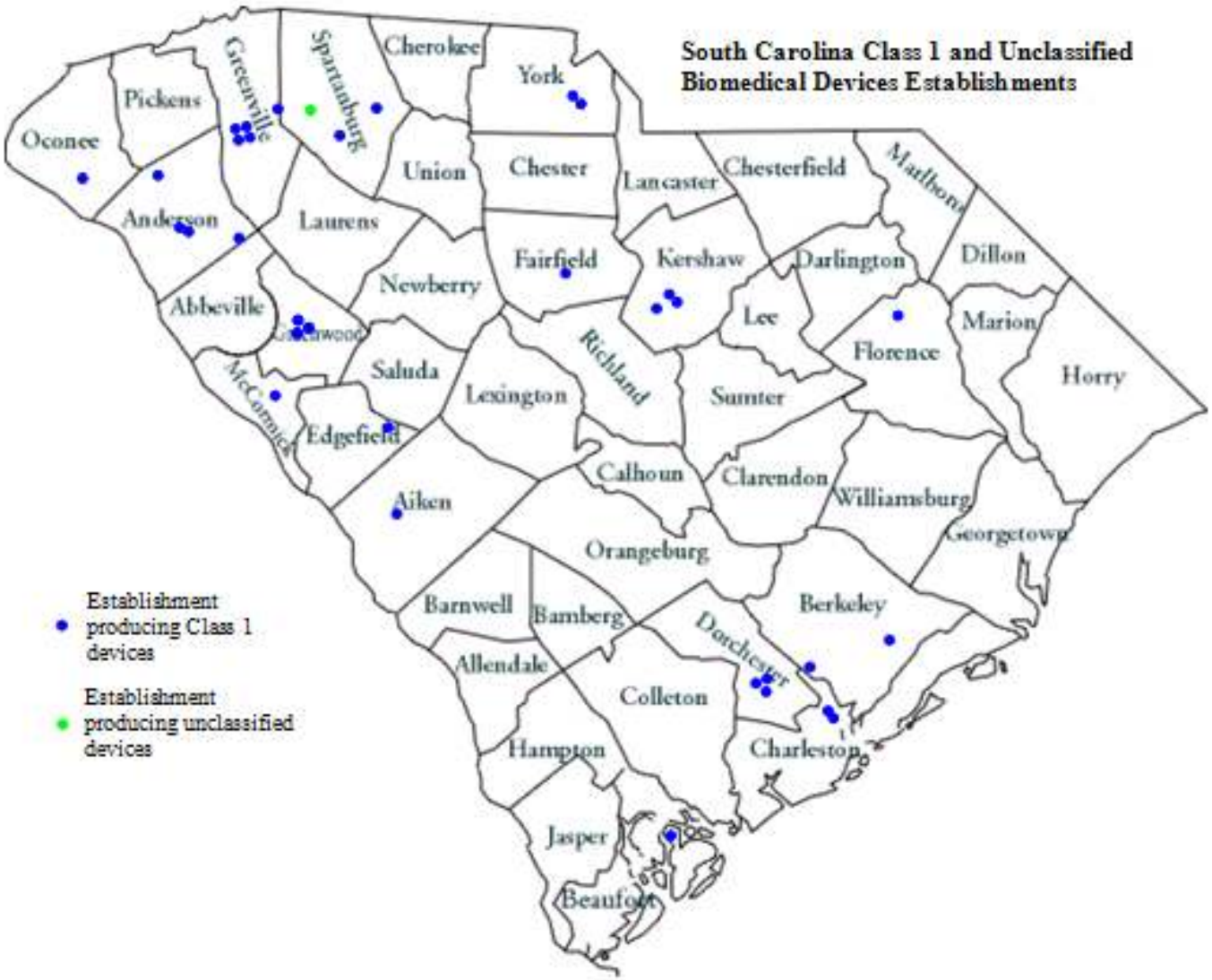

Figure 2. Locations of the 33 South Carolina establishments registered with the FDA to manufacture class I and unclassified biomedical devices.

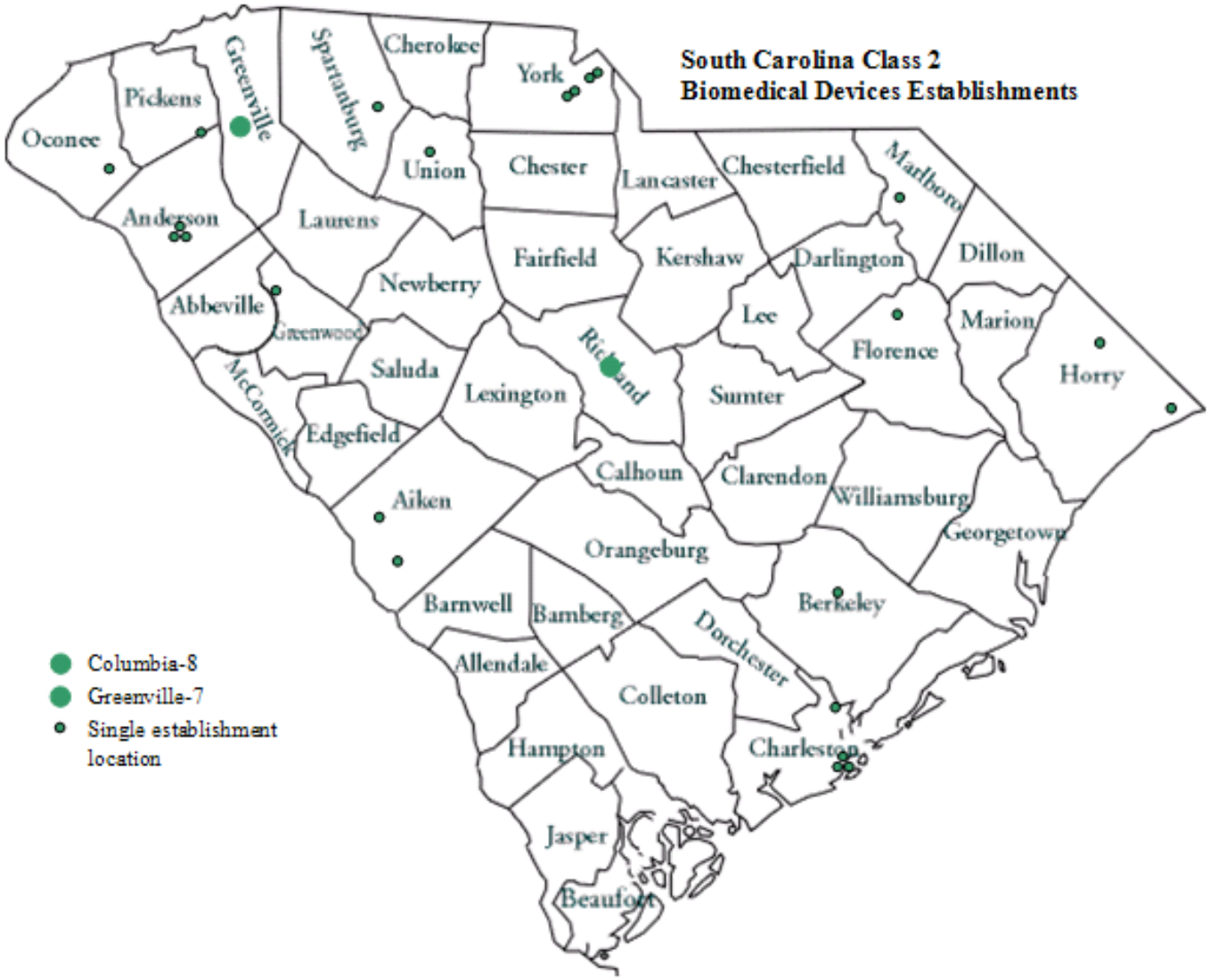

Figure 3. Locations of the 38 South Carolina establishments registered with the FDA to manufacture class II biomedical devices.

Figure 4. Locations of the three South Carolina establishments registered with the FDA to manufacture class III biomedical devices.

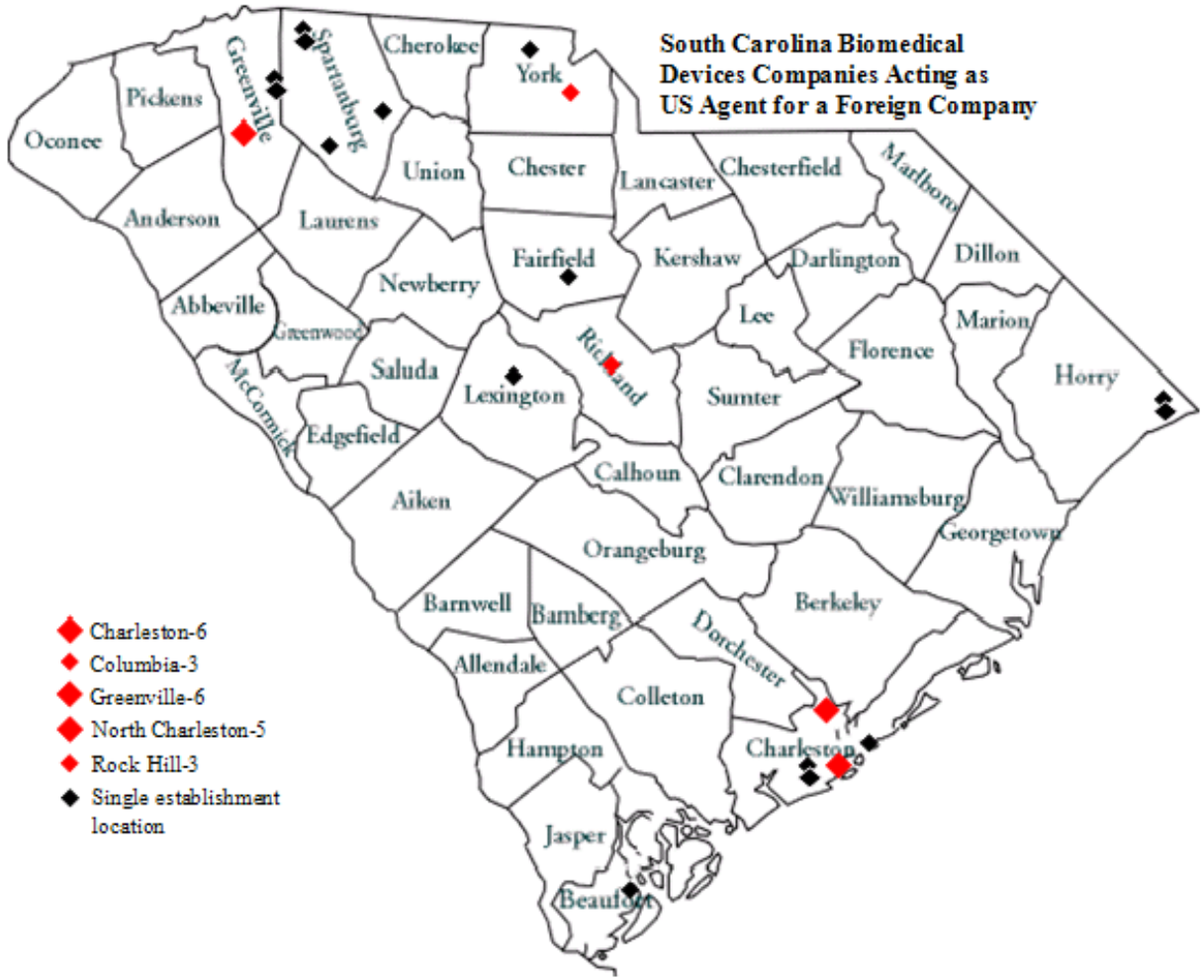

Figure 5. Locations of the 38 South Carolina establishments registered with the FDA to serve as U.S. agents for biomedical devices firms.

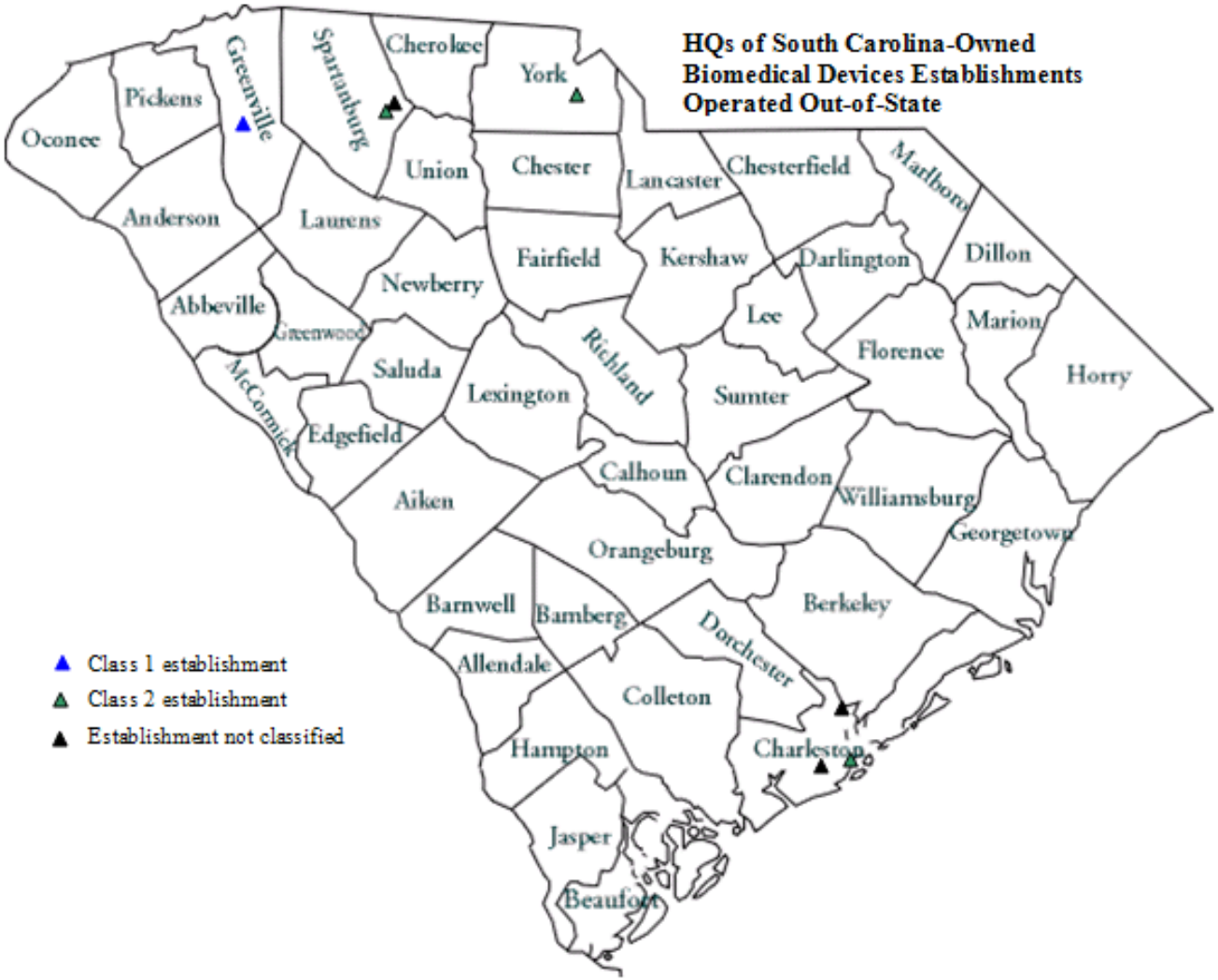

Figure 6. Headquarters locations for the seven South Carolina-owned biomedical devices firms with establishments operated out of state.

3.2 Existing Establishments by NAICS Classification

To compare the biomedical devices industry in South Carolina to similar industries in other states, data were obtained from the Reference USA database (infoUSA, 2007). Reference USA provides data for 13 million U.S. businesses. Table 5 shows the number of South Carolina establishments producing under each NAICS code associated with biomedical devices. Employment is not shown in the table due to double counting of establishments producing more than one type of good. Many establishments produce under multiple NAICS codes. For this same reason, the number of establishments under each NAICS cannot be summed.

Table 5. Reference USA South Carolina Establishment Count for Biomedical Devices NAICS Codes.

NAICS Code	2002 NAICS Code Title	Establishments
322291	Sanitary paper product manufacturing	1
325413*	In-vitro diagnostic substance manufacturing	0
325620	Toilet preparation manufacturing	6
334510*	Electromedical and electrotherapeutic apparatus manufacturing	2
334514	Totalizing fluid meter and counting device manufacturing	5
334516	Analytical laboratory instrument manufacturing	0
334517*	Irradiation apparatus manufacturing	7
339111	Laboratory apparatus and furniture manufacturing	5
339112*	Surgical and medical instrument manufacturing	164
339113*	Surgical appliance and supplies manufacturing	25
339114*	Dental equipment and supplies manufacturing	5
339115*	Ophthalmic goods manufacturing	15

* Represents primary NAICS codes for biomedical device manufaturing. These codes occur with significantly more frequency than do other codes.

The frequency of NAICS codes does not provide information about the level of technology involved in production but does hint at where the state may have experience and a competitive advantage. For example, surgical and medical instrument manufacturing (NAICS code 399112) is by far the largest component of the cluster with 164 establishments. The Upstate is home to more than half of those establishments, and 33 of the sector's establishments are in Greenville County. Some claim that a cluster may occur in an extremely small geographic area, such as a street or a few blocks. Greenville ZIP code 29607 is home to 12 establishments.

3.3 Inter-state Comparison of Biomedical Devices Clusters

The ReferenceUSA (infoUSA, 2007) and Cluster Mapping Project (Harvard University, 2007) data allow comparison of South Carolina's biomedical devices industry to that of other states. Table 6 shows the biomedical devices industry employment and establishment counts for the 50 states. Employment information was obtained from the Cluster Mapping Project, and employment location quotients (LQs) are included where calculated by the Cluster Mapping Project. An LQ is an industry cluster's share of total regional employment relative to the cluster's share of national employment. A higher LQ indicates a greater employment concentration in a local industry. An LQ greater than 1.00 signifies that a local economy is more specialized in the industry than is the nation as a whole.

The establishment counts in Table 6 serve as an alternative measure of each state's strength in the medical devices industry. The number of establishments producing biomedical devices in each state is roughly correlated to the state's level of employment in the industry. Establishment data provides information about whether a state's industry employment is driven by a few establishments or is spread across many smaller businesses.

The South Carolina biomedical devices industry is much smaller than the industries of leading states. South Carolina ranks 25th in industry employment and 31st in number of establishments (Harvard University, 2007; infoUSA, 2007). South Carolina is more specialized in medical equipment and ranks 20th among states in that sub-cluster (Harvard University, 2007). Regionally, South Carolina competes with clusters in other Southeastern states. The state's 4,169 employees place it fifth among Southern states in sector employment, following Florida, North Carolina, Georgia, and Tennessee. However, South Carolina's 225 establishments rank it ninth among the 12 Southern states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia). Only one state in the South, Florida, is among the top 10 states in the U.S. in terms of medical devices employment and establishments according to the Cluster Mapping Project (Harvard University, 2007). The South has an even weaker presence in the biomedical devices industry if

employment LQs are used to identify the strongest clusters. In that case, no Southern state is among the top 10.

Clusters are specific to sub-state geographic areas, such as metropolitan areas and cities. Even if, as a state, South Carolina lags in biomedical devices production, the clusters in Charleston, Columbia, and the Greenville-Anderson-Spartanburg CSA may be able to compete with clusters in other states. In fact, Battelle (2007) recognized Charleston and Greenville as emerging medical devices clusters, with Charleston ranked 11th in medical devices employment among mid-sized cities.

The three principal MSAs in South Carolina specialize in different biomedical devices sub-clusters. Charleston is ranked by the Cluster Mapping Project (Harvard University, 2007) as 81st in MSA medical devices employment, but its surgical instruments and supplies sub-cluster is ranked 61st. Columbia, which ranks 150th overall, ranks 80th in ophthalmic goods and 98th in biological products. Greenville's medical devices employment is ranked 136th while its medical equipment and diagnostic substances sub-clusters rank 45th and 65th, respectively. These statistics support the idea of specialized regional clusters at the MSA level.

Table 6. Rankings of States by Biomedical Devices Cluster Employment and Establishments.

Employment Rank[1]	State	Industry Employment[1]	2004 LQ[2]	Industry Establishments[3]	Employment Rank[1]	State	Industry Employment[1]	Industry Establishments[3]
1	California	67,535	1.59	3,872	26	Oregon	3,662	360
2	Pennsylvania	20,968	1.28	1,373	27	Virginia	3,211	428
3	Minnesota	20,855	2.73	745	28	Delaware	3,013	63
4	Massachusetts	20,851	2.19	1,132	29	Arkansas	2,751	158
5	Florida	20,198	0.92	1,652	30	Iowa	2,652	231
6	New York	19,259	0.81	1,730	31	New Hampshire	2,479	246
7	Indiana	15,201	1.84	523	32	Alabama	2,204	283
8	Texas	15,196	0.59	1,436	33	Maine	2,113	86
9	Wisconsin	14,382	1.85	582	34	Kansas	1,489	214
10	New Jersey	14,340	1.24	1,331	35	Kentucky	1,427	258
11	Ohio	11,813	0.78	1,083	36	Oklahoma	1,239	232
12	Colorado	11,426	1.87	500	37	New Mexico	1,208	106
13	Illinois	11,374	0.68	1,266	38	Rhode Island	1,177	144
14	Utah	10,089	3.37	252	39	South Dakota	1,172	46
15	North Carolina	9,569	0.89	597	40	West Virginia	995	89
16	Georgia	7,453	0.68	596	41	Mississippi	716	106
17	Connecticut	6,753	1.37	531	42	Idaho	689	91
18	Maryland	6,727	0.98	384	43	Louisiana	662	220
19	Tennessee	6,583	0.88	430	44	Nevada	601	127
20	Michigan	6,472	0.52	772	45	Montana	311	86
21	Washington	6,346	--	435	46	Vermont	279	65
22	Missouri	4,909	--	485	47	Hawaii	139	53
23	Arizona	4,882	--	358	48	North Dakota	117	30
24	Nebraska	4,444	--	135	49	Wyoming	80	25
25	South Carolina	4,169	--	225	50	Alaska	30	18

[1]Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard Business School. Copyright © 2005 President and Fellows of Harvard College. All rights reserved.

[2]LQ provided for only top 20 states in employment ranking.

[3]Reference USA (infoUSA, 2007) establishment count for 10 biomedical devices NAICS codes: 322291, 325620, 334510, 334514, 334517, 339111, 339112, 339113, 339114, 339115.

4. THE CLUSTERING STRATEGY

4.1 Cluster Formation

Clusters develop and are enhanced as a result of advantages stemming from concentration forces. Initially, firms may be drawn to a region as a result of natural resources, existing infrastructure, or proximity to input sources. They may also locate near large consumer bases, particularly if the final product is more expensive to ship than the inputs or if there is a need to be able to react quickly to changes in consumer preferences. Some firms, especially those that rely on research and development for continued prosperity, may wish to locate near research centers and universities. Location near other firms increases awareness of trends and technology and reduces firms' uncertainty (Feldman, Francis, and Bercovitz, 2005).

Biomedical devices firms must be able to receive inputs and transport products to consumers cost-effectively. Consequently, transportation systems are an important component of cluster development. Figure 7 shows South Carolina's interstate highways, ports, and public main hub airports (SCIway.net, 2007; South Carolina Division of Aeronautics, 2007; South Carolina Ports Authority, 2007). Figure 7 also shows the locations of ports and main hub airports in border states. This infrastructure allows the movement of people, goods, and services throughout South Carolina, the U.S., and the world. The interstate highway system provides ready truck access throughout the United States. The ports and airports allow people and cargo to travel internationally.

The three major South Carolina biomedical devices clusters each have a public main hub airport (South Carolina Division of Aeronautics, 2007). The Upstate and Columbia clusters are located at the intersections of interstate highways. The Upstate cluster lies along the stretch of I-85 between Atlanta and Charlotte. Interstate Highway 26 crosses I-85 at Spartanburg. Columbia is located at the intersections of Interstate Highways 20, 26, and 77. While Charleston has only one interstate, I-26, it is the only cluster city with a port (SCIway.net, 2007; South Carolina Ports Authority, 2007).

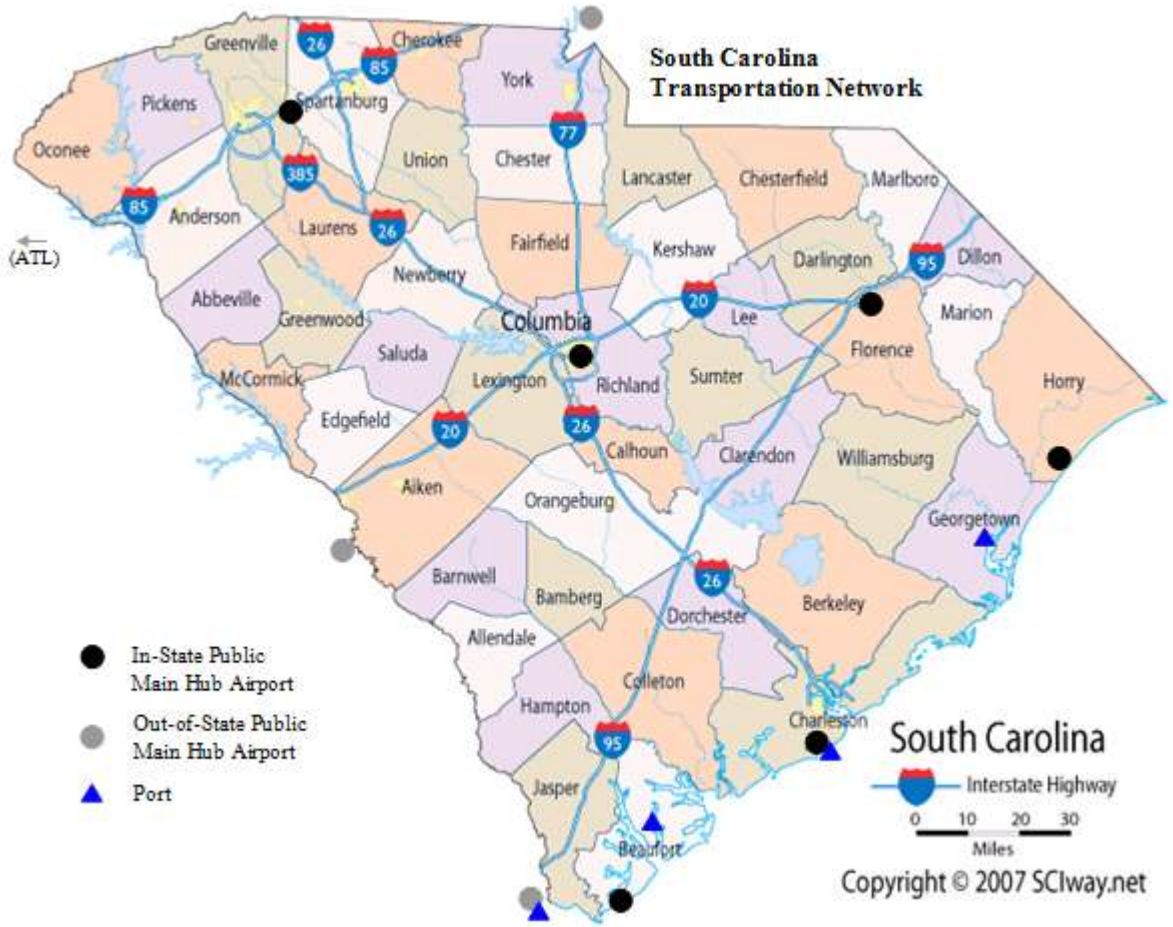

Figure 7. Interstate highways, ports, and public main hub airports in South Carolina.

Figure 8 maps the locations of South Carolina universities and technical schools, as recognized by the State of South Carolina (South Carolina Technical College System, 2007; State of South Carolina, 2007). Each of the three state research universities is located near one of the biomedical devices clusters. Clemson University in the Upstate is 18 miles from Anderson, 31 miles from Greenville, and 68 miles from Spartanburg. The University of South Carolina is located in Columbia. Charleston is home to the Medical University of South Carolina. Biomedical devices firms can benefit from the research and development efforts of universities. There may be opportunities for collaborative research between public and private entities, and small firms may benefit from business assistance programs provided by the universities.

Each cluster region also boasts numerous smaller universities and technical colleges. The technical colleges provide programs related to the biomedical field. These schools offer degrees in medical lab technology, industrial electronics (including a biomedical electronics path), electronic engineering technology, mechanical engineering technology, and radiological technology, as well as courses in the biological and physical sciences (South Carolina Technical College System, 2007). Charleston and Columbia both have medical schools affiliated with their research universities. The Upstate's research university, Clemson, does not have a medical school, although it has programs in bioengineering, biosciences, and nursing. Both Clemson and Furman University in Greenville offer pre-medical undergraduate studies. These schools may provide employees for biomedical devices firms. They also provide cultural enrichment within the communities that may help attract a diverse labor force.

Within the biomedical devices industry, proximity to major hospitals is important. These hospitals allow for clinical trials and feedback from doctors about device performance, what new techniques are coming on line, and what devices and instruments will be required by these new techniques. Charleston's Medical University of South Carolina and the University of South Carolina Medical School in Columbia both have affiliated hospitals. Charleston also has a Veterans Affairs medical center and a naval hospital in addition to regional hospitals. Columbia is home to several

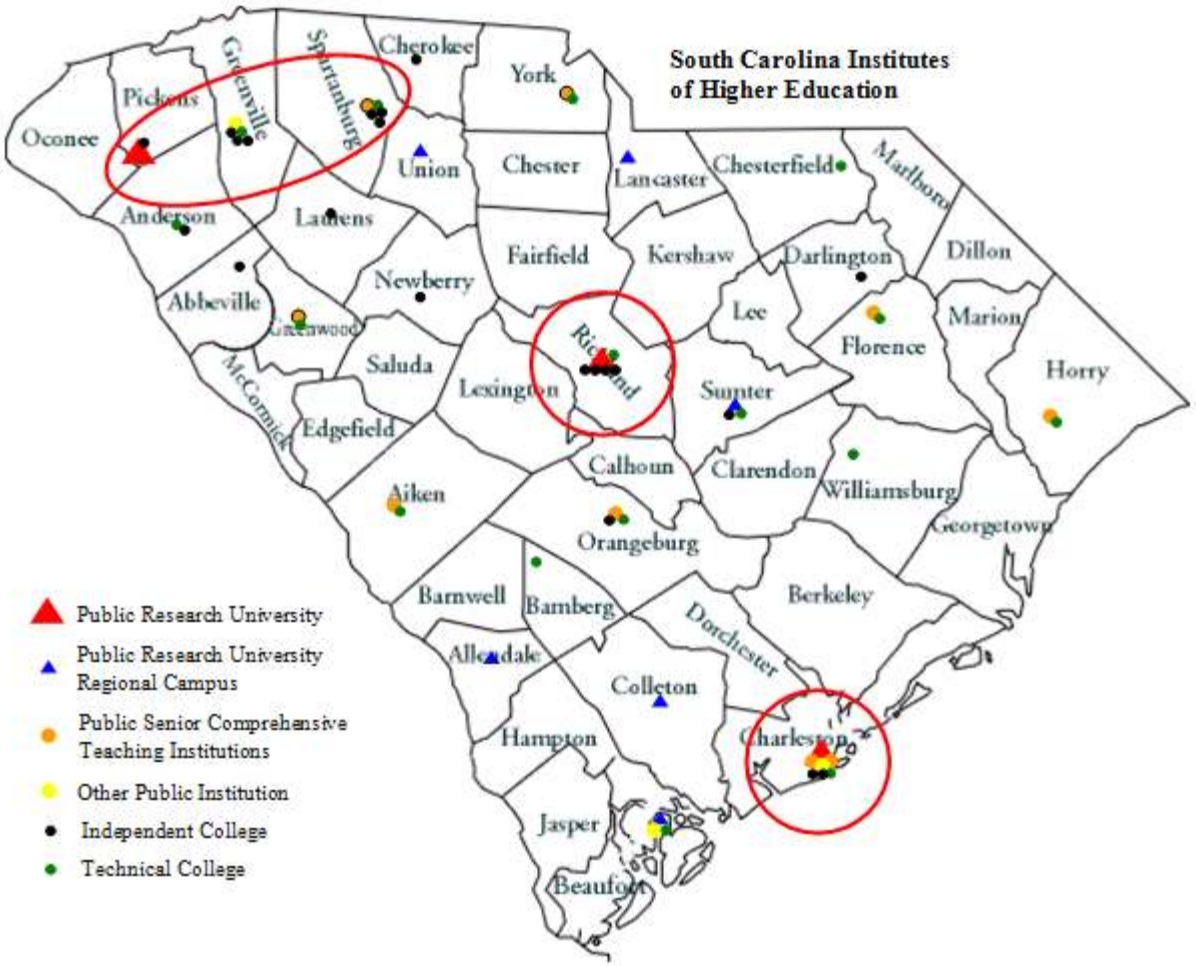

Figure 8. South Carolina institutions of higher education.

medical centers, and an army hospital. Greenville has only regional hospitals, but they are large facilities with linkages with universities and facilities in other regions.

Firms are also compelled to locate in close proximity to each other as a means of gaining market share. Some firms carefully plan their location to maximize their market share by stealing customers from one or more competitors. Other firms may hope to gain market share by filling an industry niche left by an existing firm in the region. Still others choose their location simply by copying larger firms' decisions. Some firms are generated as spin-offs of existing firms. All of these methods result in firms establishing themselves in the same location (St. John and Pouder, 2006).

4.2 Cluster Typology

There are several ways of categorizing clusters. Markusen (1996) identified four cluster types based on the characteristics of member firms and the linkages, or interdependencies, among firms within the cluster. She then described prospects for employment growth within each cluster type. Table 7 summarizes Markusen's clusters (Barkley and Henry, 1997; Markusen, 1996).

Table 7. Markusen's Typology of Industry Clusters.

Cluster Type	Characteristics of Member Firms	Intracluster Interdependencies	Employment Growth Prospects
Marshallian (classic or ideal cluster type)	Small and medium-sized locally owned firms	Substantial interfirm trade, collaboration, strong institutional support (maximizes agglomerative economies)	Dependent upon synergies and economies provided by cluster; may be encouraged by institutional support
Hub and spoke	One or several large firms with numerous smaller suppliers and service firms	Cooperation between large firms, smaller suppliers on terms of large firms	Dependent upon growth prospects of large (hub) firms
Satellite platforms	Medium and large branch plants	Minimal interfirm trade, networking	Dependent upon region's ability to recruit and retain branch plants
State-anchored	Large public or non-profit entity and related supply and service firms	Restricted to buy-sell relationships between public entity and suppliers	Dependent upon region's ability to expand political support for the public facility

Source: Barkley and Henry (1997) with modifications.

South Carolina's clusters tend to fit Markusen's satellite platform typology. Many of the state's biomedical devices firms are branches of national or multi-national corporations. There are, however, several, small locally-owned establishments. These establishments may be able to develop into Marshallian clusters that are more locationally stable and more amenable to networking than branch plants. This study focused on horizontal clusters of establishments within the same industry. However, the biomedical devices cluster has a host of suppliers and maintains linkages to auto parts manufacturers and other industries that share common resources and technologies (Walcott, 1999). These interactions, along with industry leaders' desire to focus on more technologically-advanced biomedical devices, indicate that technology districts may be pursued as a model of firm interaction.

4.3 Cluster Benefits and Evolution

Figure 9 shows the virtuous circle of cluster development. As a cluster develops, benefits accrue to its members, including external economies of scale resulting from the agglomeration of firms. These agglomerative economies include cost savings in obtaining supplies and services. Labor pools in the region grow, decreasing labor search costs to the firm as well as to the employees. Public services and infrastructure may be created to serve the cluster. Cluster members also benefit from formal and/or informal networking and information exchange. These benefits attract new firms to the region, increasing cluster size. These properties are reinforcing and further enhance the benefits of cluster membership. At some point, however, agglomerative forces are maximized and dispersal forces begin to push new activities away from the region. This may occur when congestion increases commuting costs or when increased population drives up real estate prices and forces wages to increase (Barkley and Henry, 2001).[3]

Figure 10 provides Feldman, Francis, and Bercovitz's (2005) three factor model of cluster evolution. Their model relies on a web of entrepreneurship, public policy, and regional outcomes that result from local business and policy efforts. Governments can assist entrepreneurs with favorable policy and business support, such as incubators or networking associations. Entrepreneurs achieve economic successes in the region through their own businesses success and cooperation, formal or informal, with other regional firms with similar needs. As profitability within the cluster increases and remains positive,

second-generation entrepreneurs move into the region and join the cluster. The cluster achieves further scale economies and gains political power to further secure favorable public policies (Barkley and Henry, 1997, 2001; Feldman, Francis, and Bercovitz, 2005; Porter, 2000).

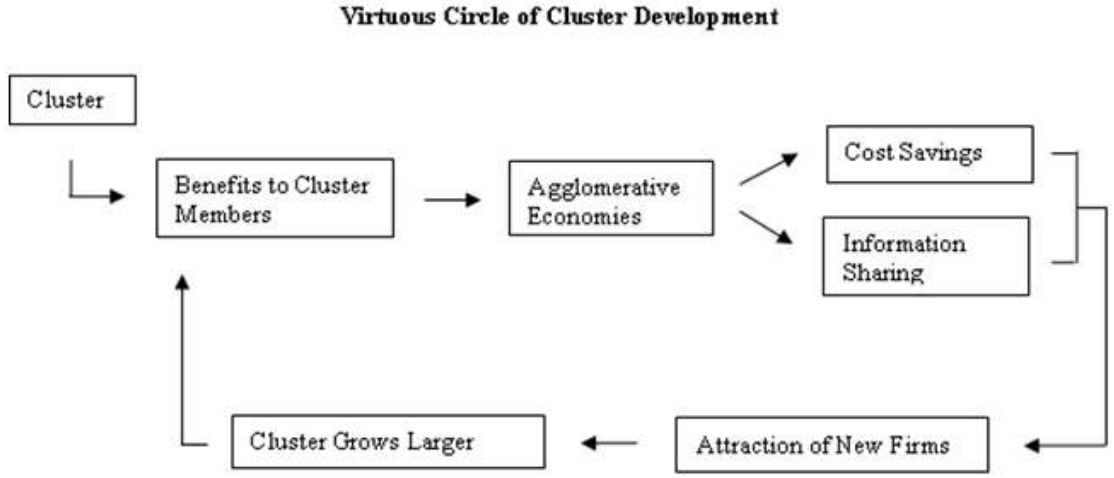

Figure 9. The virtuous circle of cluster development. Developed from Barkley and Henry (2001).

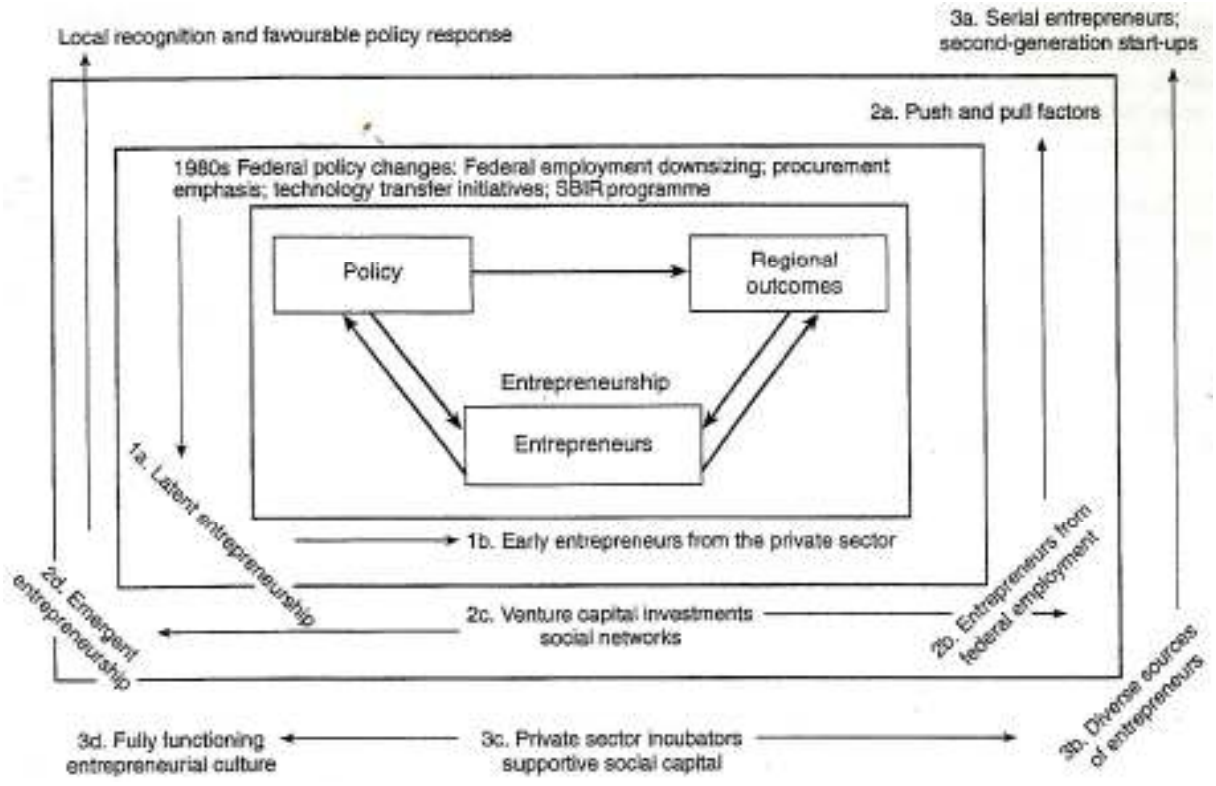

Figure 10. Evolution of the entrepreneurial cluster. Source: Feldman, Francis, and Bercovitz (2005, p. 133).

4.4. Cluster Metrics

Because there are disadvantages as well as advantages to creating industry clusters, communities need to consider whether a clustering strategy is appropriate and whether the biomedical devices cluster is a suitable target. Regions with strong industry clusters, such as Charleston, Columbia, and Greenville, likely will find the development of biomedical devices clusters beneficial. Smaller clusters, such as Beaufort and Florence, may be at a disadvantage compared to larger clusters if agglomeration economies and pools of skilled labor are critical for cluster development.

The biomedical devices industry is growing nationwide, and it is not expected to decline any time soon. Battelle (2007) cited slight industry growth from 2001 to 2004. Garber (2006) predicted that the medical devices industry, like the pharmaceutical industry, will continue to grow as baby boomers age. Investments made in this industry should pay dividends for many years if South Carolina can attract and retain biomedical devices establishments.

The suitability of a region for an industry can be determined by assessing the region's competitive advantage in that industry. A regional cluster's competitive advantage can be characterized by its location quotient (LQ).[4] The LQ represents an industry's concentration of employment, firms, or sales in a region relative to the nation. The employment LQ for an industry *i* in region *j* is given as a function:

$$LQ_{ij}=(E_{i,j}/E_j)\ /(E_{in}/E_n), \quad (1)$$

where *E* is employment and *n* and *j* represent national and regional data, respectively. Hence, the LQ is the ratio of the share of regional workers employed in a given industry to the share of workers in the same industry nationally (Schaffer, 2007).

Table 8 and Figure 11 show the strength of the South Carolina biomedical devices industry relative to the nation, as reported by the Cluster Mapping Project (Harvard University, 2007).[5] The data indicate small or emerging clusters in South Carolina. As of 2004, the biomedical devices cluster made up less than one percent of U.S. employment. In 2004, South Carolina had 4,189 medical devices industry

employees and an LQ of 0.81. The state gained 1,820 employees over the five-year period from 1999 to 2004.

Only Charleston (LQ = 1.09) was more specialized in medical devices production than was the nation as a whole. Charleston had 821 medical devices employees in 2004, which represented a 300 employee increase from 1999 to 2004. Charleston was more specialized than the nation in the production of both surgical instruments and supplies (LQ = 1.82) and biological products (LQ = 1.05), and Charleston gained 300 surgical instruments employees and 50 biological products employees over the five-year period.[6] South Carolina's specialization in the surgical instruments and supplies sub-cluster (LQ = 1.13) was heavily influenced by the size of Charleston's sub-cluster.

As noted previously, each of the three main biomedical devices clusters in the state specialized in different sub-clusters. Specialization in the overall medical devices cluster was low for both Columbia (LQ = 0.23) and Greenville (LQ = 0.28). However, Columbia's specialization in ophthalmic goods (LQ = 0.95) was close to the national average, as was Greenville's specialization in medical equipment (LQ = 0.99). This may indicate emerging clusters in these cities. Yet, the emerging clusters remained small (171 employees in Greenville and 60 employees in Columbia), and employment growth was slow for 1999-2004.

Table 8. Medical Devices Employment and LQs, 2004.

Sub-Cluster	Measure	Region			
		Charleston	Columbia	Greenville	SC
Biological Products	Employment	60	60	-	175
	LQ	1.05	0.84	-	0.45
	Change in Employment, 1999-2004*	50	0	-	115
Dental Instruments and Supplies	Employment	10	-	-	10
	LQ	0.29	-	-	0.04
	Change in Employment, 1999-2004	-60	-	-	-50
Diagnostic Substances	Employment	-	3	32	78
	LQ	-	0.04	0.46	0.19
	Change in Employment, 1999-2004	-	2	-4	10
Medical Equipment	Employment	-	9	171	694
	LQ	-	0.05	0.99	0.70
	Change in Employment, 1999-2004	-	-56	9	247
Ophthalmic Goods	Employment	10	60	10	80
	LQ	0.20	0.95	0.17	0.17
	Change in Employment, 1999-2004	50	0	0	0
Surgical Instruments and Supplies	Employment	741	80	42	3,152
	LQ	1.82	0.16	0.09	1.13
	Change in Employment, 1999-2004	310	-43	10	1,448
Total Medical Devices Cluster	Employment	821	213	255	4,189
	LQ	1.09	0.23	0.28	0.81
	Change in Employment, 1999-2004	300	-45	16	1,820

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

"-" indicates locations for which 2004 data were not disclosed.
*Where data are non-disclosed for 1999, data from the closest year available is substituted.

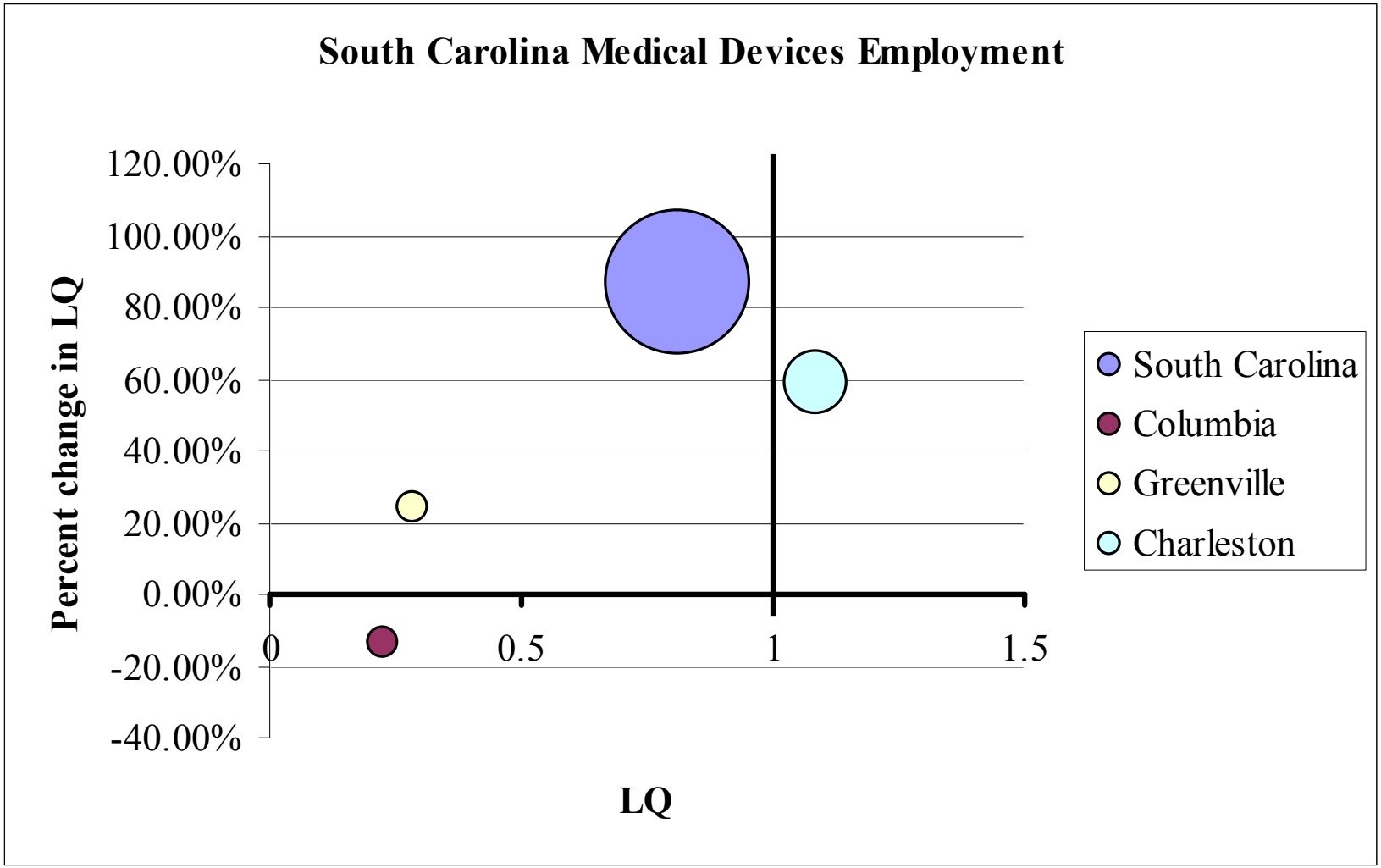

Figure 11. South Carolina biomedical devices employment. Source: Cluster Mapping Project, Institute for Strategy and Competitiveness, Harvard University Business School, 2007.

5. HISTORY AND PERFORMANCE OF OTHER BIOMEDICAL DEVICES CLUSTERS

Previous sections have identified agglomerations, or clusters, of activity in biomedical devices production in the state of South Carolina. Within the state, Charleston, Columbia, and Greenville were identified as biomedical devices clusters. Beaufort and Florence may be seen as emerging South Carolina clusters.

The biomedical devices industry is often considered part of the larger biosciences industry. Figure 12 shows the major bioscience clusters in the U.S. as identified by Battelle (2007). The yellow part of each disc shows the proportion of regional bioscience jobs in the biomedical devices field. Three of the principal medical devices clusters are in the South (Atlanta, Miami, and Tampa). The medical devices clusters in the South are relatively small compared to those in the Upper Midwest (Chicago, Indianapolis, Milwaukee, and Minneapolis), Northeast (Boston, New York, Philadelphia, and Pittsburg), and California (Los Angeles, San Diego, San Francisco, and San Jose).

Figure 13 shows regions with medical devices location quotients (LQs) greater than 1.50, as identified by Battelle (2007). Boston, Minneapolis-St. Paul, and California emerge as large employment clusters. In 2004, Los Angeles had the largest medical devices cluster with 28,304 employees. San Francisco, San Diego, and San Jose provided another 29,876 medical devices jobs in California. Although Minneapolis was the nation's second-largest medical devices employer with 23,148 jobs, its LQ of 4.27 was much larger than Los Angeles's 1.61. San Jose had an LQ of 4.41, San Francisco 1.92, and San Diego 1.42. Boston had a medical devices employment of 15,874 and an LQ of 2.14.

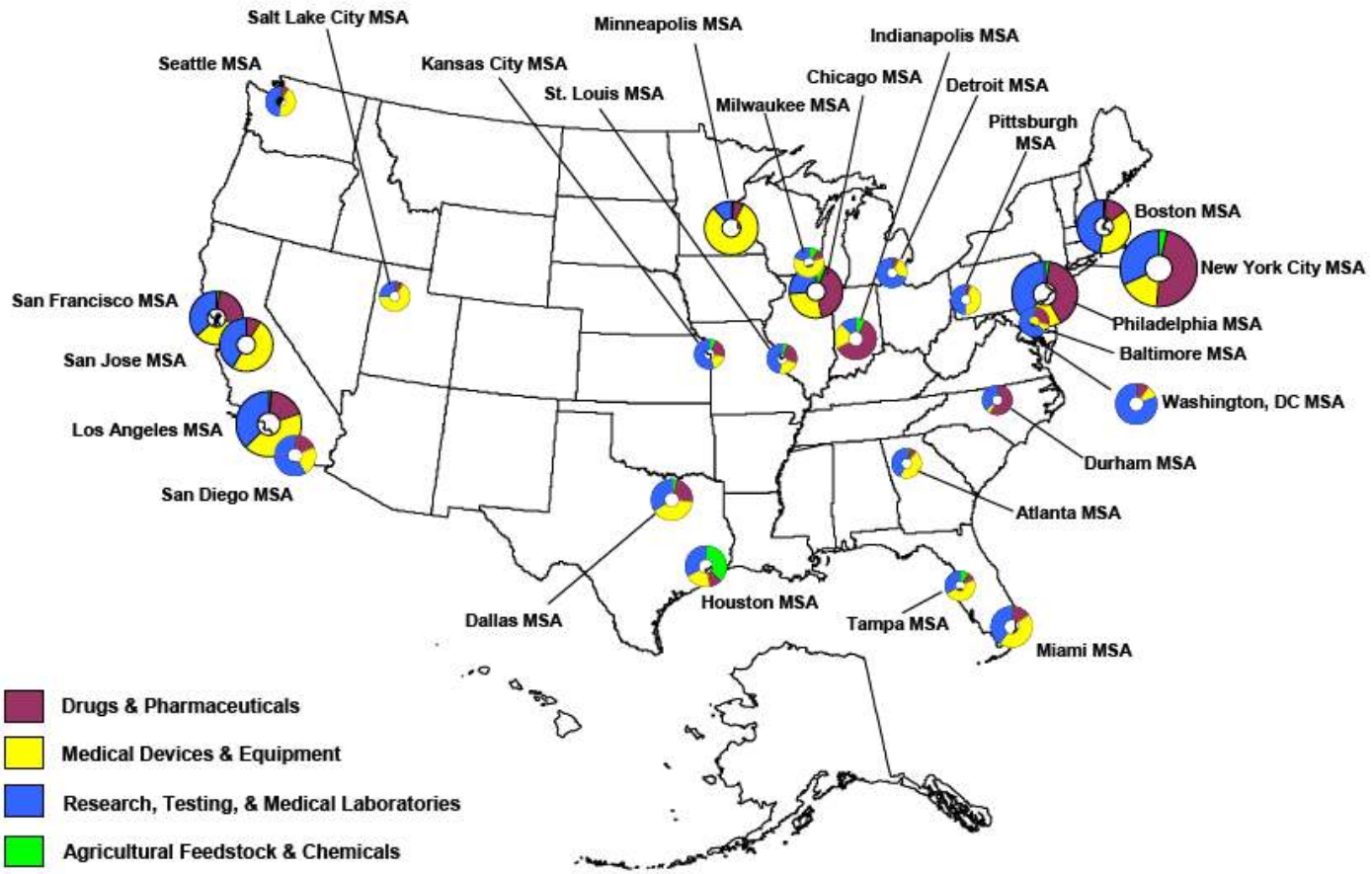

Figure 12. Metropolitan areas with total employment greater than 10,000 in the biosciences by major sub sector composition, 2004. Source: Battelle (2007).

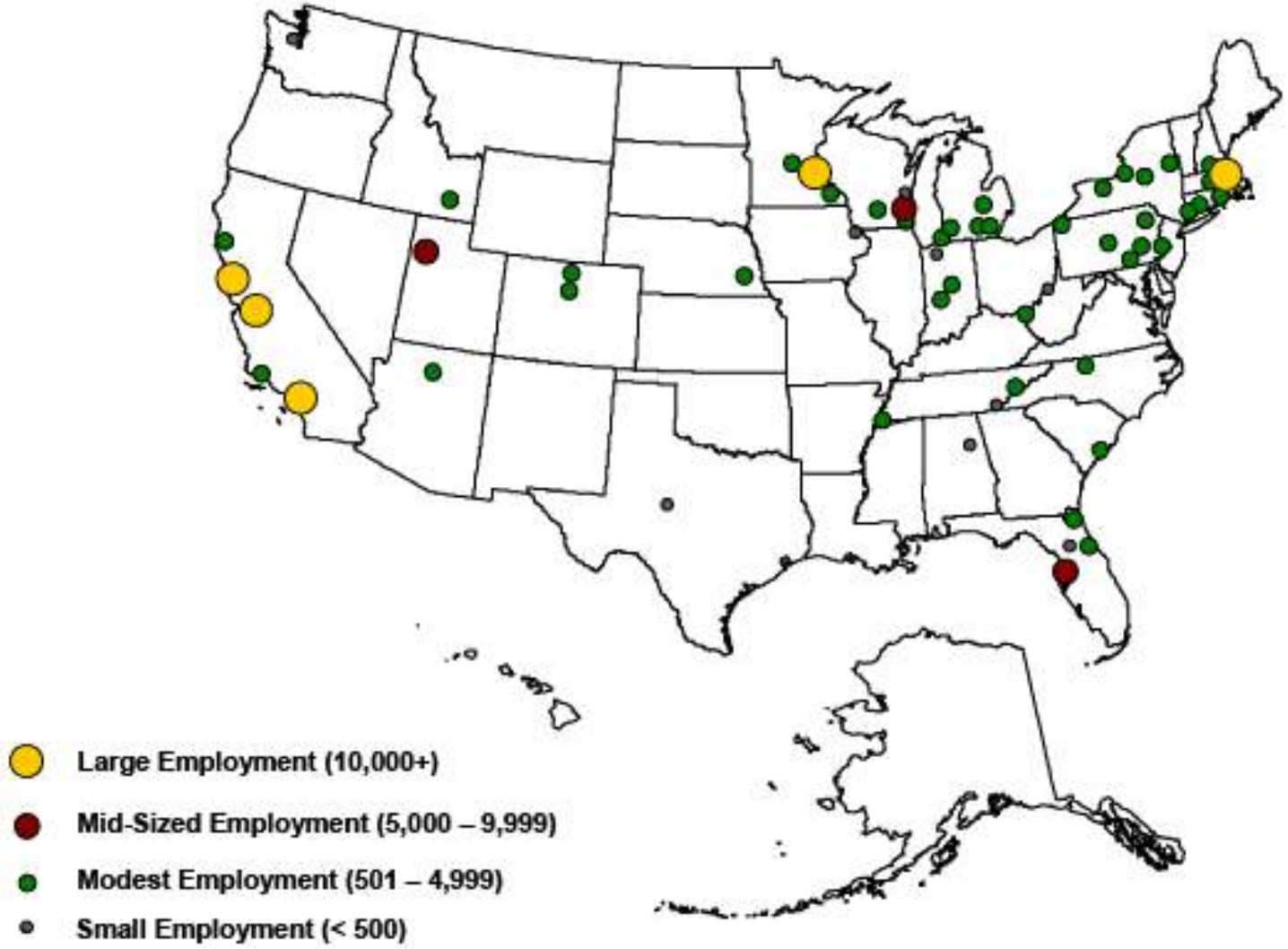

Figure 13. Regions identified by with medical devices location quotients (LQs) greater than 1.50. Source: Battelle (2007).

Table 9 provides employment and establishment numbers for the Southern medical devices clusters identified by Battelle. Tampa had the South's largest medical devices cluster with 6,083 employees and an LQ of 1.61. Some Southern cities were relatively more specialized in medical devices although their cluster employed fewer workers. Knoxville, Tennessee, had an LQ of 2.11 and employment of 2,039. Jacksonville, Florida, had an LQ of 1.98 and an employment of 3,448. Smaller Southern cities were also able to claim a place in the biomedical devices industry. For example, Charleston had an LQ of 2.40 and employment of 1,816, and Winston-Salem, North Carolina, had a medical devices industry LQ of 1.92.[7]

Table 9. Metropolitan Statistical Areas (MSAs) with Medical Devices Clusters Identified by Batelle, 2007.

MSA	LQ	2004 Employment	2004 Establishments
Anniston-Oxford, AL	2.33	313	6
Charleston-North Charleston, SC	2.40	1,816	23
Cleveland, TN	2.03	256	7
Deltona-Daytona Beach-Ormond Beach, FL	2.12	1,034	29
Gainesville, GA	1.49	312	20
Huntington-Ashland, WV-KY-OH	1.81	601	15
Jacksonville, FL	1.98	3,448	59
Knoxville, TN	2.11	2,039	51
Memphis, TN-MS-AR	1.86	3,477	58
Ocala, FL	1.64	456	15
Parkersburg-Marietta, WV-OH	2.06	448	8
Tampa-St. Petersburg-Clearwater, FL	1.61	6,083	179
Winston-Salem, NC	1.92	1,267	25

Source: Battelle (2007).

Battelle (2007) recognized both Greenville and Charleston as emerging clusters in medium-sized MSAs (MSAs with a regional employment of 75,000 to 250,000). Emerging clusters were defined as having 500 to 5,000 cluster employees in 2004 and experiencing industry job growth of 20 percent or more between 2001 and 2004.

Biomedical devices cluster development generally will not occur statewide. Attention will be directed to the specific areas of the state best positioned to gain market share. The economic and social conditions in other Southern states may more closely reflect the conditions experienced in South Carolina.

Consequently, South Carolina clusters may benefit from lessons learned in the development of other successful clusters in the South.

Direct competition to South Carolina biomedical devices clusters may come from the emerging clusters in Memphis, Tennessee, and Raleigh-Cary, North Carolina, both of which experienced industry growth greater than 20 percent from 2001 to 2004 (Battelle, 2007). However, Charleston, Columbia, and Greenville may be able to better compete with clusters in more similarly-sized MSAs, such as Winston-Salem, North Carolina, and Deltona-Daytona Beach-Orland Beach, Florida. The following discussion profiles three Southern cities with vibrant biomedical devices clusters: Tampa, Florida; Memphis, Tennessee; and Winston-Salem, North Carolina.

5.1 Tampa, Florida

Florida has three identified biomedical devices clusters. The Jacksonville, Miami, and Tampa MSAs each have a cluster. The Cluster Mapping Project recognized the Miami-Fort Lauderdale-Miami Beach area as the 11th largest medical devices cluster in terms of employment (Harvard University, 2007). Battelle (2007) recognized the Miami and Tampa clusters as the 12th and 20th largest biosciences clusters in the U.S. based on employment. Among the top 25 bioscience clusters, Miami had the 10th highest medical devices employment and Tampa the 13th. Jacksonville had the 27th highest medical devices employment. The Florida clusters are more specialized in medical devices production than in the biosciences as a whole (Battelle, 2007).

Although Miami has the larger cluster, Tampa has aggressively promoted its medical devices industry. Battelle (2007) estimated an LQ greater than 1.50 for the industry and recognized Tampa as a strong area for mid-size employment in the medical devices sector. The Greater Tampa Chamber of Commerce (2007) reported that more than 600 biosciences manufacturing plants were located in and around Tampa. The chamber touted its labor force, transportation, infrastructure, and low business costs to potential businesses. The organization also noted the proximity to local universities and hospitals where physicians conduct clinical research trials. The city is home to the University of South Florida, which includes a medical school, and the University of Tampa. Tampa also has a veterans' hospital. The

Tampa chamber provided extensive information about local business and industry conditions to businesses considering the area. And, of course, the chamber cited its rankings by the Cluster Mapping Initiative: 13th for the analytical instruments cluster and 21st for the medical devices cluster (Harvard University, 2007).

Florida shows evidence of a home market effect, in which higher demand for a good or service in a region encourages the area to specialize in its production and become a net exporter (Brakman and Garretsen, 2006). Florida is home to many retirees, and this aging population requires more medical services than the national average. The local demand for medical services and the devices with which they are performed may have a positive effect on clusters. This high level of demand encourages innovation, and political support from people requiring the services sustains industry development efforts.

5.2 Memphis, Tennessee

Memphis was identified by Battelle as an emerging cluster in a large metropolitan area. However, Memphis has about the same population as the Greenville-Anderson-Spartanburg CSA, roughly 1.2 million (USDC-CB, 2007b). Consequently, the South Carolina cities may be able to learn from the cluster developing in Memphis. With 3,477 employees and an LQ of 1.86, Memphis ranked 14th both in medical devices employment and in employment concentration among large MSAs. The Cluster Mapping Project did not recognize the Memphis area but ranked the state of Tennessee as 19th in medical devices employment and 14th in employment concentration (Harvard University, 2007).

The Memphis Region Medical and Research Web site states that "[t]he Memphis region has the three interactive medical functions necessary to become a medical hub" (Memphis Region, 2001). These three functions are identified as major hospitals, medical schools, and research centers. St. Jude Children's Research Hospital, the University of Tennessee Health Science Center, and a veterans' hospital, as well as regional hospitals, are located in Memphis. The University of Tennessee Health Science Center, St. Jude Children's Research Hospital, and the University of Memphis all have research centers focused on biomedical issues.

The Memphis biomedical devices cluster has identified three principal goals to increase its stature (Memphis Region, 2001). Goal number one is to create a council comprised of representatives of local hospitals, medical schools, universities, and the business community in an attempt to foster networking and synergy, establish political clout for the industry, and attract capital investments. Goal two is to encourage cluster members to collaborate to define the mission of the industry, set quality levels, and create a cohesive industry as opposed to the fragmented one that has previously existed. Finally, goal three is to develop a formalized plan to strengthen the cluster by advancing research and business development.

5.3 Winston-Salem, North Carolina

Battelle (2007) listed Winston-Salem as a medium-sized MSA with an emerging medical devices cluster. The Winston-Salem MSA has a population of 456,600, which is smaller than the South Carolina MSAs. However, the Winston-Salem CSA has a population of about 1.5 million (USDC-CB, 2007b). The study found the region had 1,267 medical devices employees in 2004 and an LQ of 1.92. In the same year, the Cluster Mapping Project identified 796 employees in the region (Harvard University, 2007). The Winston-Salem MSA specialized in surgical instruments and supplies, with 777 employees in that sub-cluster alone. However, the city had transitioned from medical equipment into surgical instrument production in the past five years.

Winston-Salem is home to Wake-Forest University and the WFU Baptist Medical Center, which is affiliated with the university's medical school and has an educational and research focus. Nearby Greensboro and High Point both have universities as well. In addition to the medical center, the region has multiple hospital systems, including the Moses Cone and High Point Regional health systems.

Winston-Salem's Forsyth Tech Community College is home to one of the National Center for the Biotechnology Workforce's five Centers of Expertise (Forsyth Tech, 2007). The center works to develop biotechnology industries in the region and to ensure that qualified employees are available to medical, life science, and pharmaceutical firms.

6. LESSONS LEARNED FROM OTHER CLUSTER INITIATIVES

A review of biomedical devices clusters in the U.S. indicates some general lessons regarding successful cluster location. Biomedical devices clusters appear to have unique requirements: (1) proximity to large and respected hospitals and (2) affiliation with one or more research universities with biomedical programs. Proximity to hospitals provides facilities for clinical trials and a ready avenue for communicating with medical professionals about improvements to instruments. Affiliation with research universities aids the research and development process. Collaboration between firms and universities is not exclusive to biomedical clusters, but university partnerships seem to be highly critical to cluster success in this industry. Many biomedical devices clusters develop within a context of technological innovation, and universities are a source of that innovation.

General principles of cluster location also apply to biomedical devices clusters. All the major U.S. biomedical devices clusters are located along major transportation networks (i.e., interstate highway and airports). Many of the largest clusters also have port access. Four of the five largest clusters are on a coast. The most successful clusters are in large cities that provide both localization economies and urbanization economies. These large cities provide large pools of skilled labor and have a diversity of jobs that attracts an array of people and skills. Urban areas also tend to be more accepting of people of different cultures and interests.

7. SUMMARY AND CONCLUSIONS

Charleston, Columbia, and the Greenville-Anderson-Spartanburg CSA have identifiable biomedical devices clusters. Beaufort and Florence may see clusters emerge in the future. However, these emerging clusters would most likely function as an extension of another cluster because the smaller cities do not appear to have the educational and medical infrastructure to support an independent cluster. For example, a Beaufort cluster could be seen as an extension of the Charleston cluster. As such, it would benefit from the Medical University of South Carolina and other colleges and hospitals (i.e., the veterans' hospital) in the Charleston area.

The South Carolina biomedical devices clusters are small and young relative to devices clusters in other parts of the U.S. Consequently, they currently may not offer the agglomeration economies available at other regions. Localization economies could generate fairly quickly if policies to promote South Carolina's biomedical devices industry were implemented. However, the potential costs and benefits of all such strategies should be carefully considered. Resources should be targeted to specific regions and projects where a competitive advantage may exist. Dynamic agglomeration economies take more time to develop, so South Carolina may struggle with a latecomer disadvantages. This handicap could be partially offset by encouraging networking among cluster members. An organized and focused cluster also would be expected to have more political clout.

If South Carolina's cities want to pursue a cluster strategy, they should familiarize themselves with the biomedical devices industry's requirements, including proximity to hospitals and research facilities, as well as the prerequisites of general cluster development. They should evaluate their potential to meet these requirements and the costs and benefits associated with doing so. If cities decide to support a biomedical devices cluster, they need to focus their efforts and promote their region to potential firms. Charleston initiated this process when the Charleston Regional Development Alliance (2007) identified a biosciences cluster as a target industry. The organization's Web site identifies the advantages and resources the Charleston area and the state of South Carolina can offer bioscience firms and describes the current state of the cluster. Similar efforts could be provided in other areas of the state.

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APPENDIX: SOUTH CAROLINA BIOMEDICAL DEVICE MANUFACTURING ESTABLISHMENTS AND CITIES.

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
3D SYSTEMS CORPORATION	ROCK HILL	X					
AAI PHARMA INC.	CHARLESTON		X	AAI PHARMA INC.	WILMINGTON	NC	US
ACCURATE MANUFACTURING INC	SWANSEA	X					
ACTARIS METERING SYSTEMS	GREENWOOD	X					
ADAIR APOTHECARY	LAURENTS	X					
ADG WOOD TRUSSES, LLC	LORIS	X					
ADVANCED AUTOMATION	GREENVILLE	X					
ADVANCED BIOMECHANICAL SOLUTIONS	GREENWOD	X					
ADVANCED BIOSENSOR, INC.	COLUMBIA		X	BIOTEL,INC.	EAGAN	MN	US
AGFA CORP.	GOOSE CREEK		X	AGFA HEALTHCARE N.V.	MORTSEL		BE
AGFA CORP.	GREENVILLE		X	AGFA HEALTHCARE N.V.	MORTSEL		BE
AIRSONETT, INC.	FORT MILL	X					
ALL MEDICAL	COLUMBIA	X					
ALPHA MEDICAL L.L.C.	ROCK HILL	X					
ALPHA TECHNOLOGY	ANDERSON	X					
AMERCARE, INC.	CHARLESTON	X		AMERCARE, INC.	CHARLESTON	SC	US
AMERCARE, INC.	NORTH CHARLESTON		X	SHIJIAZHUANG HOLY PLASTICS CO., LTD.	SHIJIAZHUANG	HEBEI	CH
AMERICAN HEALTH SERVICES INC	GREENVILLE	X					
AMERICAN HEALTH SYSTEMS, INC.	GREENVILLE	X					
AMERICN HOME PATIENT INC	COLUMBIA		X	AMERICAN HOME PATIENT INC	BRENTWOOD	TN	US
AMERICAN HOME PATIENT INC	CONWAY		X				
AMERICAN HOME PATIENT INC	FLORENCE		X				
AMERICAN HOME PATIENT INC	GREENVILLE		X				
AMERICAN HOME PATIENT INC	NORTH CHARLESTON		X				
AMERICAN HOME PATIENT INC	UNION		X				
ANCHOR INDUSTRIES INC	COLUMBIA	X					
APRIA HEALTHCARE	COLUMBIA		X	APRIA HEALTHCARE GROUP INC	LAKE FOREST	CA	US
APRIA HEALTHCARE	DUNCAN		X				
APRIA HEALTHCARE	NORTH CHARLESTON		X				
AQUA PRODUCTS CO	NEWBERRY	X					

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
ARC SPECIALTY PRODUCTS, BALCHEM CORPORATION	GREEN POND		X	ARC SPECIALTY PRODUCTS, BALCHEM CORPORATION	NEW HAMPTON	NY	US
ARJO WIGGINS MEDICAL, INC.	CHARLESTON		X	ARJO WIGGINS S.A.	ISSY-LES-MOULINEAUX CEDEX		FR
ARK THERAPEUTIC SERVICES, INC.	LUGOFF	X					
ARTRONICS	EASLEY	X					
ATC GROUP INC	NORTH CHARLESTON		X	DAIREI U.S. INC.	ESBJERG		DA
ATLANTIC CORPORATION	DUNCAN	X					
BAGNAL PHARMACY	AYNOR	X					
BALLINGTON CONCEPTS	GILBERT	X					
BARKER CONTROLS INC	GREENVILLE	X					
BAUSCH & LOMB INC., GREENVILLE SOLUTIONS PLANT	GREENVILLE		X	BAUSCH & LOMB, INC.	ROCHESTER	NY	US
BBA FIBERWEB SIMPSONVILLE	SIMPSONVILLE	X					
BECTON, DICKINSON & CO., (BD) PREANALYTICAL SYSTEM	SUMTER		X	BECTON, DICKINSON & CO.	FRANKLIN LAKES	NJ	US
BERCHTOLD CORP.	CHARLESTON		X	BERCHTOLD HOLDING GMBH	TUTTLINGEN		GM
BERCHTOLD CORP.	CHARLESTON		X	BERCHTOLD HOLDING AG	SCHAFFHAUSEN		SZ
BETRAS PLASTICS INC	SPARTANBURG	X					
BILL SIMS CO., INC.	IRMO	X					
BIOWATCH MEDICAL, INC.	COLUMBIA	X					
BOYD DENTAL SERVICES, LTD.	HUGER	X					
BRACE & BOOT ORTHOPEDICS	COLUMBIA		X	HANGER ORTHOPEDIC GROUP INC	BETHESDA	MD	US
BRACKETT & COCHRAN MANUFACTURING, INC.	GOOSE CREEK	X					
BRANFORD CO	SUMMERVILLE	X					
BREATHAID, LLC.	CAMDEN	X					
BRENDON BLAKE	WOODRUFF		X	REAL IDEAS, INC.	MISSION BC		CA
C A PLUS ADHESIVES	COLUMBIA	X					
C.R. BARD, INC.	MONCKS CORNER		X	C.R. BARD, INC.	MURRAY HILL	NJ	US

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
CAIRD TECHNOLOGY	COLUMBIA	X					
CALIGOR HOSPITAL DIV	GREENVILLE		X	MMS	EARTH CITY	MO	US
CAMBRIDGE MARKETING, INC.	ROCK HILL	X					
CAMPBELL BROWN INC	GREENVILLE	X					
CARDINAL HEALTH-MEDICAL PRODUCTS AND SERVICES	FORT MILL		X	CARDINAL HEALTH	MCGAW PARK	IL	US
CAROLINA DIABETIC SUPPLY INC	COLUMBIA	X					
CENTURY PLASTICS INC.	SIMPSONVILLE	X					
CERAM TEC NORTH AMERIC CORP	LAURENS		X	KOHLBERG KRAVIS ROBERTS & CO	NEW YORK	NY	US
CHAMPION ROLLER INC	ROCK HILL	X					
CHARLES RIVER LABORATORIES, INC.	CHARLESTON		X	CHARLES RIVER LABORATORIES, INC.	WILMINGTON	MA	US
CHERRY BLOSSOM ENTERPRISES INC.	WESTMINSTER	X					
CHISOLM BIOLOGICAL LABORATORY	WARRENVILLE	X					
CITSCO	LANCASTER	X					
CMS IMAGING INC	CHARLESTON	X					
COASTAL PRODUCTS INTERNATIONAL	BLUFFTON	X					
COMFORT CARE PRODUCTS CORP	NEWBERRY		X	LEW JAN TEXTILE	COMMACK	NY	US
COMMERCIAL WAREHOUSE & CARTAGE, INC.	GREER		X	COMMERCIAL WAREHOUSE & CARTAGE, INC.	FORT WAYNE	IN	US
COMP X SECURITY PRODUCTS	GREENVILLE		X	CONTRAN CORP	DALLAS	TX	US
COMPACT AIR PRODUCTS	WESTMINSTER	X					
COMPACT AUTOMATION PRODS LLC	WESTMINSTER	X					
COMPUTER DYNAMICS INC	GREENVILLE		X	GE FANUC AUTOMATION INC	CHARLOTTESVILLE	VA	US
CONCEPTS INTERNATIONAL INC	SUMMERTON	X					
CONTEC INC	SPARTANBURG	X					
CORONET GROUP-NORTH AMERICA	SUMMERVILLE		X	CORONET GROUP-NORTH AMERICA	LONGMEADOW	MA	US
CORONET-NORTH AMERICA LLC	SUMMERVILLE	X					
COVIDIEN	SENECA		X	COVIDIEN US	MANSFIELD	MA	US
CROWN COSMETICS	SIMPSONVILLE	X					
CURAE'LASE INC.	LORIS	X					
CYPRESS MEDICAL SUPPLY	MANNING	X					
DARLINGTON DENTAL CERAMICS	DARLINGTON	X					

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
DELPHI INTL.	CLOVER	X		DELPHI INTL.	CLOVER	SC	US
DELPHI INTL.	CLOVER		X	DENTALEYE AB	SPANGA		SW
DEROYAL TEXTILES, INC.	CAMDEN	X					
DIABETIC SUPPLY PROVIDERS	LANCASTER	X					
DIATECH DIAMOND USA, INC.	MT PLEASANT	X					
DIHOMA CHEMICAL & MFG	MULLINS	X					
DIVERSIFIED OPTHLAMICS INC	COLUMBIA	X					
DIVERSIFIED PLASTICS INC	LATTA	X					
DIXIE RUBBER & PLASTICS	GREENVILLE	X					
DOLGENCORP, INC.	JONESVILLE		X	DOLGENCORP, INC.	GOODLETTSVILLE	TN	US
DRIAM USA INC	SPARTANBURG	X					
DUPONT PERSONAL PROTECTION - MAR-MAC MANUFACTURING	MCBEE		X	DuPont, United States			
EASTERN DISTRIBUTION INC	GREENVILLE	X					
EDWARDS MEDICAL SUPPLY	LEXINGTON	X					
EMS-CHEMIE NORTH AMERICA INC	SUMTER	X					
ENVIRONMENTAL EXPRESS	MT PLEASANT	X					
ERAD IMAGE MEDICAL	GREENVILLE	X					
ESCOD INDUSTRIES	NORTH MYRTLE BEACH	X					
EURODENT, INC.	PENDLETON	X					
EVERGREEN MOLDING	GREENVILLE	X					
EXOPACK	SPARTANBURG	X					
FABRI-KAL CORP.	PIEDMONT		X	FABRI-KAL CORP.	KALAMAZOO	MI	US
FAST POINT FOOD STORES, INC.	SPARTANBURG	X					
FELTERS GROUP	ROEBUCK	X					
FIRST CHOICE MEDICAL EQUIPMENT	LORIS	X					
FLEXI-WALL SYSTEMS	LIBERTY	X					
FLOYD BRACE CO INC	CHARLESTON	X					
FOLLINE VISION CTR	COLUMBIA	X					
FRIDDLE'S ORTHOPEDIC APPLIANCES, INC.	HONEA PATH	X					
FRIDDLE'S ORTHOTIC & PROSTHETIC	SPARTANBURG	X					

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
FUJIFILM MANUFACTURING USA, INC.	GREENWOOD		X	FUJIFILM CORPORATION	MINATO-KU TOKYO		JA
FUNSPECS, INC.	SPARTANBURG	X					
GE MAGNETS	FLORENCE		X	GENERAL ELECTRIC CO.	FAIRFIELD	CT	US
GENPHAR	MT PLEASANT	X					
GETINGE USA, INC	NORTH CHARLESTON		X	GETINGE USA, INC	ROCHESTER	NY	US
GETINGE USA, INC	NORTH CHARLESTON		X	EEME MEDICAL DESIGN INC.	BOISBRIAND	QUEBEC	CA
GLAXOSMITHKLINE CONSUMER HEALTHCARE, L.P.	FOUNTAIN INN		X	SMITHKLINE BEECHAM CORP.	PHILADELPHIA	PA	US
GLOBAL PRECISION OPTICS	ANDERSON	X					
GLUCOTEC, INC.	GREENVILLE	X					
GO REGULATOR INC	SPARTANBURG	X	X	CIRCOR INTERNATIONAL INC	BURLINGTON	MA	US
GORRIN'S CLINIC	GREENVILLE	X					
GRANSFORS BRUKS	SUMMERVILLE	X					
GREAT TAIWAN GEAR LTD	GREER	X					
GREENVILLE ORTHOPEDIC APPL CO	GREENVILLE	X					
GREER MEDICAL SUPPLY	GREER	X					
GRIFFIN TESTING PRODUCTS INC	SALEM	X					
GROVE MEDICAL, INC.	GREENVILLE	X					
HACKER INDUSTRIES, INC.	WINNSBORO	X		HACKER INDUSTRIES, INC.	WINNSBORO	SC	US
HACKER INDUSTRIES, INC.	WINNSBORO		X	MEDSURG UK	LONDON		UK
HAEMONETICS CORP.	UNION		X	HAEMONETICS CORP.	BRAINTREE	MA	US
HAGEMEYER NORTH AMERICA, INC.	N. CHARLESTON	X					
HALL DIELECTRIC MACHINERY CO	ROCK HILL	X					
HAMILTON MFG. CO.	SUMMERVILLE	X					
HAMMETT SCIENTIFIC GLASS INC	NORTH AUGUSTA	X					
HANGER PROSTHETICS & ORTHOTICS	CHARLESTON		X	HANGER ORTHOPEDIC GROUP INC	BETHESDA	MD	US
HARRINGTON CONSULTING	LEXINGTON	X					
HARTMANN-CONCO INC.	ROCK HILL		X	PAUL HARTMANN AG	HEIDENHEIM		GM
HARTMANN-CONCO INC.	ROCK HILL		X	KARL OTTO BRAUN KG	WOLFSTEIN	PFALZ	GM
HEALTH RELATED PRODUCTS	GREENWOOD	X					
HEALTHONICS, INC.	NEW ELLENTON	X					

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
HEMO DIAGNOSTICA, LLC	JOHNS ISLAND		X	HEMODIAGNOSTICA, LLC	JOHNS ISLAND		US
HEMODIAGNOSTICA, LLC	JOHNS ISLAND		X	CRONY INSTRUMENTS SPA	ROME		IT
HENDERLITE EYE PROSTHETICS INC	MT PLEASANT	X					
HIGHLANDS ANAPLASTOLOGY	ANDERSON						
HILL-ROM MANUFACTURING, INC.	CHARLESTON		X	HILL-ROM, INC.	BATESVILLE	IN	US
HILL-ROM MANUFACTURING, INC.	NORTH CHARLESTON		X	HILDENBRAND INDUSTRIES IND	BATESVILLE	IN	US
HOKE INC	SPARTANBURG		X	CIRCOR INTERNATIONAL INC	BURLINGTON	MA	US
HOLOPACK INTERNATIONAL, INC.	COLUMBIA		X	HOLOPACK VERPACKUNGSTECHNIK GMBH	ABTSGMUND-UNTERGRONINGEN		GM
HOLOPACK INTL. CORP.	COLUMBIA	X		HOLOPACK INTL. CORP.	COLUMBIA	SC	US
HOME MEDICAL CARE	ANDEREWS	X					
HOMECARE MEDICAL SYSTEMS, INC.	CHARLESTON	X					
ICCA, A DIVISION OF INTERNET SERVICES CORPORATION	FORT MILL	X					
IMIX ADR (USA)	GREENVILLE		X	PROVOTEC GMBH & CO. KG	ESPELKAMP		GM
IMIX ADR, LTD.	LANDRUM		X	IMIX ADR FINLAND OY	TAMPERE		FI
IMPOEX INTERNATIONAL, LTD.	LITTLE RIVER	X		IMPOEX INTERNATIONAL,	LITTLE RIVER	SC	US
IMPOEX INTERNATIONAL, LTD.	LITTLE RIVER		X	FORMA PLAST AB	OCKELBO		SW
INCARE MEDICAL EQUIPMENT	MYRTLE BEACH	X					
INFINITY AIR PRODUCTS	ROCK HILL	X					
INFOR GLOBAL SYSTEMS	GREENVILLE		X	GOLDEN GATE CAPITAL	SAN FRANCISCO	CA	US
INREACH CORPORATION	ANDERSON	X					
INTERAY INTERNATIONAL X-RAY	NORTH CHARLESTON	X					
INTERNATIONAL BUSINESS STRATEGIES	MOUNT PLEASANT		X	IT DR. GAMBERT GMBH	WISMAR	M-V	GM
INTERNATIONAL BUSINESS STRATEGIES, LLC	MOUNT PLEASANT	X		INTERNATIONAL BUSINESS STRATEGIES, LLC	MOUNT PLEASANT	SC	US
INT'L PLASTICS, INC.	GREENVILLE	X					
INTL. NEEDLE, INC.	CLOVER		X	INTL. NEEDLE, INC.	ROCK HILL	SC	US
ISOMEDIX OPERATIONS INC.	SPARTANBURG		X	STERIS CORPORATION	MENTOR	OH	US
J C ROSE & ASSOC	GREENVILLE	X					
J.R. DOWNEY	ANDERSON	X					
JACKSON DAVENPORT OPTICIANS	CHARLESTON	X					
JANPAK OF CHARLESTON	WANDO		X	JANPAK SUPPLY SOLUTIONS	DAVIDSON	NC	US

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JARDEN PLASTC SOLUTIONS	GREER		X	JARDEN CORPORATION	RYE	NY	US
JAVLYN MANUFACTURING CO INC	CAYCE	X					
KALE RESEARCH AND TECHNOLOGY	SPARTANBURG	X					
KASH & KARRY PHARMACY	GREENVILLE	X					
KENDALL, A DIVISION OF TYCO HEALTHCARE GROUP LP	GREENWOOD		X	TYCO HEALTHCARE GROUP, LP	MANSFIELD	MA	US
KENDALL, A DIVISION OF TYCO HEALTHCARE GROUP LP	SENECA		X	TYCO HEALTHCARE GROUP, LP	MANSFIELD	MA	US
KENYON WELLS & ASSOC INC	LEXINGTON	X					
KIGRE INC	HILTON HEAD ISLE	X					
KIMBERLY-CLARK CORP.	BEECH ISLAND		X	Kimberly-Clark Corp			
KING DRUG COMPANY OF FLORENCE, INC.	FLORENCE		X	LYNDALE ENT., INC.	WILMINGTON	NC	US
KOBRA INC.	ROCK HILL		X	GEBR. BRASSELER GMBH & CO. KG	LEMGO		GM
KOMET USA LLC	ROCK HILL		X	GEBR. BRASSELER GMBH & CO. KG	LEMGO		GM
L & L WINGS, INC.	MYRTLE BEACH	X					
LABORATORY DESIGN & EQUIP INC	FORT MILL	X					
LATITUDE HEALTHCARE LLB	CHARLESTON		X	CEFNDY HEALTHCARE	RHYL	DENBIGH SHIRE	UK
LEAR CORP.	DUNCAN		X	LEAR CORP.	SOUTHFIELD	MI	US
LEATHERWOOD ELECTRONICS & MFG., INC.	NORTH CHARLESTON	X					
LEINER HEALTH PRODUCTS	FORT MILL		X	LEINER HEALTH PRODUCTS	CARSON	CA	US
LESLIE W. ORGAN	CHARLESTON		X	DIROS TECHNOLOGY, INC.	MARKHAM		CA
LEXINGTON MEDCIAL	ROCK HILL		X	LEXINGTON PRECISION CORP	NEW YORK	NY	US
LINCARE	WEST COLUMBIA		X	LINCARE HOLDINGS INC	CLEARWATER	FL	US
LINKBROKERS INTERNATIONAL	LITTLE RIVER	X		LINKBROKERS INTERNATIONAL	LITTLE RIVER	SC	US
LINKBROKERS INTERNATIONAL	LITTLE RIVER		X	VUPIESSE ITALIA S.R.L.	RIMINI		IT
LONGS DRUGS	COLUMBIA		X	LONGS DRUG STORES CORP	WALNUT CREEK	CA	US
LOVELY-335	SIMPSONVILLE	X					

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
LUCKY SALES INC.,	GREER	X		LUCKY SALES INC.,	GREER	SC	US
LUCKY SALES INC.,	GREER		X	WENZHOU N. & A. FOREIGN TRADE CORP.	WENZHOU	ZHEJIAN	CH
LUCKY SALES INC.,	GREER		X	ZHEJIANG KAIDA OPTICAL CO., LTD	WENZHOU		CH
MACK MOLDING CO.	INMAN	X					
MAKRAMOS INTL.	MULLINS	X					
MARKO INC	SPARTANBURG	X					
MARLEY ENGINEEERED PRODUCTS	BENNETTSVILLE	X					
MARTIN INC	PIEDMONT	X					
MATRX	IRMO		X	HENRY SCHEIN, INC.	MELLVILLE	NY	US
MAXWELL MEDICAL	LEXINGTON	X		MAXWELL MEDICAL	LEXINGTON	SC	US
MAXWELL MEDICAL	LEXINGTON		X	E. JANACH SRL	COMO		IT
MCKESSON DRUG CORP.	CAYCE		X	MCKESSON HBOC, INC.	SAN FRANCISCO	CA	US
MCLESKEY-TODD PHARMACY	GREER						
MEDQUIP, INC.	HILTON HEAD IS.	X					
MED CENTER PARMACY & MEDICAL	DARLINGTON	X					
MEDI HOME CARE	BEAUFORT	X					
MEDI HOME CARE	CHARLESTON	X					
MEDI HOME CARE	GREENVILLE	X					
MEDI HOME CARE	SUMTER	X					
MEDI HOME CARE	COLUMBIA	X					
MEDI HOME CARE	FLORENCE	X					
MEDI HOME CARE	SENECA	X					
MEDICAL RENTAL & SALES INC	UNION	X					
MEDICINE MAN MEDICAL SUPPLIES	SUMMERVILLE	X					
MEDICINE MART	LEXINGTON	X					
MEDICINE SHOPPE	CLINTON		X	CARDINAL HEALTH INC	DUBLIN	OH	US
MEMORIAL PHARMACY IN	GREENVILLE	X					
MIDAVOL PROTECTIVE PRODUCTS LLC.	GREENVILLE	X					
MIDLAND MANUFACTURING COMPANY, INC.	COLUMBIA	X					
MIDLANDS X-RAY SALES & SVC	GILBERT	X					

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
MILLIKEN CHEMICAL	SPARTANBURG	X					
MOBLEY DRUGS & MEDICAL	LANCASTER	X					
MORETEX CHEMICAL PRODUCTS INC	SPARTANBURG	X					
MOUNT VERNON MILLS, INC.	JOHNSTON		X	MOUNT VERNON MILLS, INC.	MAULDIN	SC	US
MOUNT VERNON MILLS, INC.	MCCORMICK		X	MOUNT VERNON MILLS, INC.	MAULDIN	SC	US
MSI VIKING GAGE	DUNCAN	X					
NEW BUR USA LLC	ROCK HILL		X	GEBR. BRASSELER GMBH & CO. KG	LEMGO		GM
NEW SOUTH OPTICAL LABORATORIES	GREENVILLE	X					
NEWCO INC	FLORENCE	X					
NORTH AMERICAN RESCUE PRODUCTS, INC.	GREENVILLE	X		NORTH AMERICAN RESCUE PRODUCTS, INC.	GREENVILLE	SC	US
NORTH AMERICAN RESCUE PRODUCTS, INC.	GREENVILLE		X	GOLDEN SEASON PTE LTD	SINGAPORE		SN
NORTH SAFETY PRODUCTS	CHARLESTON		X	NORCROSS SAFETY PRODUCTS LLC	OAK BROOK	IL	US
NOVA GAS TECHNOLOGIES	NORTH CHARLESTON	X					
NOVA HEALTH PRODUCTS, LLC	FLORENCE	X					
O V LABS	NORTH CHARLESTON	X					
ORGAN RECOVERY SYSTEMS	CHARLESTON	X					
PALMETTO GBA	COLUMBIA	X					
PALMETTO STEEL RULE DIE	PIEDQ	X					
PARKER-HANNIFIN TECH SEAL DIV	SPARTANBURG		X	PARKER-HANNIFIN CORP	CLEVELAND	OH	US
PARRISH HOME MEDICAL INC	GREENWOOD	X					
PATTERSON DENTAL CO	CHARLESTON		X	PATTERSON COMPANIES INC	ST PAUL	MN	US
PATTERSON DENTAL SUPPLY	GREENVILLE		X	PATTERSON COMPANIES INC	ST PAUL	MN	
PATTERSON LOGISTICS SERVICES, INC.	BLYTHEWOOD		X	PATTERSON COMPANIES, INC.	ST. PAUL	MN	US
Pee Dee Biomechanics/Pee Dee Brace & Limb	Florence		X	Hanger Orthopedic Group			
PELION SURGICAL LLC	AIKEN	X					

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
PERSONAL TOUCH	SURFSIDE BEACH	X					
PHC MEDICAL SALES	CHARLESTON	X					
PHOTOTHERAPY "UV" ASSOC.	LEXINGTON	X					
PIEDMONT GROUP INC	SPARTANBURG	X					
PIEDMONT MEDICAL EQUIPMENT CO	ROCK HILL	X					
PIEDMONT ORTHOTIC LABORATORY	ROEBUCK	X					
PORVAIR FILTRATION GROUP INC	ROCK HILL	X					
PRAXAIR HEALTHCARE SVC	FLORENCE		X	PRAXAIR INC	DANBURY	CT	US
PRESCRIPTION SHOPPE PHARMACY	GEORGETOWN	X					
PRINCESS UNIFORMS & ACCES INC	ABBEVILLE	X					
PRINCETON MEDICAL GROUP, INC.	MT. PLEASANT	X					
PRO PAC, INC.	CHARLESTON	X					
PROFESSIONAL PHARMACY	ANDERSON		X	LEONARDS PRESCRIPTION PHARMACY	BIG SPRING	TX	US
PROFESSIONAL PHARMACY SVC INC	FLORENCE	X					
PROGRESSIVE BIOMECHANICS	FLORENCE	X					
PROPP DRUGS	ANDERSON	X					
PROTECH INTERNATIONAL	BLUFFTON		X	PROTECH INTERNATIONAL HOLDINGS LTD.	NT	HONG KONG	CH
PSORALITE-SUNMAKER, INC.	COLUMBIA	X					
PURE WATER, INC.	ANDERSON	X					
QS/1 DATA SYSTEMS	SPARTANBURG		X	J M SMITH CORP	SPARTANBURG	SC	US
REESE X-RAY & DIAGNOSTIC	NORTH AUGUSTA	X					
REGENT MEDICAL AMERICAS, LLC DISTRIBUTION CENTER	ANDERSON		X	REGENT MEDICAL OVERSEAS LIMITED	IRLAM		UK
RESMED-PIEDMONT HIGHWAY DISTRIBUTION CTR #3	PIEDMONT		X	RESMED CORP.	POWAY	CA	US
RESOURCE 1 TECHNOLOGY SERVICES	GREER	X					
RESTORATIVE ARTS DENTAL LAB	CHARLESTON	X					
REVOLUTIONS MEDICAL CORP	MT PLEASANT	X					
RHODES TEXTILES INC	TRAVELERS REST	X					
RHYTHMLINK INTERNATIONAL, LLC	COLUMBIA	X		RHYTHMLINK INTERNATIONAL, LLC	COLUMBIA	SC	US
RHYTHMLINK INTERNATIONAL, LLC	COLUMBIA		X	SPES MEDICA S.R.L.	BATTIPAGLIA		IT
RHYTHMLINK INTERNATIONAL, LLC	COLUMBIA		X	PASSAGEMAKER	SHENZHEN		CH

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
RICE MILLS, INC.	BELTON	X					
RIEGEL CONSUMER PRODUCTS DIV	JOHNSTON	X					
RIETER CORP.	SPARTANBURG		X	NETECH NEESER TECHNIK AG	WINTERTHUR		SZ
ROAD RESCUE INC	MARION		X	SPARTAN MOTORS INC	CHARLOTTE	MI	US
ROBERTSON OPTICAL LABORATORIES	GREENVILLE	X					
ROCKWELL MEDICAL TECHNOLOGIES, INC.	HODGES		X	ROCKWELL MEDICAL TECHNOLOGIES, INC.	WIXOM	MI	US
RODNEY L. MCLAIN	LANDRUM		X	IMASCOPE INC.	GATINEAU	QUEBEC	CA
ROEBUCK PLASTICS, INC.	MOORE	X					
ROYAL LABS NATURAL COSMETICS	JOHNS ISLAND	X					
RPI MEDICAL	FLORENCE	X					
S.O.S. GROUP, INC.	HILTON HEAD ISLAND	X					
SAFETY EQUIPMENT CO.	COLUMBIA	X					
SAFETY RESOURCE INC	ROCK HILL	X					
SAFETY RESOURCES INC	EASLEY	X					
SAMMETH DRUG CO	SENECA	X					
SCAN TECH MEDICAL, LLC.	COLUMBIA	X					
SCENTS UNLIMITED	LITTLE RIVER	X					
SERVALL CORP.	ANDERSON	X					
SHAKESPEARE COMPANY LLC	COLUMBIA		X	K2, INC.	CARLSBAD	CA	US
SIGNALIFE, INC.	GREENVILLE	X					
SIZEWISE RENTALS LLC	COLUMBIA	X					
SJS X-RAY CORP.	MT. PLEASANT	X					
SMILE MAKERS, INC.	SPARTANBURG	X					
SOLUTION TECHNOLOGIES INC	HODGES	X					
SONIX IV CORP.	NORTH CHARLESTON		X	SONIX IV CORP.	HUNTINGTON BEACH	CA	US
SOUTH OF THE BORDER SHOPS, INC.	DILLON	X					
SOUTHERN OPTICAL	CHARLESTON		X	OMEGA OPTICAL INC	DALLAS	TX	US
SOUTHERN OPTICAL	GREENVILLE		X	OMEGA OPTICAL INC	DALLAS	TX	US
SPAN PACKAGING SERVICES LLC.	GREENVILLE	X					
SPAN-AMERICA MEDICAL SYSTEMS, INC.	GREENVILLE	X					

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
SPARTAN INTL.	SPARTANBURG	X					
SPECIALIZED ENVIRONMENTAL INC	EASLEY	X					
SPIRAX-SARCO INC	BLYTHEWOOD	X					
SSL AMERICAS, DISTRIBUTION CENTER	ANDERSON		X	SSL AMERICAS, DIVISIONS OF SSL INTERNATIONAL	NORCROSS	GA	US
STAT MEDICAL	LADSON	X					
STAUBLI CORP	DUNCAN	X					
STEEGER USA INC	INMAN	X					
STRAND IMPORT & DIST., INC.	MYRTLE BEACH	X					
STRATCO INC	SENECA	X					
SUMTER MEDICAL SUPPLIES INC	SUMTER	X					
SURETEK MEDICAL	GREENVILLE	X					
SURGICAL TECHNOLOGY LABORATORIES INC.	COLUMBIA	X					
T & S BRASS & BRONZE WORKS INC	TRAVELERS REST	X					
TACTICAL MEDICAL SOLUTIONS, INC.	ANDERSON	X					
TEKGRAF CORP	GREENVILLE	X					
THE BEN SILVER CORPORATION	CHARLESTON	X					
THE BRANFORD COMPANIES INC.	SUMMERVILLE	X					
THE MARKETOR GROUP	MT. PLEASANT	X					
TJL DIRECT	TEGA CAY	X					
TRUMPF MEDICAL SYSTEMS, INC.	CHARLESTON	X		TRUMPF MEDICAL SYSTEMS, INC.	CHARLESTON	SC	US
TRUMPF MEDICAL SYSTEMS, INC.	CHARLESTON		X	TRUMPF KREUZER MEDIZIN SYSTEME GMBH + CO.KG	PUCHHEIM		GM
TUCKER-WELLS MEDICAL	FLORENCE	X					
TUDOR SCIENTIFIC GLASS CO	NORTH AUGUSTA	X					
TURBO WHEELCHAIR CO., INC.	BEAUFORT	X					
TURNER HEALTHCARE PRODUCTS, INC.	GREER	X					
URBRICH PRECISION FLAT WIRE	WESTMINSTER	X					
UPSTATE MEDICAL SUPPLIES	GREER	X					
UNITED PACIFIC INC	COLUMBIA		X	SWEDE-O, INC.	NORTH BRANCH	MN	US
UNITED STATES DENTAL LASER, INC.	HILTON HEAD	X					
VARIAN MEDICAL SYSTEMS INC	MT PLEASANT		X	VARIAN MEDICAL SYSTEMS, INC.	PALO ALTO	CA	US

Establishment Name	Establishment City	HQ	Branch	Owner/Operator Name	Owner/Operator City	Owner/ Operator State Code	Owner Country Code
VARIAN MEDICAL SYSTEMS INTERAY	NORTH CHARLESTON		X	VARIAN MEDICAL SYSTEMS, INC.	PALO ALTO	CA	US
VET KARE PRODUCTS	CHESTER	X					
VOODOO EYEWEAR	FORT MILL	X					
WALL HOME MEDICAL EQUIPMENT	LAKE CITY	X					
WATER & POWER TECHNOLOGIES OF TEXAS, INC.	COLUMBIA		X	WATER & POWER TECHNOLOGIES, INC.	SALT LAKE CITY	UT	US
WATTSVILLE DRUGS	LAURENTS	S					
WILKINS' OPTICIANS, INC.	SPARTANBURG	X					
X-RAY OF GREENVILLE INC	GREER	X					
YORK X-RAY INC	LYMAN	X					
Z-TECH, INC.	CHARLESTON		X	Z-TECH (CANADA) INC.	TORONTO ON		CA
ZEUS INDUSTRIAL PRODUCTS INC	ORANGEBURG	X					

Sources: FDA (2007) and infoSource (2007).

Note: Establishments listed as a headquarters for at least one aspect of their business but as a branch for another are listed on two separate lines. This occurs most frequently when a manufacturing establishment also serves as a US agent for an overseas firm.

ENDNOTES

[1] Many regions and much of the literature refer to this cluster as the medical devices cluster or sub-sector, which is often found within a biosciences or biomedical initiative (Minnesota Biomedical and Bioscience Network, 2007; U.S. Department of Health and Human Services, 2007).

[2] The principal benefit of identifying establishments' NAICS codes is that this allows the modeling of economic activity within various regions. Social accounting matrix (SAM) and computable general equilibrium (CGE) models identify industry sectors by NAICS codes. These models are often used to estimate the contribution of an industry or firm to an economy and approximate the effects of a change to the status quo.

[3] While some communities may achieve the cluster benefits described in this section, other communities will be unable to capture these advantages. There are, in fact, disadvantages to a clustering strategy. Cluster advantages identified by Barkley and Henry (1997, 2001) include the strengthening of localization economies, facilitation of industrial reorganization, encouragement of networking among firms, and focusing of public resources. Disadvantages include difficulty in picking winners, difficulty in establishing supportive institutions, and the possible competitive disadvantage of latecomers to an industry.

[4] The location quotient (LQ) is a static measure of industry employment in a region relative to the nation. The LQ therefore describes past competitive advantage. Shift-share analysis identifies current advantage by comparing regional industry employment growth to both overall and industry-specific national growth rates.

[5] The Cluster Mapping Project data have the advantage of avoiding data disclosure problems associated with MSA-level data available from government sources.

[6] Employment gains in the biological products, ophthalmic goods, and surgical instruments and supplies sub-clusters were partially offset by a loss of 60 jobs in the dental instruments and supplies sub-cluster between 1999 and 2004. The U.S. as a whole also lost 1,446 dental instruments and supplies jobs over this period.

[7] The Battelle (2007) and Cluster Mapping Project (Harvard University, 2007) LQs differ based on differences in biomedical devices industry definitions and data sources. The two studies' industry definitions are similar but not identical. Battelle uses Quarterly Census of Employment and Wages (ES-202) data from the U.S. Bureau of Labor Statistics. Battelle's data are available at the six-digit NAICS code level from 2001 to 2004. The Cluster Mapping Project uses County Business Patterns data from the U.S. Census Bureau. The Harvard University data is available at the four-digit Standard Industrial Classification (SIC) code from 1990 to 2004.