Identification of Industry Clusters

For Guiding

Economic Development Efforts

In Cincinnati USA

Prepared for

The Cincinnati USA Partnership

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Executive Summary

Purpose

In order to strengthen its economic development performance, the Cincinnati USA Partnership has chosen to adopt a strategy that identifies and focuses on a limited number of industry clusters. The information contained in this report is intended to guide the Partnership and its members in their business attraction, retention, and development efforts and to serve as a foundation for policy decisions.

Employment Overview

- The first three sections present an overview of employment by industry and occupation, along with recent and projected changes. Together, they offer a picture of the context in which the subsequent cluster analysis is developed.

Employment by Industry

- Cincinnati USA's economy is no longer dominated by manufacturing industries. Today, more people are employed in professional and business services than in manufacturing.

- The most important changes that have occurred in the Cincinnati area's industrial composition between 1990 and 2000 are the increases in various service sectors and the decline in manufacturing.

- In the next five years, Cincinnati USA's economy will be affected by national growth in service-producing sectors. Some of the most rapid growth is expected to occur in industries that have considerable employment in high skill-high wage positions.

Employment by Occupation

- Overall, the occupation structure in the Cincinnati area is similar to the national structure, though Cincinnati USA has significantly more employment in production-related occupations, and an above average number of workers in high-paying executive, professional, and technical occupations.

- Between 1990 and 2000, occupational employment in the Cincinnati area showed tremendous growth in service occupations as well as executive, professional, & technical occupations. Precision workers, machine operators & blue collar occupations showed little growth through the period.

- In the next five years, the greatest increases are expected in *Management, business, & financial*, *Professional and related*, and *Service* occupations. Of these occupation groups, the first two are mostly made up of positions requiring at least a four-year college degree. The third area, *Service*, includes a wide variety of job types, including many that also require at least some amount of specialized post-secondary training, if not a college degree.

Use of Cluster Analysis

- The next section offers a short explanation of what industry clusters are, and how they can be used in setting a regional economic development strategy.

- Structural changes in the Cincinnati area economy call for new approaches to economic development. Cluster analysis helps economic development specialists monitor and understand these economic changes and take appropriate actions for the benefit of their communities.

- Clusters grow naturally, and it is difficult and expensive to create clusters through public policy. While the development of clusters should be market-induced, some proactive attention is appropriate.

- Cluster policy should be used in an interactive way. Clusters are dynamic. A cluster analysis is not a one-time prescription. To be successful, there should be good communication with the analysts, business community, and the policy makers/implementers.

- Cluster policy is most valuable in identifying targets for recruitment and retention. For recruitment, cluster analysis is able to define an environment in which certain firms are more likely to succeed. Obviously, the probability of successfully recruiting firms that are well suited to a region is higher than for firms less well suited. For more effective retention of firms, better knowledge of clusters can help economic developers focus on strengthening the cluster by supporting the infrastructure underlying the cluster.

- Cluster analysis is widely used. At least half of all states and major metropolitan areas have carried out cluster studies or are in the process of doing so.

Approach to Cluster Identification

- The next section documents the results of the process of identifying industry clusters. It contains information about the clusters considered in this analysis, the screening criteria that are used to promote or exclude various clusters, and a final list of the clusters proposed to the Partnership as candidates for economic development efforts.

- Our first step in identifying industry clusters for the Cincinnati USA region is to find industries that are related at the national level by being part of the same supply chain. Each pair of industries in the same supply-chain cluster is linked in one of the following three ways:

    - one buys from (sells to) the other, either directly or indirectly;

- their purchase patterns from other industries are similar; or
- they have similar sales patterns to other industries.

- We then subject the 29 clusters identified by the factor analysis technique to six different statistics that can be used for screening and cluster evaluation. They are 1) high average wages, 2) a strong employment base, 3) an export, rather than local, industry, 4) a high location quotient, 5) strong national growth, and 6) strong local growth relative to national growth. Using our screening process, we are left with ten candidate clusters.

- We validate the ten candidate clusters by seeing how they compare to clusters from six previous studies for the Cincinnati USA region. We then validate our recommendations by linking our industrial clusters to occupational clusters that are strong in the region.

Listing of the Ten Candidate Clusters

- This section presents brief snapshots of each of the recommended candidate clusters, to serve as a ready reference for economic developers and decision-makers. It also contains diagrams of several clusters for the purpose of illustrating relationships within clusters.

- The ten Cincinnati USA clusters recommended as candidates for targeting by the Cincinnati USA Partnership are as follows:

Office-Oriented Clusters

1. ***Advanced Design Services***—offers good wages and high national growth
2. ***Business Management***—has strong wages and local concentration
3. ***Financial Services***—is strong in wages and growth

Technology-Oriented Clusters

4. ***Biotechnology***—shows reasonably good wages and growth
5. ***Digital Equipment & Telecommunications***—has one part that is relatively strong in wages and another with strong growth
6. ***Software & Data Processing***—is high on wages and growth

Manufacturing-Oriented Clusters

7. ***Advanced Manufacturing***—is very large, has moderate wages, a very strong local concentration
8. ***Aerospace***—specifically engines and equipment, has a strong local concentration and is strong in wages
9. ***Chemicals & Plastics***—has relatively good wages and a very strong local concentration
10. ***Motor Vehicle Manufacturing***—has moderate wages and good local growth

- Each of the ten clusters had average annual wages at least as high as $35,000 in 2001.

- Each of the ten clusters can be considered an export cluster engaged in selling goods and/or services to businesses outside the region.

- Each of the ten clusters accounted for at least one percent of employment in the Cincinnati MSA in 2001.

- All ten of the clusters have critical occupations that are concentrated within the Cincinnati USA region.

- The analysis in this report discovers two new clusters, *Advanced Design Services* and *Business Management*, that have not been recommended in any of six previous relevant cluster analyses for the Cincinnati USA region.

- The ten clusters differ with respect to strength of location quotient, national growth, and relative local growth.

Cluster definition is an art as well as a science, so the final definition of any cluster selected by the Partnership will also be based on other criteria as well, including the political and strategic considerations previously identified by the Partnership.

Data Sources and Definitions

This project began with extensive data collection and analysis for the Cincinnati USA region, defined as the new 15-county Cincinnati Metropolitan Statistical Area.[1] The U.S. Census Bureau's County Business Patterns (CBP) data base was selected as the principal source for a detailed picture of employment by industry and occupation. Its primary limitation is that it does not include people who are employed in the public sector, those who work on farms, and those who are self-employed. Other federal data sources include the 1990 and 2000 U.S. Censuses, employment projections from the Bureau of Labor Statistics (BLS), BLS wage and salary data by industry and occupation, and the latest NAICS-based input-output tables for the U.S. economy.[2]

[1] The 15-county Cincinnati Metropolitan Statistical Area (MSA) includes Hamilton, Butler, Warren, Clermont, and Brown Counties in southwestern Ohio; Boone, Kenton, Campbell, Gallatin, Grant, Pendleton, and Bracken Counties in northern Kentucky; and Franklin, Dearborn, and Ohio Counties in southeastern Indiana.

[2] The 1997 Benchmark Input-Output Accounts for the United States are based on NAICS (North American Industrial Classification System). As opposed to the former SIC (Standard Industrial Classification) system which classifies establishments that have similar products, NAICS groups together establishments with similar production processes.

Section 1: Profile of Industry Sectors in the Cincinnati Metropolitan Area

Table 1 compares the private, non-agricultural employment of the Cincinnati Metropolitan Statistical Area (MSA), totaling 940,084, with that of the United States as a whole, 115,061,184.[3] The four sectors with highest local specialization (highest location quotient) are highlighted in bold.[4]

Table 1: 2001 Employment by Industry Sector

NAICS Code	Industry Sector Description	United States	Cincinnati MSA	Location Quotient
11	Forestry, fishing, hunting, and agriculture support	0.2%	0.0%	0.12
21	Mining	0.4%	0.1%	0.20
22	Utilities	0.6%	0.6%	1.06
23	Construction	5.6%	5.5%	0.97
31	Manufacturing	13.9%	14.7%	1.06
42	**Wholesale trade**	**5.3%**	**6.6%**	**1.23**
44	Retail trade	12.9%	12.4%	0.96
48	**Transportation & warehousing**	**3.3%**	**4.1%**	**1.27**
51	Information	3.3%	2.5%	0.76
52	Finance & insurance	5.4%	5.4%	0.99
53	Real estate & rental & leasing	1.8%	1.6%	0.89
	Financial activities (52 & 53)	7.2%	6.9%	0.97
54	Professional, scientific & technical services	6.2%	5.6%	0.90
55	**Management of companies & enterprises**	**2.5%**	**3.2%**	**1.28**
56	Admin, support, waste mgt, remediation services	7.9%	7.1%	0.90
	Professional and business services (54,55,56)	16.6%	15.9%	0.96
61	Educational services	2.3%	1.7%	0.73
62	Health care & social assistance	12.6%	12.4%	0.98
	Education and health services (61 & 62)	14.9%	14.1%	0.94
71	Arts, entertainment & recreation	1.5%	1.6%	1.06
72	Accommodation & food services	8.7%	8.7%	1.01
	Leisure and hospitality (71 & 72)	10.2%	10.4%	1.01
81	Other services (except public administration)	4.7%	4.4%	0.93
95	**Auxiliaries (exc corporate, subsidiary & regional mgt)**	**0.9%**	**1.8%**	**2.04**

We see, from Table 1, that Cincinnati USA's economy is no longer dominated by manufacturing industries. Today, more people are employed in professional and

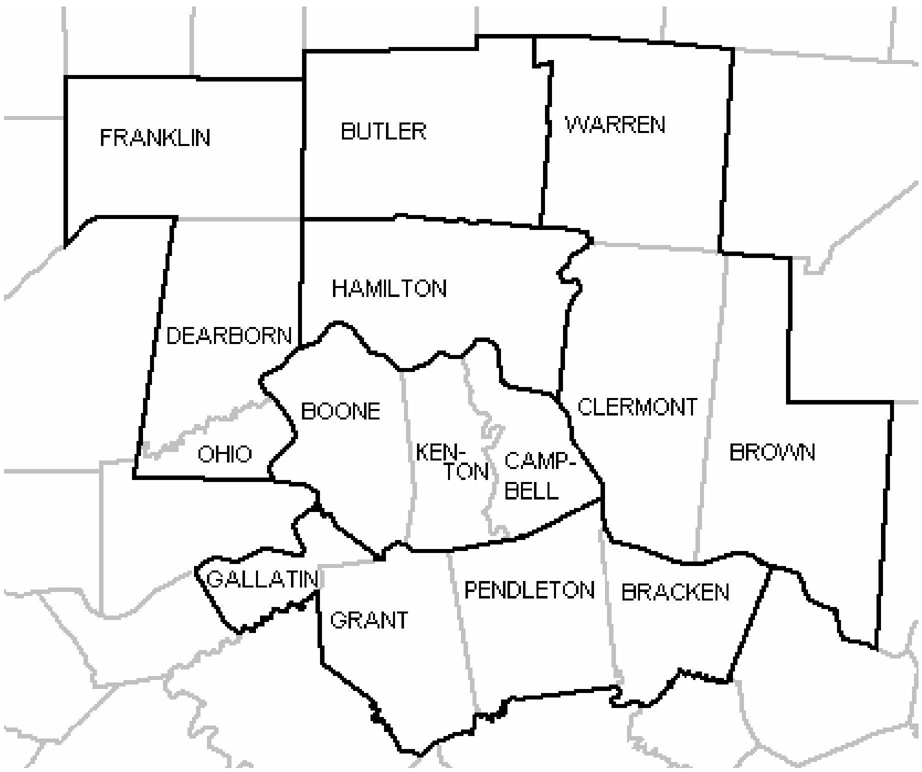
[3] The data in this table come from the County Business Patterns data base, the principal source of employment statistics throughout this report, because it offers data about individual industries on an annual basis.

[4] A location quotient (LQ) for an industry is defined as the share of employees in that industry in the Cincinnati MSA divided by the industry's counterpart share for the United States. An LQ > 1 signifies a greater concentration of the industry in the region than in the United States as a whole.

business services than in manufacturing, and one of these service industry sectors, *Management of companies and enterprises*, demonstrates considerable local specialization. Other sectors with high local specialization are *Wholesale trade*; *Transportation & warehousing*; and *Auxiliaries*.[5]

The map below shows the 15 counties of the Cincinnati MSA divided into six geographic sectors.

Six Geograpic Sectors in the Cincinnati MSA



The employment distribution for the metropolitan area can be summarized as follows:

Ohio has 82 percent of employment.

- Hamilton County accounts for 58 percent of all employment.
- Butler County contains 12 percent of the MSA's employment.
- The Eastern counties—Warren, Clermont, and Brown—have 12 percent.

[5] The Auxiliaries, Excluding Corporate, Subsidiary, and Regional Managing Offices Industry Sector (sector 95) includes establishments with payroll primarily engaged in providing services to one or more establishments of the same enterprise. These establishments generally do not produce any products nor provide services for customers outside the enterprise, but may do so as a secondary activity. (See U.S. Census Bureau Subject Series, 1997 Economic Census *Auxiliaries, Excluding Corporate, Subsidiary, and Regional Managing Offices*.)

Kentucky has 16 percent of employment.

- The Tri-ED area, consisting of Boone, Kenton, and Campbell Counties, holds 15 percent.
- The Southern counties—Gallatin, Grant, Pendleton, and Bracken—have 1 percent.

Indiana has 2 percent of employment.

- The Western counties—Franklin, Dearborn, and Ohio—in the Cincinnati USA area account for the remaining 2 percent of employment.

Appendix A describes the variations in industry specialization between the geographic sectors within the Cincinnati MSA.

Section 2: Profile of Occupations in the Cincinnati Metropolitan Area

An appropriate, skilled labor force is a key factor for successful industries in a regional economy. Hiring and training costs for workers are lower when there is a large supply of skilled workers in a metropolitan area that match the skill needs of businesses in that area. Furthermore, professional contact among a large number of skilled workers at the local level can spark innovation and the transfer of cutting-edge practices. For these reasons, it is important to understand the occupational structure of the metropolitan area. This section of the report provides detailed information on employment by occupation for the Cincinnati MSA. Employment by occupation describes the occupational structure of the area.

Table 2 shows employment by occupation estimates for the Cincinnati MSA as well as the entire United States. Employment data are presented for 22 major occupation groups. These groups indicate employment in detailed professional specialties such as *architecture and engineering*, service occupations such as *food preparation and serving*, sales occupations, and blue-collar occupations such as *installation, maintenance, and repair*.[7] Overall, the occupation structure in the Cincinnati MSA is similar to the national structure, though there are differences. The Cincinnati MSA has significantly more employment in *production*, and in *transportation and material moving*.[8] Shares of employment are similar in most professional and technical occupations (these begin in the table with *business and financial operations* and end with *arts, design, entertainment, sports, and media*). Table 2 shows less employment in the Cincinnati MSA in *education, training and library* occupations. One explanation for this result is our use of private-sector employment in this study. (Many employees with occupations in *education, training, and library* work in the public sector, for example.)

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[7] These estimates are derived using the 2002 National Industry-Occupation Employment Matrix (NIOEM), which shows the employment in the 22 occupation groups (and hundreds of even more detailed occupation groups) for each industry. The NIOEM is applied to employment-by-industry data for the Cincinnati MSA to estimate 2001 employment by occupation for the metropolitan area. Coefficients from the NIOEM also are the source of United States data in Table 3. State governments produce estimates of employment by occupation both statewide and for pre-specified regions of each state. These reports are updated periodically. For example, in the state of Kentucky, regional reports are updated every three years. However, the estimates prepared during this study offer several advantages for analysis of the MSA economy.

- The occupation model developed in this study produces data on employment by occupation that precisely match the region of interest. Employment by occupation can be estimated for the Cincinnati MSA, and any county or group of counties within the MSA that are of interest. Existing state reports use pre-existing regions that do not necessarily match MSA borders.
- Occupation estimates can be updated any time, using the model developed in this study. Annual updates are possible each time new employment by industry data become available. All state reports are not produced annually, and the reports of the three states may be released on different schedules.
- The model in this study utilizes a national industry-occupation employment matrix rather than a state matrix. Therefore, the same matrix is used for counties in each of the three states.

[8] The occupation location quotient is defined as the percentage share of a particular occupation in the Cincinnati MSA divided by the percentage share of that occupation in the United States.

Table 2: 2001 Employment by Occupation Group			
Occupation Group	United States	Cincinnati MSA	Occupation Loc. Quot.
Management	7.0%	5.8%	0.83
Business and financial operations	3.8%	3.8%	1.00
Computer and mathematical science	2.1%	2.2%	1.05
Architecture and engineering	1.8%	1.9%	1.06
Life, physical, and social science	0.9%	0.7%	0.78
Community and social services	1.5%	1.2%	0.80
Legal	0.8%	0.6%	0.75
Education, training, and library	5.9%	2.1%	0.36
Arts, design, entertainment, sports, & media	1.7%	1.5%	0.88
Healthcare practitioners and technical	4.6%	4.9%	1.07
Healthcare support	**2.3%**	**2.6%**	**1.13**
Protective service	2.2%	1.2%	0.55
Food preparation and serving related	**7.1%**	**8.6%**	**1.21**
Building and grounds cleaning & maintenance	3.8%	3.1%	0.82
Personal care and service	3.1%	2.3%	0.74
Sales and related	10.6%	11.5%	1.08
Office and administrative support	16.6%	18.4%	1.11
Farming, fishing, and forestry	0.7%	0.2%	0.29
Construction and extraction	5.1%	4.6%	0.90
Installation, maintenance, and repair	4.0%	4.1%	1.03
Production	**7.8%**	**10.4%**	**1.33**
Transportation and material moving	**6.8%**	**8.3%**	**1.22**

Employment by occupation exceeds the national average for the share of *production* employment in all six geographic sectors in the Cincinnati MSA. The same can be said for *transportation and material moving* employment. Appendix B to this report compares the sectors in their specialization by occupation.

Table 3 gives additional detail for occupations. The 22 occupation groups in Table 2 (and Appendix B) are comprised of summary occupations, themselves comprised of many detailed occupations. Table 3 shows 34 occupation specialties (most at the summary occupation level) in which the Cincinnati MSA has a high occupation location quotient. The table, which divides these occupations into three major wage categories, reveals that many of these occupations have high wages, while many others offer at least moderately good wages.

Table 3 shows that most of the highest-paying occupations are found among either *executive, professional, and technical* occupations or among *precision workers,* *machine operators, and blue-collar* occupations. The table illustrates the Cincinnati MSA's concentration of expertise in management, marketing, promotions, advertising, and sales. There is also a specialty in financial and insurance activities, as well as computer programming and science, and architecture and engineers. There is also specialization in health-care occupations, and a strong specialization in production occupations and air transportation occupations.

Table 3: Occupational Specialties in the Cincinnati MSA

Occupation Code	Executive, professional & technical	Precision workers, machine operators, & blue collar	Service	Sales
Average salary: $40,000 and over				
Top Executives	X			
Advertising, Marketing, Promotions, PR, & Sales Mgrs	X			
Operations Specialties Managers	X			
Buyers and Purchasing Agents	X			
Claims Adjusters, Appraisers, Examiners, & Investigators	X			
Credit Analysts	X			
Financial Analysts and Advisors	X			
Loan Counselors and Officers	X			
Computer and Mathematical Science Occupations	X			
Architecture and Engineering Occupations	X			
Aircraft Mechanics and Service Technicians		X		
Supervisors, Production Workers		X		
Supervisors, Transportation and Material Moving Workers		X		
Air Transportation		X		
Sales representative, wholesale and manufacturing				X
Average salary: $30,000-$39,999				
Sheet Metal Workers		X		
Industrial Machinery Installation, Repair, and Maintenance		X		
Metal Workers and Plastic Workers		X		
Printing Occupations		X		
Inspectors, Testers, Sorters, Samplers, and Weighers		X		
Water Transportation		X		
Health Technologists and Technicians			X	
Supervisors, Office and Administrative Workers			X	
Desktop Publishers			X	
Average salary: Less than $30,000				
Preschool teachers, except special education	X			
Assemblers and Fabricators		X		
Butchers and Meat Cutters		X		
All Other Material Moving Occupations		X		
Healthcare Support Occupations			X	
Supervisors, Food Preparation and Serving Workers			X	
Cooks, Restaurant			X	

Hosts & Hostesses, Restaurants, Lounges, & Coffee Shops	X	
Medical Secretaries	X	
All Other Sales and Related Workers		X

Section 3: Major Employment Changes in the Cincinnati Metropolitan Area

Major Changes by Industry, 1990 to 2000

The 2000 Census revealed some significant changes in the industrial composition of the Cincinnati MSA. Table 4 presents the changes that have occurred between the two censuses for those aggregate sectors that did not undergo significant definitional change between 1990 and 2000. The most important employment changes in Table 4 are the increases in the various service sectors and the decline in manufacturing.[10]

Table 4: Cincinnati MSA Employment By Industry Group, 1990 and 2000

	1990	2000	Change
Total Employed persons, 16 years & over	872,258	982,727	12.7%
Agriculture, forestry, fishing and hunting, and mining	12,985	4,643	-64.2%
Construction	51,517	65,953	28.0%
Manufacturing	181,917	171,949	-5.5%
Finance, insurance, real estate and rental and leasing	57,663	72,973	26.6%
Professional and other services	128,864	239,976	86.2%
Educational, health and social services	143,513	183,451	27.8%
Public administration	28,676	35,085	22.3%

Industry Outlook

In the next five years, Cincinnati USA's economy will be affected by national industry trends. Table 5 compares Cincinnati USA's employment by industry sector with that of the nation, and also shows the Bureau of Labor Statistics' national projections for the period from 2002 to 2012. Note that service-producing sectors show growth, while most goods-producing sectors do not. Some of the most rapid growth is expected to occur in industries that have considerable employment in high skill-high wage positions.

[10] There were substantial revisions to both industry and occupation classifications between the 1990 and 2000 Censuses. This made comparisons of employment between the two Censuses difficult. The decline in employment in the broad wholesale-retail-transportation-warehousing-utilities sector (from 267,123 in 1990 to 208,697 in 2000) is associated with the lack of comparability between old and new industry classification systems.

Table 5: 2001 Industry Employment Mix and 2002-2012 Growth Outlook			
Industry Sector	US: 2001	Cincinnati: 2001	U.S. Growth: 2002-2012
Forest, fish, hunt, & agric. support	0.2%	0.0%	-2%
Mining	0.4%	0.1%	-12%
Utilities	0.6%	0.6%	-6%
Construction	5.6%	5.5%	15%
Manufacturing	13.9%	14.7%	-1%
Wholesale trade	5.3%	6.6%	11%
Retail trade	12.9%	12.4%	14%
Transportation & warehousing	3.3%	4.1%	22%
Information	3.3%	2.5%	18%
Financial activities	7.2%	6.9%	12%
Professional and business	16.6%	15.9%	30%
Education and health	14.9%	14.1%	26%
Leisure and hospitality	10.2%	10.4%	18%
Other services	4.7%	4.4%	16%
Auxiliaries	0.9%	1.8%	**
Unclassified	0.1%	0.0%	**
Public administration	**	**	8%

** No data available.

Major Changes by Occupation, 1990 to 2000

Changes in industrial structure have been accompanied by changes in occupation structure in the Cincinnati MSA. Table 6 compares employment in five aggregate occupation groups from the 1990 Census and 2000 Census. Results show tremendous growth in *service* occupations as well as *executive, professional, & technical* occupations. *Precision workers, machine operators & blue-collar* occupations show little growth through the period. These results are consistent with the rapid growth in the services industries presented above, and indicate the general strong growth in occupations that require advanced education.

Table 6: Cincinnati MSA Employment By Occupation, 1990 and 2000			
Occupation Group	1990	2000	Change
Total Employed persons, 16 years & over	872,258	982,727	12.7%
Executive, professional & technical	267,804	331,972	24.0%
Sales	104,037	111,442	7.1%
Administrative support, including clerical	149,692	162,784	8.7%
Service	110,191	136,554	23.9%
Precision workers, machine operators, & blue collar	240,534	239,975	-0.2%

Occupation Outlook

In the next five years, the Cincinnati MSA's labor force can also be expected to undergo some degree of transformation in response to changes in industry needs. Table 7 compares the MSA's employment by occupation with that of the nation, and also shows the Bureau of Labor Statistics' national projections for the period from 2002 to 2012. The greatest increases are expected in *Management, business, & financial*, *Professional and related*, and *Service* occupations. Of these occupation groups, the first two are mostly made up of positions requiring at least a four-year college degree. The third area, *Service*, includes a wide variety of job types, including many that also require at least some amount of specialized post-secondary training, if not a college degree.

Table 7: Occupation Employment Mix and 2002-2012 Growth Outlook

Occupation Group	US: 2001	Cincinnati: 2001	U.S. Growth: 2002-2012
Management, business, & financial	10.8%	9.6%	15%
Professional and related [a]	19.3%	15.1%	23%
Service [b]	18.5%	17.8%	20%
Sales and related	10.6%	11.5%	13%
Office and administrative support	16.6%	18.4%	7%
Farming, fishing, and forestry	0.7%	0.2%	3%
Construction and extraction	5.1%	4.6%	15%
Installation, maintenance, and repair	4.0%	4.1%	14%
Production	7.8%	10.4%	3%
Transportation and material moving	6.8%	8.3%	13%

[a] Healthcare support; Protective service; Food preparation and serving related; Building and grounds cleaning & maintenance; Personal care and service.

[b] Computer and mathematical science; Architecture and engineering; Life, physical, and social science; Community and social services; Legal; Education, training, and library; Arts, design, entertainment, sports, & media; Healthcare practitioners and technical.

Section 4: The Cluster Approach to Economic Development

Cluster analysis is a tool that is increasingly adopted by economic development organizations to improve their effectiveness by allowing them to focus their efforts in a world of limited resources and global competitiveness.[11] An analysis of a community's clusters can be very helpful in identifying where it has a competitive advantage. Structural changes in regional economies have called for new approaches to economic development. Cluster analysis has helped economic development specialists guide their regions through a process that builds on an understanding of the changes and suggests appropriate actions to take.

What a Cluster Is

A cluster is a group of strongly interdependent firms or organizations that are somehow related to one another and therefore impact one another. Because of the relationship of firms within a cluster, growth (or decline) in one firm creates a better (worse) business environment for the others in the group. The whole is greater than the sum of its parts.

Some clusters depend on special buyer-supplier linkages that tie firms together. Other clusters are based on labor pools and occupation concentrations. These are especially important when large numbers of a particular type of worker are needed or when specialized labor is important. Firms congregate in areas that provide the type of specialized labor they need. Labor, in turn, tends to migrate to those areas where there is a strong demand for their services. Firms in clusters may depend on shared knowledge of technology and other strategies, and may benefit from a certain type of economic infrastructure or environment with information and knowledge, accessible technology, adequate financing, or acceptable business climate. Examples of economic infrastructure include universities, research institutes, engineering companies, brokers, consultants, favorable laws and regulations, or industry information. Firms that are especially reliant on this type of infrastructure tend to locate in a region that provides these specialties, and this reinforces the further development of the cluster. The resulting agglomeration of firms within this cluster creates helpful economies for all members of the cluster.

Advantages of Clusters

Firms that are part of a strong cluster have a positive impact on an area's economy. The economic efficiencies that firms within clusters create for one another will reduce costs or help to create better products. For this reason, firms within clusters are the most likely to grow and to succeed. This growth and expertise

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[11] This technique has intellectual roots both in industrial organization economics and regional geography. While industrial economists stress inter-industry and inter-organization linkages as well as intra-industry competition (see, for example, AUDRETSCH and FELDMAN, 1996; PORTER, 1990, 1998; and YAMAWAKI, 2002), economic geographers and regional economists focus on the importance of agglomeration economies in industrial location and spatial concentration (DOERINGER and TERKLA, 1995; MARKUSEN, 1996).

within a cluster often leads to higher rates of technological change and innovation. The same expertise and supportive infrastructure reduce the risk to investment in start-up companies. Furthermore, since cluster firms tend to buy from one another, the purchase of inputs by a cluster firm is more likely to be made from another cluster firm rather than a firm outside the region, leading to high economic impact.

Using a Cluster Analysis

The role of economic development organizations in creating clusters should be well understood. Clusters grow naturally, and it is difficult and expensive to create clusters through public policy. While the development of clusters should be market-induced, some proactive attention is appropriate. Studies show that clusters become stronger when firms consciously work at improving their competitive advantage by addressing common problems such as workforce recruitment, training issues, developing infrastructure, and establishing needed research and training programs at universities. Economic developers can work as a catalyst that brings these firms together in order to support structures and incentives that assist the clustering and innovation process. Cluster policy should avoid focusing on only the "classic" clusters or targets. Often small and emerging clusters have more potential.

Cluster policy is most valuable in identifying targets for recruitment and retention. For recruitment, cluster analysis is able to define an environment in which certain firms are more likely to succeed. Obviously, the probability of successfully recruiting firms that are well suited to a region is higher than for firms less well suited. Importantly, these firms are more likely to succeed if they fit well into a cluster. For more effective retention of firms, better knowledge of clusters can help economic developers focus on strengthening the cluster by supporting the infrastructure underlying the cluster. This might include providing more information on training needs, eliminating regulatory barriers to better cluster development, or providing platforms for constructive dialogue among firms within the cluster.

Finally, cluster policy should be used in an interactive way. Clusters are dynamic. A cluster analysis is not a one-time prescription. To be successful, there should be good communication with the analysts, business community, and the policy makers/implementers. Forums should be convened in which firms and organizations within the cluster can address shared problems and changes within the cluster. A monitoring system should be developed to track changes in the cluster and the responsiveness of the economic infrastructure to these changes.

Section 5: Analysis of Potential Clusters

Economic development strategy based on cluster analysis will focus on expansion, retention, and attraction of businesses in selected clusters. Identification of regional clusters begins with an examination of the input-output relationships among industries. National clusters are then defined using a factor analysis of the economic linkages among individual industries. National clusters are then screened based on their strengths in the regional economy. Both location-quotient analysis and shift-share analysis are part of the screening process for identifying regional clusters. Finally, validation of a smaller group of "candidate clusters" occurs using both occupation-by-industry data to identify pockets or clusters of workers with specialized skills that support particular industrial clusters in the region, as well as political and business priorities as gleaned from six recent studies relevant to the Cincinnati USA region.

Statistical Identification

Our first step in identifying industry clusters for the Cincinnati USA region is to find industries that are related at the national level by being part of the same supply chain. Each pair of industries in the same supply-chain cluster are linked in one of the following three ways:

1. one buys from (sells to) the other, either directly or indirectly;
2. their purchase patterns from other industries are similar; or
3. they have similar sales patterns to other industries.

Using the Department of Commerce's *Input-Output Transactions Between NAICS Sectors* (1997) and a statistical technique, known as factor analysis,[12] we find 29 national clusters that we are able to interpret straightforwardly.[13] They are listed in Appendix C, along with their accompanying NAICS industries and codes.

The NAICS (North American Industrial Classification System) system of categorizing industries, that has within the last decade replaced the SIC (Standard Industrial Classification) system, gives special attention to new and emerging industries, service industries, and industries engaged in the production of advanced technologies. Hence, the NAICS system permits a balanced view of the United States industrial structure. Linkages across major sectors in the economy are uncovered using the factor analysis technique. Whereas some of the clusters that our statistical approach reveals are either primarily manufacturing clusters (such as

[12] We follow the factor-analysis technique outlined in Edward J. Feser and Edward M. Bergman (2000), "National Industry Cluster Templates: A Framework for Applied Regional Cluster Analysis," *Regional Studies*, **34**, pp. 1-19. We use a Promax rotation rather than a Varimax rotation in the factor analysis to account for inter-factor correlations. There are 122 industrial sectors in the 1997 input-output tables.

[13] Factor analysis leads to 32 clusters. Two are wholly contained in one of the other clusters. A third appears not to be internally consistent but is rather composed of industries that do not have normal cluster relationships with one another. Hence, we are left with 29 clusters to analyze further.

Chemicals & Plastics) or service clusters (*Business Management*), others include a mix of industries (*Software & Data Processing*).

Regional Characteristics and the Screening of Potential Clusters

We then subject the 29 clusters identified by the factor analysis technique to six different statistics that can be used for screening and cluster evaluation. Based on the results of those statistics, we are able to come up with ten candidate clusters that we describe and discuss in Section 6. We note that we use the statistics to eliminate some of the clusters from further consideration. We do not use the statistics to "rank order" the remaining clusters, nor do we "rank order" the evaluation statistics themselves to say, for example, that one statistic is more useful than another.

- High Average Wages

  Our first criterion for cluster recommendation is that the cluster has a positive impact on local incomes. Hence, we look for industrial clusters that pay relatively high wages. We measure this screen as national payroll for the cluster divided by national employment for the year 2001.

- Strong Employment Base

  Our second screen is that a cluster must have a reasonably strong employment base within in the Cincinnati MSA. Without at least a modest concentration of business within a particular cluster, a cluster is unlikely to take root and succeed. Moreover, some clusters are important because of their considerable size. We measure employment base as percent MSA employment for 2001.

- Export Industry

  We require our screened clusters to have industries that serve more than just the local economy. They must have an export base. New money from outside the region can help facilitate economic development by way of impact multipliers.[14]

- Location Quotient (LQ)

  If a cluster has a strong presence in the region, relative to its presence in the nation, then it is more likely to succeed than otherwise. Relative local importance is measured by the cluster's location quotient for 2001.

[14] The distinction between export and local is specific to the Cincinnati MSA. Whereas some regions, such as New York and Los Angeles, may export from the *Movies, TV, & Radio* Cluster, this is not true for firms in the Greater Cincinnati area.

- Strong National Growth

  If a cluster is exhibiting strong national growth in employment, it is more likely to succeed regionally than otherwise. National trends may indicate where there are opportunities to "catch a wave" that can help to boost the local economy. We measure national growth as percent change in employment at the national level between 1998 and 2001.

- Strong Relative Local Growth

  If a cluster is exhibiting strong local growth relative to national growth, this shows its ability to succeed in the face of an adverse national trend. We measure this screen as the percentage change in local employment from 1998 to 2001 less the percentage change in national employment over that same time period.

Table 8 lists the 29 clusters identified from the factor analysis along with values for the six screens.

Table 8: National Cluster Strength in the Cincinnati MSA								
		Cluster Screen						
Cluster	2001 MSA Employment	2001 Avg. Wages	Emplmt % of MSA	Export Production	Location Quotient	National Growth	Local Growth	Local minus National
Advanced Design Services	16,173	$47,493	1.7%	Export	1.02	9.3%	2.6%	-6.7%
Aerospace	9,069	$57,900	1.0%	Export	1.23	-10.4%	-7.6%	2.8%
Agriculture	200	$34,190	0.0%	Local	0.16	-4.9%	18.3%	23.2%
Banking	30,591	$64,248	3.3%	Export	0.91	13.3%	10.1%	-3.2%
Biotechnology	45,063	$41,074	4.8%	Export	0.95	6.6%	12.0%	5.4%
Business Management	47,393	$61,560	5.0%	Export	1.27	8.3%	-6.4%	-14.7%
Business Support and Services	196,286	$19,413	20.9%	Export	1.01	10.9%	6.0%	-4.9%
Chemicals and Plastics	20,870	$40,716	2.2%	Export	1.41	-4.9%	1.0%	5.9%
Construction Materials	143,162	$25,078	15.2%	Local	0.92	4.4%	2.2%	-2.2%
Digital Equipment	14,904	$56,605	1.6%	Export	0.73	-0.4%	7.0%	7.4%
Entertainment	3,913	$48,759	0.4%	Export	1.01	16.3%	7.3%	-9.0%
Food and Beverages	158,729	$26,609	16.9%	Export	1.18	4.3%	9.3%	5.0%
Metalworking and Industrial Machinery	56,209	$37,980	6.0%	Export	1.36	-5.4%	-0.5%	4.9%
Mining and Transportation	1,634	$47,300	0.2%	Local	0.84	-6.2%	21.3%	27.5%
Motor Vehicle Manufacturing	19,149	$36,228	2.0%	Export	1.01	-3.6%	10.7%	14.3%
Movies, TV, and Radio	9,934	$45,872	1.1%	Local	0.92	11.0%	-5.2%	-16.2%
Oil and Gas Extraction & Transportation	169	$72,699	0.0%	Export	0.15	-5.2%	18.2%	23.4%
Petroleum Products	6,996	$61,348	0.7%	Export	0.91	-1.9%	-1.8%	0.1%
Primary Nonferrous Metals	10,169	$35,852	1.1%	Export	1.13	-7.3%	4.3%	11.6%
Printing and Publishing	43,164	$30,445	4.6%	Export	1.02	6.0%	1.7%	-4.3%
Securities and Insurance	25,019	$45,215	2.7%	Export	1.11	2.5%	4.8%	2.3%
Software and Data Processing	15,442	$69,197	1.6%	Export	0.79	33.7%	20.5%	-13.2%
Telecommunications	14,703	$49,075	1.6%	Export	0.96	14.8%	34.7%	19.9%
Textiles and Apparel	2,666	$23,864	0.3%	Export	0.34	-25.3%	-4.6%	20.7%
Transportation Support & Services	35,883	$64,741	3.8%	Export	1.16	7.2%	-4.4%	-11.6%
Truck Transportation	13,663	$33,442	1.5%	Export	0.88	7.6%	16.2%	8.6%
Urban Services	372,447	$28,649	39.6%	Local	0.93	8.7%	8.8%	0.1%
Utilities	57,202	$40,415	6.1%	Local	0.99	10.5%	8.5%	-2.0%
Wood Products	4,082	$33,750	0.4%	Export	0.62	-5.5%	2.1%	7.6%

We use the following simple screening procedure.

1. Each cluster with a 2001 average wage below $35,000 is excluded.
2. Each cluster with employment less than 1 percent of the MSA total for 2001 is excluded.
3. The *Movies, TV, & Radio* Cluster and the *Utilities* Cluster are excluded because they are local, rather than export, clusters.
4. *Transportation Support & Services* is excluded since it is overwhelmingly accounted for in the *Business Management* Cluster, so we capture its advantages to the region elsewhere. (Transportation industries in this cluster are concentrated in Northern Kentucky, and Angelou has recommended a *Transportation* Cluster to Tri-ED. The Partnership may wish to consider how it can support Tri-ED's efforts if it adopts this cluster.)

The 13 remaining clusters, as shown in Table 9, all paid average annual wages in 2001 exceeding $35,000; each employed at least one percent of the total number of employees in the MSA in 2001; and each is classified as an export industry. This table provides no additional screening.

Table 9: National Cluster Strength in the Cincinnati MSA

Cluster	Cluster Screen						
	2001 MSA Empl'm't	2001 Avg. Wages	Emplmt % of MSA	Location Quotient	National Growth	Local Growth	Local minus National
Advanced Design Services	16,173	$47,493	1.7%	1.02	9.3%	2.6%	-6.7%
Aerospace	9,069	$57,900	1.0%	1.23	-10.4%	-7.6%	2.8%
Banking	30,591	$64,248	3.3%	0.91	13.3%	10.1%	-3.2%
Securities and Insurance	25,019	$45,215	2.7%	1.11	2.5%	4.8%	2.3%
Biotechnology	45,063	$41,074	4.8%	0.95	6.6%	12.0%	5.4%
Business Management	47,393	$61,560	5.0%	1.27	8.3%	-6.4%	-14.7%
Chemicals and Plastics	20,870	$40,716	2.2%	1.41	-4.9%	1.0%	5.9%
Digital Equipment	14,904	$56,605	1.6%	0.73	-0.4%	7.0%	7.4%
Telecommunications	14,703	$49,075	1.6%	0.96	14.8%	34.7%	19.9%
Metalworking and Industrial Machinery	56,209	$37,980	6.0%	1.36	-5.4%	-0.5%	4.9%
Primary Nonferrous Metals	10,169	$35,852	1.1%	1.13	-7.3%	4.3%	11.6%
Motor Vehicle Manufacturing	19,149	$36,228	2.0%	1.01	-3.6%	10.7%	14.3%
Software and Data Processing	15,442	$69,197	1.6%	0.79	33.7%	20.5%	-13.2%

Anticipating the results of our cluster validation below, which makes use of occupational similarities across clusters as well as results of previous studies, we combine six clusters into three. Specifically, we combine *Banking* and *Finance & Insurance* into a *Financial Services* cluster. Similarly, we combine *Metalworking & Industrial Machinery* and *Primary Nonferrous Metals* into a cluster entitled *Advanced Manufacturing*. We also combine *Digital Equipment* and *Telecommunications* into a *Digital Equipment & Telecommunications* cluster.

The regional characteristics of the ten remaining candidate clusters may be summarized as follows:

1. ***Advanced Design Services*** offers good wages and high national growth.
2. The ***Advanced Manufacturing*** Cluster has at its heart *Metalworking and Industrial Machinery*; it is very large, has moderate wages, a very strong LQ, and a potential cluster expansion in *Primary Nonferrous Metals*.
3. ***Aerospace***, specifically engines and equipment, is strong in wages and LQ, but has been declining both locally and nationally.
4. ***Biotechnology*** shows reasonably good wages and growth, with an average LQ.
5. ***Business Management*** has strong wages and LQ but has experienced local job loss.
6. ***Chemicals & Plastics*** has relatively good wages and a very strong LQ.
7. The ***Digital Equipment & Telecommunications*** Cluster combines *Digital Equipment*, which is relatively strong in wages and weak in LQ, with *Telecommunications*, which adds strong growth.
8. The ***Financial Services*** Cluster (which includes *Banking* along with *Finance & Insurance*) is strong in wages and growth, with an average LQ.
9. ***Motor Vehicle Manufacturing*** has moderate wages, an average LQ, and good local growth.
10. ***Software & Data Processing*** is high on wages and growth, but low on LQ.

Cluster Validation

We validate our recommendation of the ten candidate clusters by, first, seeing how they compare to clusters from six previous studies for the Cincinnati USA region. Ultimately, target cluster selection involves strategic choice (selection of clusters based on regional advantage and expected payoff for the region) and an understanding of political (in keeping with statewide economic development efforts) and business priorities. Hence, an understanding of prior thinking on the topic of cluster identification and selection is required. Second, we validate our recommendation by linking our industrial clusters to occupational clusters that are strong in the region.

In the course of this analysis, six studies are given very careful examination:

- *An Ohio Technology-Based Economic Development Strategy* (March 2002, Battelle)
- *Hamilton County's Comparative and Competitive Advantages* (December 2003, Hamilton County Regional Planning Commission)
- *Northern Kentucky New Economy Marketing Strategy—Target Industry Study* (October 2003, Angelou Economics)
- *Target Marketing Strategy* (March 1999, The Wadley-Donovan Group)
- *Kentucky Clusters: Industrial Interdependence and Economic Competitiveness* (June 2001, University of North Carolina)
- *Technology Workforce Assessment of Cincinnati USA* (2003, Cypress Research Group)

Our results of this validation exercise are as follows:

- *Advanced Manufacturing* is featured in all six studies.
- *Advanced Design Services* is not identified in the other studies (but is validated by our occupational analysis below).
- *Aerospace* is identified as a cluster in two of the six studies.
- *Biotechnology* shows up in five of the six studies.
- *Business Management* has not been identified in any of the other studies (but is discovered through our factor analysis technique).
- *Chemicals & Plastics* is identified in three of the above six studies.
- *Digital Equipment & Telecommunications* is suggested in four of the studies.
- The *Financial Services* Cluster shows up as a cluster in two studies.
- Motor Vehicle Manufacturing appears in two studies.
- *Software & Data Processing* is mentioned in three studies.

Industries in the ten candidate clusters are then evaluated according to occupation match. The idea is to determine whether the Cincinnati MSA has a sufficient labor force in the *critical occupations* of the industries in each cluster. Critical occupations are those occupations that either require very high skill levels (a post-baccalaureate education) or account for an above-average (exceeds the average by at least one standard deviation) share of industry employment.

For each industry, we determine the average location quotient across all critical occupations, thus generating a summary location quotient for critical occupations. If this location quotient exceeds 1.00, then the Cincinnati area is specialized in the industry's critical occupations. As Table 10 shows, for each of the ten candidate clusters, at least 80 percent of the industries have occupational specialization. For seven of the clusters, 100 percent of the industries have occupational specialization.

Table 10: Percent of Industries in the Cluster with Strong Occupational Specialization

Cluster Name	Percentage	Industries Where Not Specialized
Advanced Manufacturing	100%	
Advanced Design Services	100%	
Aerospace	100%	
Biotechnology	100%	
Business Management	86%	Management Consulting Services (# 54161)
Chemicals & Plastics	100%	
Digital Equipment & Telecomm	92%	Personal & Household Goods R & M (# 8114)
Financial Services	80%	Securities & Commodities (# 5231)
Motor Vehicle Manufacturing	100%	
Software & Data Processing	100%	

We also use occupation data to come up with occupational clusters and then check to see whether our industrial clusters tend to employ workers from these clusters. Our approach is, first, to identify in which skilled occupations the Cincinnati MSA specializes (using occupation location quotients), and, second, to identify which groups of industries are heavily reliant on the area's occupational specialties. Such groups of industries would have substantial advantages in operating in the Cincinnati area.[15]

In Table 11, we identify the set of industries that use these specialized occupations at least twice as much as the average industry. Most of the industries are within the industrial clusters that have been identified above as a potential fit for the Cincinnati metropolitan area. Many of the manufacturing industries would fall into the *Aerospace*, *Advanced Manufacturing*, *Chemicals & Plastics*, or *Motor Vehicle Manufacturing* Cluster. Looking outside of manufacturing, *Software publishers* (NAICS 5112) is a component of the *Software & Data Processing* Cluster, as is *Computer systems design & related services* (NAICS 5415).

Table 11: Industries Supported by Occupational Concentrations, and Related Clusters

NAICS	Industry	Clusters
323	Printing & related support activities	Printing & Publishing
326	Plastics & rubber products mfg	Chemicals and Plastics
331	Primary metal mfg	Metalworking and Machinery; Primary Nonferrous Metals
332	Fabricated metal product mfg	Metalworking and Machinery; Primary Nonferrous Metals; Motor Vehicle Manufacturing
333	Machinery mfg	Metalworking and Machinery
334	Computer & electronic product mfg	Information Technology
335	Electrical equip, appliance & component mfg	Information Technology
336	Transportation equipment mfg	Motor Vehicle Manufacturing Aerospace
3379	Other furniture related product mfg	*none*
3391	Medical equipment & supplies mfg	Biotechnology
4812	Nonscheduled air transportation	*none*
483	Water transportation	Coal and Ore Transportation
5112	Software publishers	Information Technology; Software and Data Processing
5413	Architectural, engineering & related services	Advanced Design Services
5415	Computer systems design & related services	Software and Data Processing
6215	Medical & diagnostic laboratories	Biotechnology
6219	Other ambulatory health care services	*none*
6231	Nursing care facilities	*none*

Analysis further reveals a modification to the *Advanced Design Services* Cluster. *Architecture, engineering & related services* (NAICS 5413), along with *Computer systems design* (NAICS 5415), both benefit from Cincinnati's occupational specialization in *engineering*, *drafting*, and *computer science*. This finding suggests that both 5413 and 5415 belong in the same cluster. *Specialized design services*

[15] Occupations with employment above 200 in the Cincinnati MSA have to have an occupation location quotient (LQ) above 1.5 and typically require a college degree. Occupations with employment above 500 have to have a LQ above 1.3 and typically require a high school degree. Occupations with employment above 1,000 have to have an LQ above 1.2, and occupations with employment above 2,000 have to have an LQ above 1.1.

(NAICS 5414: *industrial design, graphic design*), also is concentrated in the Cincinnati MSA (based on its industrial location quotient), even though this industry is not identified as a strong occupational match. Taken together, 5413, 5414, and 5415 indicate that *Advanced Design Services* is another potential industrial cluster with a good occupational fit for the Cincinnati area. The core of occupational specialties that underpin this cluster is in the professional and technical occupations, particularly in design specialties ranging from *architecture* to *engineering* to *graphic design*, and *computer science*. Further, this integration of design fields in the cluster is consistent with the combination of the College of Engineering and the College of Design, Art, Architecture & Planning at the University of Cincinnati.

Section 6: Portfolio of "Candidate Clusters"

Table 12 summarizes some key characteristics of the ten candidate clusters.

Table 12: Ten Candidate Clusters for the Cincinnati Metropolitan Statistical Area (MSA)

Cluster (and components)	2001 MSA Emplmt.*	2001 US Emplmt.	2001 LQ	% of MSA	MSA % Chg	US % Chg	2001 Average Wages
Office-Oriented							
Advanced Design Services	16,173	1,942,048	1.02	1.7	7.1	9.3	$47,493
Business Management	47,393	4,549,784	1.27	5.0	-1.4	6.7	$61,560
Financial Services	55,567	6,829,208	1.00	5.9	7.6	8.6	$56,591
(Banking)	30,591	4,111,514	0.91	3.3	10.1	13.1	$64,248
(Securities and Insurance)	25,019	2,751,724	1.11	2.7	4.8	2.5	$45,215
Technology-Oriented							
Biotechnology	45,063	5,783,687	0.95	4.8	9.8	6.6	$41,074
Digital Equipment & Telecomm	25,267	3,915,387	0.79	2.7	16.9	6.4	$55,524
(Digital Equipment)	14,904	2,505,432	0.73	1.6	7.0	-0.4	$56,605
(Telecommunications)	14,703	1,882,254	0.96	1.6	23.6	14.8	$49,075
Software and Data Processing	15,442	2,387,395	0.79	1.6	20.5	33.7	$69,197
Manufacturing-Oriented							
Advanced Manufacturing	62,951	5,755,002	1.34	6.7	-0.1	-5.6	$38,053
(Metalworking and Industrial Machinery)	56,209	5,064,429	1.36	6.0	-1.2	-5.4	$37,980
(Primary Nonferrous Metals)	10,169	1,099,303	1.13	1.1	6.6	-7.3	$35,852
Aerospace	9,069	902,879	1.23	1.0	-7.6	-10.4	$57,900
Chemicals and Plastics	20,870	1,808,794	1.41	2.2	1.0	-4.9	$40,716
Motor Vehicle Manufacturing	19,149	2,331,558	1.01	2.0	14.2	-3.6	$36,228

* Clusters are based on private employment only, which understates activity in some cases, such as in Biotechnology.

In the cluster descriptions that follow, modifications of some definitions are recommended in order to match more closely the lists of industries found in similar clusters in the six studies discussed in the previous section. Again, the ten candidate clusters are not rank-ordered. They are listed alphabetically by sub-group: office-oriented, technology-oriented, and manufacturing-oriented clusters.

As noted previously, industries[16] within each cluster are related to one another by being part of the same supply chain. Each pair of industries in the same supply-chain cluster are linked in one of the following three ways:

1. one buys from (sells to) the other, either directly or indirectly;
2. their purchase patterns from other industries are similar; or
3. they have similar sales patterns to other industries.

[16] In some cases, the industries identified in this section have alphabetical characters in their codes. Such an occurrence indicates that the listed industry is a combination of two or more NAICS industries.

Office-Oriented Clusters

ADVANCED DESIGN SERVICES

Four industries related to advanced design services are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

3323	Architectural and structural metal products
3351	Electric lighting equipment
5324	Machinery and equipment rental and leasing
5413	Architectural and engineering services

This cluster offers good wages (2001 average of $47,493). National employment growth between 1998 and 2001 exceeded overall economic growth. Although local growth was not as strong, the cluster's location quotient is still average (1.02). This cluster had total private sector employment, as reported in County Business Patterns (CBP) of 16,173 in 2001, which accounts for 1.7 percent of the MSA total.

Some of these industries identified in the factor analysis might fit better as part of the supporting-cluster infrastructure than as components of the cluster itself. Two other industries would seem to fit well here, on the basis of their close industry associations and the occupational linkages that have been identified between them and the core industry, *architectural and engineering services*. They are

5414	Specialized design services
5415	Computer systems design & related services

Together, these industries could form a small, but important, *Advanced Design Services* Cluster. The national outlook for this cluster is one of very rapid growth.

BUSINESS MANAGEMENT

Six industries related to business management are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

4920	Courier and messenger services
4930	Warehousing and storage
5142	Data processing services
5324	Machinery and equipment rental and leasing
5418	Advertising and related services
5500	Management of companies and enterprises

The Business Management Cluster is characterized by very high wages (2001 average of $61,560) and average national growth between 1998 and 2001 (6.7 %). The cluster's location quotient is 1.27, indicative of a strong competitive advantage, but it has been falling because of decreasing local employment. This cluster had CBP-reported employment of 47,393 in 2001, which accounts for 5.0 percent of the total MSA employment, but 663 less than in 1998. Economic development efforts in this area should focus heavily on retention and expansion, as well as attraction.

FINANCIAL SERVICES
Six industries related to financial services are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

4850 Transit and ground passenger transportation
52A0 Monetary oversight and credit intermediation
5230 Securities, commodity contracts, investments
5240 Insurance carriers and related services
5250 Funds, trusts, and other financial vehicles
5321 Automotive equipment rental and leasing

Four of these industries were grouped together in *Banking*, and three formed a *Securities and Insurance* group. The industry held in common is NAICS 5250 - *funds, trusts, and other financial vehicles*.

The *Financial Services* Cluster shows very good wages (2001 average of $56,591). Both local and national employment growth exceeded the overall national economy's performance between 1998 and 2001. The cluster's location quotient is 1.00, right at the national average. This cluster had CBP-reported employment of 55,567 in 2001, which accounts for 5.9 percent of the total for the Cincinnati area.

If this cluster is selected as a target, it may be appropriate to focus on the four "core" industries (the "52" series). This would be more consistent with the cluster definition in the analysis done for Tri-ED. The two industries that are associated with transportation may fit better into a support-of-market role.

Technology-Oriented Clusters

BIOTECHNOLOGY
Four industries related to biotechnology are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

3254 Pharmaceuticals and medicines
3391 Medical equipment and supplies
5419 Other professional and technical services
6210 Ambulatory health care services

Based on the frequency with which they are mentioned in similarly-focused studies, two other industries might be included here. They are

3345 Electronic instruments
5417 R & D in the physical, engineering, and life sciences

The case could be made as well that 5419 and most of 6210 (all but 6215: medical and diagnostic laboratories) should not be included.

The Biotechnology Cluster shows reasonably good wages (2001 average of $41,074) and local growth that exceeded national growth between 1998 and 2001.

Because of this local growth, the cluster's location quotient has risen to a respectable 0.95, not yet at the national average, but growing. This cluster had CBP-reported employment of 45,063 in 2001, which accounts for 4.8 percent of the total. This figure would be reduced by an exclusion of the non-laboratory components of 6210 and increased by inclusion of the two additional recommended industries. More importantly, related public-sector employment at places such as the University of Cincinnati Medical Center, a very important participant in this cluster, is not included in this employment figure.

DIGITAL EQUIPMENT & TELECOMM

Nine industries related to digital equipment and telecommunications are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

3333 Commercial and service industry machinery
3341 Computer and peripheral equipment
334A Audio, video, and communications equipment
3344 Semiconductors and electronic components
3345 Electronic instruments
5112 Software
5133 Telecommunications
5414 Specialized design services
811A Electronic, commercial, and household goods repair

Seven of these industries were grouped together in *Digital Equipment*, and three formed a *Telecommunications* group. The industry held in common is 811A - *electronic, commercial, and household goods repair*, an industry that other studies may have overlooked. On the other hand, almost all other industries are mentioned in either or both of the Ohio and Hamilton County analyses. *Software* was omitted from both, and it might be better to reserve it for its own cluster.

The *Digital Equipment & Telecomm* Cluster pays very good wages (2001 average of $55,524), and local growth exceeded national growth by more than 10 percent between 1998 and 2001. Because of this local growth, the cluster's location quotient has risen to 0.79, below average, but growing. This cluster had CBP-reported employment of 25,267 in 2001, which accounts for 2.7 percent of the total in the MSA.

SOFTWARE & DATA PROCESSING

Five industries related to software and data processing are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

3341 Computer and peripheral equipment
5112 Software
5141 Information services
5142 Data processing services
5415 Computer systems design and related services

The *Software & Data Processing* Cluster has the highest wage level within the portfolio of candidate clusters (2001 average of $69,197). Local growth trailed national growth between 1998 and 2001, but still represented a 20 percent increase in employment. The cluster's location quotient is one of the lowest (0.79), but the growth potential of this cluster offers opportunity for the area to develop a specialization here. This cluster had CBP-reported employment of 15,442 in 2001, which accounts for 1.6 percent of the MSA total.

Similar clusters in the studies for Ohio and Hamilton County do not include any manufacturing industry in this cluster. Other adjustments might also be considered in order to define a cluster that is more effectively focused on local strengths and growth potential.

Manufacturing-Oriented Clusters

ADVANCED MANUFACTURING

Twenty-four industries related to advanced manufacturing are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

- 2122 Metal ores [no emplmt. data available]
- 331A Primary ferrous metal products
- 331B Primary nonferrous metal products
- 3315 Foundry products
- 3321 Forgings and stampings
- 3322 Cutlery and handtools
- 3323 Architectural and structural metal products
- 3324 Boilers, tanks, and shipping containers
- 332A Ordnance and accessories
- 332B Other fabricated metal products
- 3331 Agriculture, construction, and mining machinery
- 3332 Industrial machinery
- 3333 Commercial and service industry machinery
- 3334 HVAC and commercial refrigeration equipment
- 3335 Metalworking machinery
- 3336 Turbine and power transmission equipment
- 3339 Other general purpose machinery
- 3351 Electric lighting equipment
- 3352 Household appliances
- 3353 Electrical equipment
- 3359 Other electrical equipment and components
- 336A Motor vehicle bodies, trailers, and parts
- 336B Other transportation equipment
- 3399 Other miscellaneous manufactured products

Most of these industries were grouped together in *Metalworking & Industrial Machinery*, while the remaining few fit together around nonferrous metals.

This cluster shows moderate wages (2001 average of $38,053), but some of the industries and firms within it can be expected to pay more. Locally, employment was unchanged between 1998 and 2001, while it declined nationally. Its location quotient is 1.34, suggesting that the MSA has some real competitive advantage. This cluster had CBP-reported employment of 62,951 in 2001, which accounts for 6.7 percent of total employment in the Cincinnati area.

This very broad cluster is sometimes defined even more broadly to include industries that are part of the *Motor Vehicle*, *Aerospace*, and *Biotechnology* Clusters. Overall, the list of industries matches rather well with the results of merging similar clusters from the studies for Ohio and Hamilton County. Two industries could be dropped (2122: *metal ores*; 336A: *motor vehicle bodies, trailers, and parts*).

AEROSPACE

Two industries related to aerospace are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

3345 Electronic instruments
3364 Aerospace products and parts

The Aerospace Cluster has very good wages (2001 average of $57,900). Employment declined locally between 1998 and 2001, but by less than the national rate of loss. Its location quotient of 1.23 suggests some degree of competitive advantage. This cluster had CBP-reported employment of 9,069 in 2001, which accounts for 1.0 percent of the total in the MSA.

Since the actual assembly of aircraft and space vehicles is carried out in only a handful of U.S. cities, this might be more accurately defined as an *Aerospace Parts & Equipment* Cluster, a change that would significantly increase the location quotient measure. In addition, a few other industries might be included here, based on definitions used by Ohio (541330 - *engineering services*) and Tri-ED (*related repair and maintenance:* NAICS codes 811219 and 811310).

CHEMICALS & PLASTICS

Eight industries related to chemicals and plastics are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

3221 Pulp, paper, and paperboard
3251 Basic chemicals
3252 Resins, rubber, and artificial fibers
3253 Agricultural chemicals
3255 Paints, coatings, and adhesives
3256 Soaps, cleaning compounds, and toiletries
3259 Other chemical products
3260 Plastics and rubber products

The *Chemicals & Plastics* Cluster shows reasonably good wages (2001 average of $40,716). It experienced a small local increase in employment, despite a national decline between 1998 and 2001. Its location quotient of 1.41 indicates a significant competitive advantage in at least some of its component industries. This cluster had CBP-reported employment of 20,870 in 2001, which accounts for 2.2 percent of the Cincinnati area's total.

All of the industries in this cluster were mentioned in either or both of the Ohio and Hamilton County analyses, except NAICS 3221 - *pulp, paper, and paperboard*.

MOTOR VEHICLE MANUFACTURING

Six industries related to motor vehicle manufacturing are identified through the factor analysis as having a substantial degree of economic linkage with one another. They are

3160	Leather and allied products
3315	Foundry products
3336	Turbine and power transmission equipment
3361	Motor vehicles
336A	Motor vehicle bodies, trailers, and parts
8111	Automotive repair and maintenance

This cluster shows moderate wages (2001 average of $36,228), though there can be considerable variation within it. It experienced a substantial local increase in employment, despite a national decline between 1998 and 2001. Its location quotient is 1.01, indicating an average level of concentration. This cluster had CBP-reported employment of 19,149 in 2001, which accounts for 2.0 percent of the MSA total.

A number of other industries might be added to this cluster, particularly if it is more narrowly targeted toward automotive supply. The Tri-ED study takes such an approach, excluding 3361 - *motor vehicles*, but incorporating several other closely-related industries. They are

332	Fabricated metals
33392	Transportation machinery
3353	Electrical equipment

Together, but excluding 3361, these industries would best be described as an *Automotive Suppliers* Cluster.

Inter-Industry Cluster Linkages

Inter-industry linkages are shown in Figures 1 through 3 for three of the ten clusters. Manufacturing industries are in rectangular shapes, while service industries are represented by ovals. Sizes of the rectangles and ovals are not to scale. An arrow shown in a particular direction signifies that at least five percent of the sales of the seller or five percent of the purchases of the buyer are accounted for by its cluster partner. Thick arrows require at least 40 percent of a buyer's purchases or 40 percent of a seller's sales accounted for by its partner industry.

Figure 1 depicts the structure of the *Biotechnology* Cluster. The pharmaceutical industry sells to both *ambulatory health care services* and *veterinary services* (part of NAICS 5419, *other professional & technical services*). Also linked are *medical equipment & supplies* and *electronic medical instruments*, which sell to *ambulatory health care services*. The pharmaceutical industry relies on research provided by 5417, *scientific research & development services*. The thick arrow shows a strong linkage between medical equipment and ambulatory health care, while other linkages are not as strong. No reverse linkage is strong enough to be highlighted.

Figure 2 shows the buyer-seller relationships among industries in the *Chemicals & Plastics* Cluster. In this cluster, *basic chemicals* sells to all seven other industries depicted. Two of the industries, *agricultural chemicals* and *pulp, paper, & paperboard*, have no additional linkages. Other industries, including plastics and paints, buy from resins as well as *basic chemicals*. Finally, the *soaps, cleaning compounds, and toiletries* industry buys from plastics. The two strongest linkages are seen to be between *basic chemicals* and resins and between resins and plastics. Interestingly, although *basic chemicals* is an input sector for the pharmaceutical industry, the value of the linkage represents less than five percent of total intermediate purchases of the latter industry and less than five percent of the intermediate sales of *basic chemicals*. Indeed, the two industries do not fit in the same cluster according to our input-output analysis.

Figure 3 shows a representation of the *Software & Data Processing* Cluster. In this cluster, the supply-chain linkages are fairly simple, with goods and services moving in a single direction between sectors. 79 percent of the software industry's sales are purchased by *computers & peripheral equipment*, hence, the thick arrow from software to computers. Meanwhile, 14 percent, 12 percent, and 5 percent of purchases of *information services*, *data processing services*, and *computer systems design*, respectively, are accounted for by *computers & peripheral equipment*. Again, as was true for the *Biotechnology* Cluster, no reverse linkage is strong enough to be highlighted.

Figure 1. Biotechnology

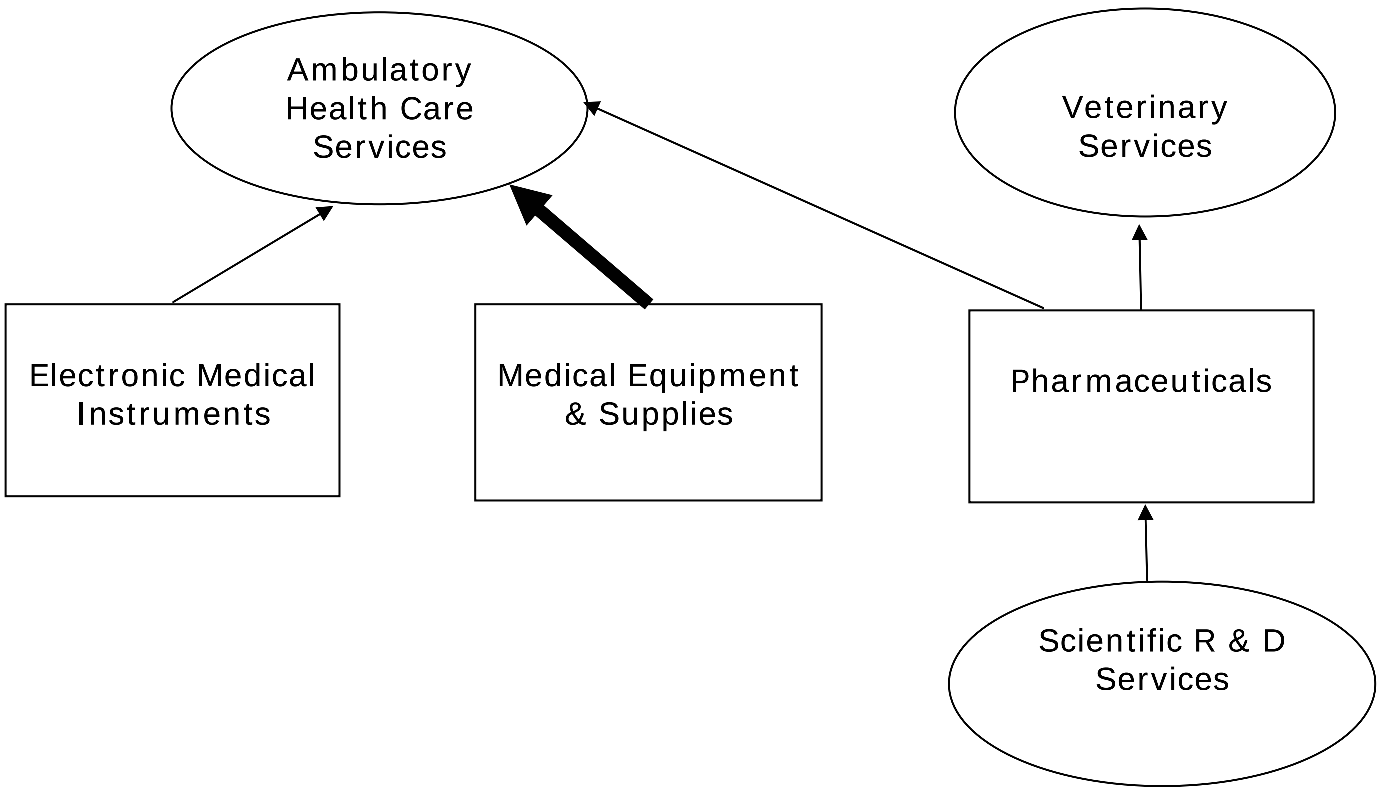


Figure 2. Chemicals and Plastics

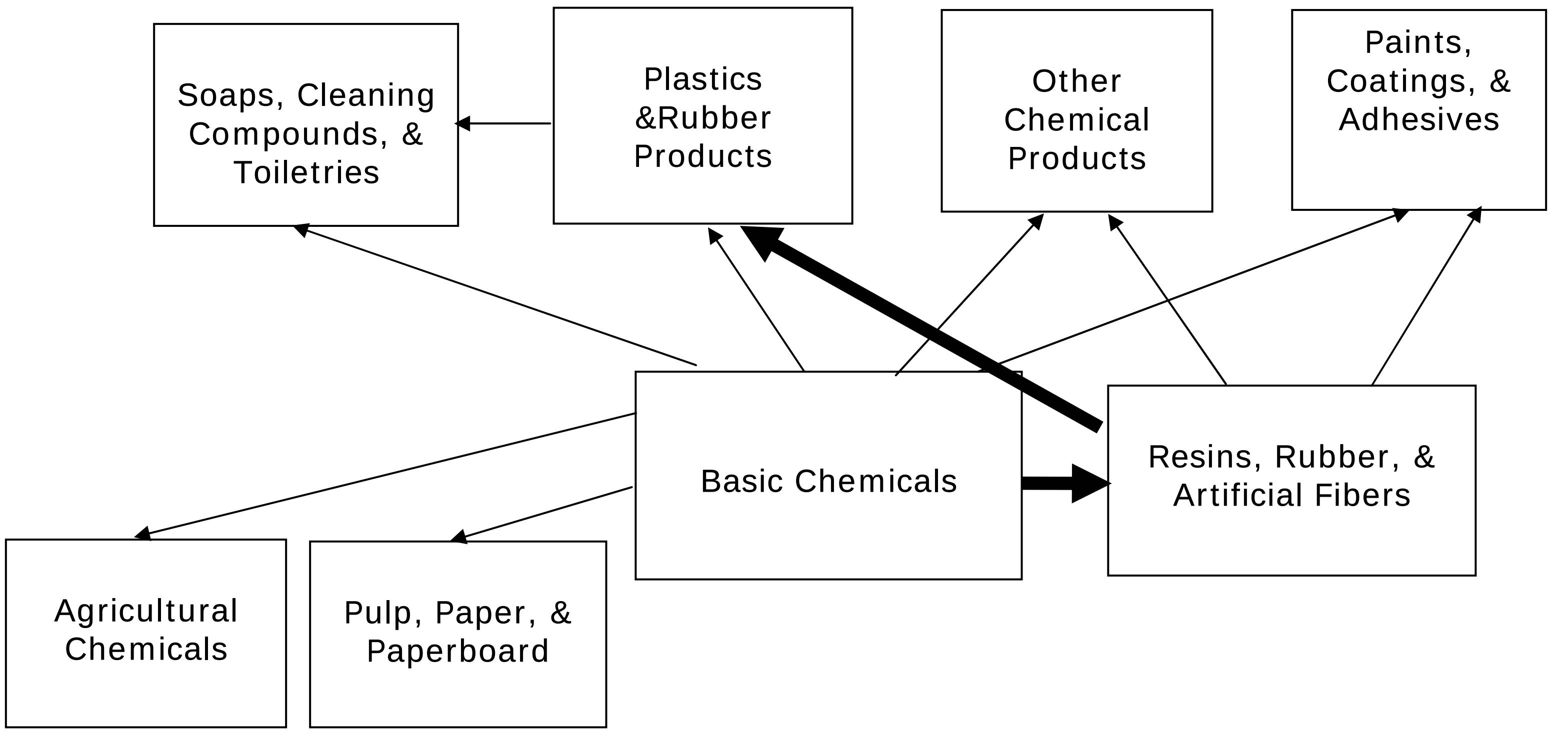
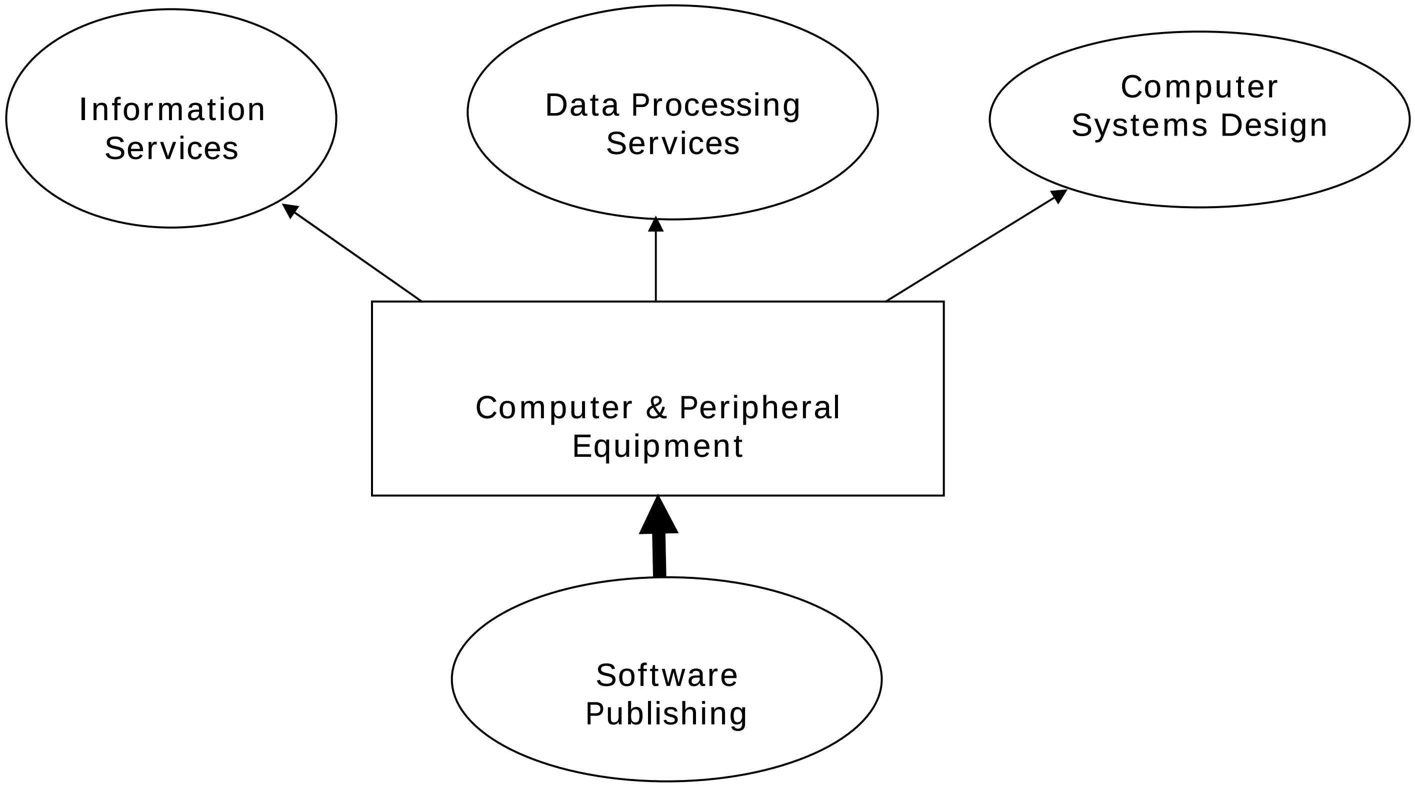


Figure 3. Software and Data Processing



Appendix A

There are variations in industry specialization between geographic sectors within the MSA. Using MSA location quotients,[17] the five most highly specialized industry sectors are identified for each geographic sector. The only industry sector without any geographic specialization is real estate.

2001 Above Average Industry Groups for Individual Regions

	Hamilton	Butler	Eastern	Tri-ED	Southern	Western
Forest, fish, hunt, & agri. support			X	X		X
Mining		X			X	X
Utilities			X			X
Construction			X			
Manufacturing		X			X	
Wholesale trade					X	
Retail trade					X	
Transportation & warehousing				X		
Information	X		X			
Finance & insurance		X				
Real estate & rental & leasing						
Professional, scientific & technical	X					
Management of companies	X					
Admin, support, waste mgt, remediation	X					
Educational services	X			X		
Health care & social assistance		X				
Arts, entertainment & recreation			X			X
Accommodation & food services				X	X	X
Other services (except public admin)		X				
Auxiliaries				X		

- Hamilton County is above average in *Information*; the various professional and business services; and *Educational services*.
- Butler County is above average in *Mining*; *Manufacturing*; *Finance & insurance*; *Health care & social assistance*; and *Other services*.
- The Eastern tier is above average in *Forestry, fishing, hunting, & agricultural support*; *Utilities*; *Construction*; *Information*; and *Arts, entertainment & recreation*.
- The Tri-ED region is above average in *Forestry, fishing, hunting, & agricultural support*; *Transportation & warehousing*; *Educational services*; *Accommodation & food services*; and *Auxiliaries*.
- The Southern tier is above average in *Mining*; *Manufacturing*; *Wholesale trade*; *Retail trade*; and *Accommodation & food services*.
- The Western tier is above average in *Forestry, fishing, hunting, & agricultural support*; *Mining*; *Utilities*; *Arts, entertainment & recreation*; and *Accommodation & food services*.

[17] A regional location quotient is computed as sector employment in a specific industry as a percentage of total sector employment divided by the MSA employment in the same industry as a percentage of total MSA employment.

Appendix B

The table below compares the geographic sectors in their specialization by occupation. Using occupation location quotients (how each sector compares to the MSA average),[18] the five most highly specialized occupation groups are identified for each sector. Hamilton County specializes in sciences, legal, artistic, and healthcare occupations. Specializations in other geographic sectors tend to connect with industry sectors in which they are strong. Several occupation groups, such as *management* and *farming/fishing/forestry*, do not show any geographic specialization.

Employment by Occupation for Individual Regions

Occupation Group	Hamilton	Butler	Eastern	Tri-ED	Southern	Western
Management						
Business and financial operations						
Computer and mathematical science	X					
Architecture and engineering			X		X	
Life, physical, and social science	X					
Community and social services		X				
Legal	X					
Education, training, and library				X		
Arts, design, entertainment, sports, & media	X					
Healthcare practitioners and technical	X					
Healthcare support		X				
Protective service						X
Food preparation and serving related			X	X		X
Building and grounds cleaning & maintenance						X
Personal care and service				X		X
Sales and related					X	
Office and administrative support						
Farming, fishing, and forestry						
Construction and extraction			X			X
Installation, maintenance, and repair		X	X	X	X	
Production		X	X		X	
Transportation and material moving		X		X	X	

[18] The occupation location quotient is defined as the percentage share of a particular occupation in a geographic sector of the MSA divided by the percentage share of that occupation in the Cincinnati MSA.

APPENDIX C

National Supply-Chain Clusters

Cluster	Industries in Cluster*
Aerospace	Aerospace products & parts (3364), Electronic instruments (3345)
Agriculture	Agriculture & forestry support services (1150), Agricultural chemicals (3253), Animal products (1120), Tobacco products (3122)
Advanced Design Services	Architectural & engineering services (5413), Machinery & equipment rental & leasing (5324), Electric lighting equipment (3351), Architectural & structural metal products (3323)
Banking	Securities, commodity contracts, & investments (5230), Funds, trusts, & other financial vehicles (5250), Automotive equipment rental & leasing (5321), Monetary oversight & credit intermediation (52A0)
Biotechnology	Pharmaceuticals & medicines (3254), Medical equipment & supplies (3391), Ambulatory health care services (6210), Other professional & technical services, including veterinary services (5419)
Business Management	Management of companies & enterprises (5500), Advertising & related services (5418), Warehousing & storage (4930), Courier & messenger services (4920), Machinery & equipment rental & leasing (5324), Data processing services (5142)
Business Support & Services	Courier & messenger services (4920), Federal government enterprise services (S001), Air transportation (4810), Monetary oversight & credit intermediation (52A0), Accommodations (7210), Management & technical consulting services (5416), Employment services (5613), All other administrative & support services (561A), Food & beverage services to customer order (7220), Transit & ground passenger transportation (4850)
Chemicals & Plastics	Basic chemicals (3251), Resins, rubber, & artificial fibers (3252), Other chemical products (3259), Paints, coatings, & adhesives (3255), Soaps, cleaning compounds, & toiletries (3256), Agricultural chemicals (3253), Pulp, paper, & paperboard (3221), Plastics & rubber products (3260)
Construction Materials	Nonmetallic mineral products (3270), Retail trade (4A00), Furniture & related products (3370), HVAC & commercial refrigeration equipment (3334), Paints, coatings, & adhesives (3255), Wood products (3210), Other electrical equipment & components (3359), Architectural & structural metal products (3323), Architectural & engineering services (5413), Household appliances (3352), Nonmetallic minerals (2123), Electric lighting equipment (3351)

* Industries are listed in the order of statistical strength of association with the cluster.

National Supply-Chain Clusters (Continued)

Cluster	Industries in Cluster*
Digital Equipment	Audio, video, & communications equipment (334A), Semiconductors & electronic components (3344), Electronic instruments (3345), Computer & peripheral equipment (3341), Electronic, commercial, & household goods repair (811A), Commercial & service industry machinery (3333), Software (5112)
Entertainment	Performing arts, spectator sports, & museums (71A0)
Food & Beverages	Food products (3110), Fish & other nonfarm animals (1140), Beverage products (3121), Animal products (1120), Food & beverage services to customer order (7220), Crop products (1110), Converted paper products (3222), Leather & allied products (3160), Wholesale trade (4200), Boilers, tanks, & shipping containers (3324)
Metalworking & Industrial Machinery	Other transportation equipment (336B), Agriculture, construction, & mining machinery (3331), Other general purpose machinery (3339), Industrial machinery (3332), Cutlery & handtools (3322), Other fabricated metal products (332B), Turbine & power transmission equipment (3336), Metalworking machinery (3335), Ordnance & accessories (332A), Primary ferrous metal products (331A), Electrical equipment (3353), Motor vehicle bodies, trailers, & parts (336A), Forgings & stampings (3321), Household appliances (3352), Commercial & service industry machinery (3333), Electric lighting equipment (3351), Architectural & structural metal products (3323), HVAC & commercial refrigeration equipment (3334), Other miscellaneous manufactured products (3399)
Mining & Transportation	Coal mining (2121), Rail transportation (4820), Water transportation (4830), Nonmetallic mineral mining & quarrying (2123)
Motor Vehicle Manufacturing	Motor vehicles (3361), Automotive repair & maintenance (8111), Foundry products (3315), Leather & allied products (3160), Motor vehicle bodies, trailers, & parts (336A), Turbine & power transmission equipment (3336)
Movies, TV, & Radio	Motion pictures & sound recordings (5120), Radio & television broadcasting (5131), Magnetic media products (3346), Cable networks & program distribution (5132), Advertising & related services (5418)
Oil & Gas Extraction & Transportation	Oil & gas (2110), Pipeline transportation (4860)
Petroleum Products	Rights to nonfinancial intangible assets (5330), Petroleum & coal products (3240), Natural gas distribution (2212), Mining support services (2130), Electric power (2211)
Primary Nonferrous Metals	Primary nonferrous metal products (331B), Boilers, tanks, & shipping containers (3324), Foundry Products (3315), Metal ores (2122), Other electrical equipment & components (3359), Other miscellaneous manufactured products (3399)

* Industries are listed in the order of statistical strength of association with the cluster.

National Supply-Chain Clusters (Continued)

Cluster	Industries in Cluster*
Printing & Publishing	Newspapers, books, and directories (5111), Printed products (3230), Information services (5141), Converted paper products (3222), Civic, social, professional, and similar organizations (813B), Pulp, paper, and paperboard (3221), Other chemical products (3259)
Securities & Insurance	Insurance carriers and related services (5240), Funds, trusts, and other financial vehicles (5250), Transit and ground passenger transportation (4850)
Software & Data Processing	Software publishing (5112), Information services (5141), Computer & peripheral equipment (3341), Data processing services (5142), Computer systems design & related services (5415)
Telecommunications	Telecommunications (5133), Specialized design services (5414), Electronic, commercial, and household goods repair (811A)
Textiles & Apparel	Apparel (3150), Yarn, fabrics, and other textile mill products (3130), Non-apparel textile products (3140)
Transportation Support & Services	Sightseeing transportation & transportation support (48A0), Travel arrangement & reservation services (5615), Water transportation (4830), Management of companies & enterprises (5500)
Truck Transportation	Truck transportation (4840), Federal government enterprise services (S001), Sightseeing transportation & transportation support (48A0)
Urban Services	Educational services (6100), Personal & laundry services (8120), Warehousing & storage (4930), Real estate (5310), Waste management & remediation services (5620), Ambulatory health care services (6210), Legal services (5411), Social assistance (6240), Civic, social, professional, & similar organizations (813B), Amusements, gambling, & recreation (7130), Accounting & bookkeeping services (5412), Consumer goods & general rentals (532A), Scientific research & development services (5417), Maintenance & repair construction (2303), Management & technical consulting services (5416), Other professional & technical services (5419), Electric power (2211), Crop products (1110), All other administrative & support services (561A), Travel arrangement & reservation services (5615), Retail trade (4A00), Specialized design services (5414), Accommodations (7210), Water & sewage treatment (2213), Machinery & equipment rental & leasing (5324)
Utilities	State & local government enterprise services (S002), Water & sewage treatment (2213), Electric power (2211), Maintenance & repair construction (2303), Pipeline transportation (4860)
Wood Products	Forestry and logging products (1130), Wood products (3210), Pulp, paper, and paperboard (3221)

* Industries are listed in the order of statistical strength of association with the cluster.

Appendix D

Methods of Economic Analysis and Data Analysis Notes

Location Quotient Analysis

The location quotient (LQ) method of analysis is a measure of the relative concentration or specialization of economic activity (i.e., the comparative advantage) in an area. It is often used in economic base studies as an initial step in understanding which sectors are driving a region's economy, and it most often uses employment as the gauge.

The location quotient method begins by determining the proportion of a local area's total employment that is in each industry cluster. The same is then done for a much larger area, typically the nation. The local proportion is then divided by the national proportion (hence the name "location quotient"). Those industry clusters where the local proportion of employment exceeds the proportion of the national area (a location quotient greater than 1.00) are considered to be export-oriented to the degree that their location quotients exceed 1.00, and therefore part of the economic base. Other industries or clusters are assumed to be largely serving local demand and are therefore non-basic. A location quotient that is substantially greater than 1.00 suggests that the cluster has some local advantage in production. Clusters with high location quotients may be targeted as clusters with a high level of exports, following from the premise that if a greater portion of people are employed in this cluster, then the region produces relatively more of this product and sells the excess to people outside the region.

Employment Change

Location quotients are helpful, particularly in giving a sense of how the composition of local employment differs from national patterns. However, they are static and by themselves provide limited guidance for economic development. A number of additional questions must be answered in order to gain a fuller understanding of the factors affecting the health of the local economy. One such question is "What parts of the local economy have gained or lost employees?"

Shift-Share Analysis

Analysis of the data leads, in turn, to other questions, such as "How have local industry clusters performed relative to the nation?" "Which ones have a comparative advantage?" and "Have employment changes been caused by local or external forces?" A procedure called "shift-share analysis" helps answer these questions. Shift-share analysis examines the shifts over time in the employment patterns of a local or regional economy compared to the nation. Its method is to take the change in employment for an area and decompose it into the three sources that account the change: overall national economic growth, economic shifts among the various economic sectors, and local economic growth.

The National Growth Component The first source of change is the growth or contraction in the American economy. Relying on the concept that "a rising tide lifts all boats," national growth in employment is assumed to affect the total employment in the region. The national growth component is that part of the change in total employment in a region ascribed to the rate of growth of employment in the nation as a whole. The effect of the national growth component is felt most acutely during the peaks and valleys of the business cycle, i.e. during recessions and boom times.

The Industrial Mix Component The second element in the analysis is the extent to which an industry cluster has grown, net of effects from the national growth component. This component is determined by calculating the rate of change for an economic sector at the national level and subtracting from it the national growth component. In this way, the second aspect of the shift-share analysis, the industrial mix component, considers the effects of growth or decline in the individual clusters. This component of the shift-share analysis identifies how various clusters are affected by growth or decline at the national level. For example, there has been a steady decline in almost all manufacturing clusters. Therefore, areas that have been highly dependent on manufacturing clusters have a more negative overall industrial mix component.

The Local Share The local share reflects how a region's industries and clusters performed compared to the national average for each industry. In other words, the third and final component of shift-share analysis reflects the difference between the actual change in employment and the employment change to be expected if each industry cluster grew at the national rate. A positive local share component generally indicates that an area has a competitive advantage, which may be due to local firms or clusters having superior technology, management, or market access, or the local labor force having higher productivity and/or lower wages. A negative local share component could be caused by local shortcomings in one or more of these areas.

Using *County Business Patterns* Data

Age of the Data *County Business Patterns* contains the latest available detailed data on industries at the county level. This data is generally released approximately two to two and a half years after collection. The latest available data is from 2001, at the beginning of the recent recession.

Coverage of the Data *County Business Patterns* covers private, non-agricultural employment. While this includes the vast majority of all business employment, it is important to keep in mind that certain types of employment are omitted, specifically: agricultural employment, government employment, and the self-employed. Most significantly for this analysis is the omission of the Cincinnati area's largest employer, the University of Cincinnati, which has approximately 15,400 employees. This is a particularly important factor when considering those clusters that rely heavily on university-based research.

Data Suppression The widespread existence of data suppression in the *County Business Patterns* database is a major obstacle to conducting a regional industry analysis. Because this database strives to protect the anonymity of individual businesses, employment is suppressed for industries where there only are a handful of employers within the reported geographic area. To overcome this obstacle, the

Economics Center developed a method for estimating the value of these suppressed cells.

Industry Classification Beginning with the 1997 Economic Census and the 1998 data from *County Business Patterns*, the North American Industry Classification System (NAICS) has replaced the U.S. Standard Industrial Classification (SIC) system. NAICS completely reshapes the way industries are categorized. It places a greater focus on *HOW* goods and services are produced, whereas the old SIC system was organized according to *WHAT* was produced. Those responsible for designing the new system identify several other benefits:

Relevance - NAICS identifies hundreds of new, emerging, and advanced technology industries. And NAICS reorganizes industries into more meaningful sectors--especially in the service-producing segments of the economy.

International Comparability - NAICS was developed in cooperation with Statistics Canada and Mexico's INEGI. NAICS provides for comparable statistics among the three NAFTA trading partners.

Consistency - NAICS defined industries according to a consistent principle: businesses that use similar production processes are grouped together.

Adaptability - NAICS will be reviewed every 5 years, so classifications and information keep up with our changing economy.

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