

Critical Skill Shortages Project: Recommendations for Selection of Two Key Industry Clusters for Further Work

**A Report for
WorkSource – Greater Austin
Area Workforce Board**

A Research Initiative of *WorkSource*-Greater Austin Area Workforce Board

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Executive Summary

The Critical Skill Shortages project aims to demonstrate what can be accomplished by working with employers in two selected industry clusters, education and training providers, and community organizations to alleviate emerging skill shortages in key occupations that may hinder economic development.

This report reviews the nine industry clusters that the Greater Austin Chamber of Commerce has targeted for economic development in its "Opportunity Austin" campaign to recruit and retain jobs in Austin. The report also compares Austin's target clusters with the Texas statewide economic development efforts.

This report assesses the suitability and receptiveness of each industry cluster for implementing workforce development efforts to remedy labor shortages and support the growth of the cluster. We seek to identify mid-skill occupations that are emerging into a labor shortage situation. These occupations should be suitable for targeting by the workforce system and employers in the industry sector should be sufficiently organized and receptive to collaborate on analyzing the root causes of the shortages and in contributing to the remedies.

On the basis of this assessment of Austin's nine industry clusters, we recommend two clusters that appear to offer the best prospects for progress in further work. The two clusters we are recommending for further work in this project are:

(1) Biosciences, including biomedical and pharmaceutical products;

and

(2) Wireless technologies.

Both of our selected industry clusters are emerging industries, populated by small firms, and characterized by fast changing technologies. In each of these industry clusters, there are approximately 100 firms located in the Greater Austin area. For both of these clusters, the Greater Austin Chamber of Commerce has established a Task Force of local leaders to develop detailed strategies for recruitment and expansion of the industries. The Chamber is forming a new Advisory Committee for biosciences/biomedical with which we can work; and it collaborates with the Texas Health Care and Bioscience Institute to sponsor networking events. In wireless, the Wireless Alliance has an active interest in workforce issues; Austin Community College is forming a new advisory committee for Wireless Technology; and Capital Idea is helping to organize training programs in wireless technology. In short, we believe there is good potential for industry engagement in both of these clusters.

Introduction

The overall aim of this project is to better align the workforce development system with economic development efforts in Austin to improve both. This is a long-term endeavor that will not be accomplished in a single summer; but this project aims to facilitate the process.

The task offers several challenges. The coding structures of labor market statistics do not accommodate well to industry cluster analysis. Desirable detailed data and timely information is often not available. Yet industry clusters need to be defined in operational terms in order to gather data and to provide useful information and guidance. Occupational descriptions and skill standards in emerging industries are often still in flux and not well standardized across firms. Firms in growing clusters frequently do not identify or project their future workforce needs and are unwilling to commit resources to planning. They also may be reluctant to collaborate with competitive peers to address workforce needs. Typically, small firms are not sufficiently organized to articulate their needs to educators and trainers. In contrast to the perspective of economic developers who think in terms of industry clusters, workforce developers and educators tend to think in terms of skill clusters and transferability of skills. Economic development staff and educators use different nomenclature as if they speak different languages.

Cluster-driven economic development has been embraced by Texas and by Austin. Both the Greater Austin Chamber of Commerce (GACC) and the State of Texas currently take a cluster-based approach to economic development, focused on industry clusters that are viewed as "economic drivers" of vibrant, sustainable, prosperous communities.

The Greater Austin Chamber of Commerce conducted a special "Opportunity Austin" campaign to raise \$11 million for economic development. In 2004, GACC embarked on a five-year program of action targeting nine economic clusters:

1. Automotive Manufacturing
2. Biosciences, including biomedical, and pharmaceutical products
3. Product Manufacturing
4. Wireless Technology
5. Transportation and Logistics
6. Computer Software
7. Clean Energy
8. Semiconductors
9. Digital Media

The State of Texas also has a cluster-based economic development initiative, authorized by S.B. 275 passed in 2003 by the Texas Legislature. The Governor's Cluster Initiative, which is staffed by the Texas Workforce Commission, established statewide "cluster group" or committee of industry experts each of the six industry clusters. These clusters, which are called "engines of the Texas economy," include the following:

1. Advanced technologies and manufacturing
2. Aerospace and defense
3. Biotechnology and Life Sciences
4. Energy
5. Computer and information technology
6. Petroleum Refining and Chemical Products

The state hired as consultants to this effort Richard Seline and his staff at New Economy Strategies. The initiative sponsored forums in major Texas areas (Houston, Dallas, Austin, San Antonio, El Paso, and for selected clusters, the Rio Grande Valley). The forums produced a SWOT (strengths, weaknesses, opportunities, threats) analysis in each area and targeted cluster. Findings from the forums were then combined into a statewide SWOT analysis. Each cluster group is now producing a brief report to Governor Perry with policy recommendations.

In a separate but related effort, called the "Texas Technology Initiative" or the "State Strategy on Advanced Technology" (SSAT), teams of experts from across Texas were established for six advanced technologies underlying the clusters:

1. Advanced Energy Application
2. Biotechnology
3. Software Technology/Wireless
4. Micro-Electrical-Mechanical Systems (MEMS)
5. Nanotechnology
6. Semiconductors

Although the GACC and the State of Texas define the clusters differently, there is considerable overlap. Texas generally defines the clusters more broadly than does the Chamber. For example, the Texas cluster *computer and information technology* encompasses the GACC targets of *computer software*, *wireless technology*, and *digital media* as well as part of the category *semiconductors*. Likewise, the State category *advanced technologies and manufacturing* includes GACC targets *automotive manufacturing*, *product manufacturing*, and a portion of *semiconductors*. Finally, the Texas State category *energy* includes *clean energy* (See side-by-side comparison in Table 1).

Table 1: Target Industry Cluster Comparisons: Austin and State of Texas

GACC Opportunity Austin Industry Clusters	Texas Industry Clusters	SSAT Underlying Technologies
Biomedical	Biotechnology and Life Sciences	Biotechnology
	Aerospace and Defense	
Automotive Manufacturing	Advanced Manufacturing	
Product Manufacturing		
		Micro-electrical-mechanical systems
		Nanotechnology
Semiconductors	Information & Computer Technology	Semiconductors
Wireless Technology		Wireless/
Computer Software		Software Technology
Digital Media		
Transportation & Logistics		
Clean Energy	Energy	Advanced Energy Applications
	Petroleum Refining & Chemical Products	

Cluster Driven Economic Development and the Role of Workforce Development

The modern concept of industry clustering was popularized by Michael Porter of Harvard's Business School. In *The Competitive Advantage of Nations* (1990), Porter developed the Diamond Model in which the competitive advantage of nations lies in four interlinked advanced factors: (1) demand conditions, (2) industry strategy or rivalry, (3) related and supporting industries, and (4) factor conditions. In the model, government also plays a role as catalyst and challenger to encourage and push businesses to raise their aspirations and move to higher levels of competitive performance, stimulate early demand for advanced products, focus on specialized factor creation and to stimulate local rivalry by limiting direct cooperation and anti-trust regulations. Porter used his "diamond of advantage" to determine which firms, sectors or industries had competitive advantages, and his emphasis on the importance of related and supporting firms or industries encouraged interest in clusters. Although his work on competitive advantages was originally applied to nations, he recognized that a majority of the economic activities takes place at the regional level. So, he extended his theory to regional, state and metropolitan economies (Porter, 2000).

According to Porter, clusters are a striking feature of the economy of virtually every country, region, state and even metropolitan area, especially in advanced economies. Clusters are not unique, they are highly typical, and therein lies a paradox: the enduring competitive advantages in a global economy lie increasingly in local things: knowledge, relationship, and motivation (Porter, 1998a, p.78).

What is a cluster? Definitions and approaches to defining clusters

In order to use cluster as a focus of analysis and policy, a cluster must be defined clearly. But the criteria for clusters have proven to be very difficult to pin down. There are as many definitions as there are types of organizations using the term (Rosenfeld, 1995). Jacobs and DeMan (1996, p. 425) argue that there is no single correct definition of the cluster concept; different dimensions are of different interest.

The basic definition of an industry cluster is *the geographical concentrations of industries that gain performance advantages through co-location* (Doeringer and Terkla 1995, p. 225).

Porter defined a cluster as *a geographically proximate group of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g. universities, standard agencies, trade associations, etc) in a particular field, linked by commonalities and complementarities*. Clusters can take varying forms depending on their depth and sophistication, but a majority of them include end-product or service companies, suppliers of specialized inputs, components, machinery, and services, financial institutions, and firms in related industries. Often they also include the producers of complementary products and specialized infrastructure providers, including governmental entities (Porter, 1998b, p. 199). Porter (1998a, p. 50) argues that clusters can be considered as an alternative way of organizing a value chain.

Jacobs and DeMan (1996) and Rosenfeld (1996, 1997) provided in-depth discussions on the different definitions of industry clusters. Cluster policy is quite advanced in Europe. Roelandt and den Hertog (OECD 1999, p. 157) gave the following working definition of clusters: *clusters are characterized as networks of production of strongly interdependent firms, knowledge producing agents and customers linked to each other in a value-adding production chain*.

Stuart Rosenfeld, an American who has done much work with states and community colleges, defined an industry cluster as *a geographically bounded concentration of similar, related or complementary businesses, with active channels for business transactions, communications and dialogue, that share specialized infrastructure, labor markets and services, and that are faced with common opportunities and threats* (1997, p. 10).

In a subsequent publication, Rosenfeld explained the concept in more operational terms: *A cluster consists of groups of companies and/or services and all of the public and private entities on which they in some way depend, including suppliers, consultants, bankers, lawyers, education and training providers, business and professional associations and government agencies.* (2002, p. 8).

Rosenfeld further explains the minimum requirements of a cluster as follows: *a scale of demand sufficient to produce externalities (i.e., sufficient number of firms with common or overlapping needs to create or attract more services and resources, including labor than would be available to more isolated firms)... The externalities produced by mature and growing clusters include mid-skilled technical labor force members who are educated locally, and less geographically mobile and specialized services such as bankers, consultants, and accountants with a depth of understanding. There is a depth of relationship among members within the region. The dynamics of clusters are embodied in the value-added and knowledge-adding chains among its members* (2002, pp. 9-10).

Rosenfeld's explanation highlights the importance of the mid-skilled labor force and the workforce development system's role in creating it.

The Targeted Occupations Process and Economic Development

Texas developed a process for selecting occupations for training investments starting in the mid-1980s as part of programs under the Job Training Partnership Act. Relying on detailed labor market information data by occupation and area, the Texas State Occupational Information Coordinating Committee—now the Texas Workforce Commission's (TWC) Career Development Resources office—developed the early lists for local workforce programs to use. Initially, these were termed “demand occupations” and indicated jobs that were projected to grow rapidly in the coming years. The state workforce agency provided the lists as part of the annual planning guidelines for local training programs.

These have become “targeted occupations” lists and reflect both job growth prospects and minimum expected wages. TWC establishes the recommended process for selecting the targeted occupations, but local boards have discretion over how they implement them, including being allowed to set their own criteria and add (and subtract) occupations to the list. For example, the criteria adopted by *WorkSource* for occupations to be included on the list are minimum wage of \$9.59/hour; good employment growth prospects; and length of training or number of hours of training within board guidelines.

The 39 occupations on *WorkSource*'s 2005 list can be sorted roughly by industry cluster using the Greater Austin Chamber of Commerce's *Opportunity Austin* clusters (shown in the shaded rows), producing the list displayed in Table 2. Note that only 14 of the 39 targeted occupations fall into 6 of the 9 *Opportunity Austin* industry clusters. There are no targeted occupations in the other 3 clusters. Most of the targeted occupations are classified into other industry sectors, particularly Construction or Health Care.

The process currently used by *WorkSource* to select Targeted Occupations does not match well with the “economic driver” industry clusters targeted by Austin for economic development, nor does it identify emerging occupations and industries very well, because the Targeted Occupations list is used to respond to current and emerging needs. A different approach may be needed to augment existing processes to make more effective connections between cluster-driven, future-oriented economic development and occupation-oriented, skill-driven workforce development. This discussion is not intended as criticisms of *WorkSource* or its Target Occupations list, nor do we suggest that the process for targeting occupations should be altered. Rather this project seeks viable strategies to supplement the existing process in order to use workforce development resources more effectively to facilitate economic development. This approach is likely to result in more effective workforce development strategies for those in need as well.

**Table 2: Targeted Occupations Sorted by Industry
Capital Workforce Development Area**

2005 Target Occupations, by Industry Sector	Average Wage 2004	Projected Growth Rate 2000-2010
Automotive		
Auto Body Repairers	\$20.04	13.4%
Auto Mechanics	\$17.43	21.6%
Transportation & Logistics		
Bus Drivers, Commercial & School	\$11.46 - \$15.69	23.4%, 26.3%
Truck Drivers, Heavy	\$15.02	17%
Truck Drivers, Light	\$13.55	22.9%
Computer Software		
Computer Software Engineers, Applications	\$38.19	52.2%
Computer Software Engineers, Systems Software	\$40.94	54.5%
Computer Hardware Engineers	\$36.39	23.7%
Wireless Technology		
Computer Security Specialists	Emerging	Emerging
Computer Support Specialists	\$20.73	74.6%
Digital Media		
Multi-Media Specialist	\$22.95	9.1%
Biomedical		
Medical Assistants	\$12.77	48.4%
Medical Lab Technicians	\$13.17	20.3%
Pharmacy Technicians	\$12.08	38.7%
Product Manufacturing		
n/a		
Clean Energy		
n/a		

Semiconductors		
n/a		
Construction		
Carpenters	\$16.86	14.7%
Drafters	\$23.06	28%
Electricians	\$21.24	19.2%
Helpers-carpenters	\$11.11	14.3%
Helpers-electricians	\$11.72	13.2%
Locksmiths	\$13.48	0%
Operating Engineers, Construction & Earth Moving Equipment Operators	\$13.48	15.5%
Plumbers/Pipefitters	\$17.05	11.8%
Heating/A.C. Mechanics	\$19.35	26.6%
Leisure & Hospitality		
Cooks, Restaurant	\$8.68	23.2%
Foodservice Managers	\$20.40	17.2%
Healthcare		
Dental Assistants	\$16.11	37.6%
Dental Hygienists	\$38.20	37.5%
Emergency Medical Technicians	\$13.73	30.3%
Health Professions, N.E.C.	\$12.06	24.4%
Licensed Chemical Dependency Counselor	\$14.98	26.1%
Licensed Vocational Nurses	\$17.52	15.6%
Medical Assistants	\$12.77	48.4%
Medical Lab Technicians	\$13.17	20.3%
Pharmacy Technicians	\$12.08	38.7%
Registered Nurses	\$23.73	22.8%
Surgical Technicians	\$14.55	43.5%
Education		
Instructional Aides	\$11.00	30.5%
Teachers, Elementary*	\$20.73	25.4%
Teachers, Secondary*	\$22.13	32.1%
Other		
Administrative Assistants (executive & general clerical)	\$13.11 - \$17.08	12%
Bookkeeping/Acc. Clerks	\$14.25	4.1%
Child Care Workers	\$9.61	23.5%

Note: The three occupations classified under "Biomedical" are also listed under "Healthcare."

Methodology of this Study

We began this study with a set of questions that related directly to our selection criteria, which is summarized in Chart 1. In short, we wanted to determine the labor market

suitability of the industry cluster and the potential for industry engagement. Labor market suitability has five elements:

1. Critical to economic development. Is the industry cluster targeted by the Greater Austin Chamber of Commerce or by the State of Texas?
2. Strong employment demand. Are employers hiring and do they have ongoing openings?
3. Experiencing shortages in key occupations. Do demand figures show shortages? Are significant numbers of jobs involved?
4. Good Earnings, Benefits and Opportunities for Advancement. Do the positions pay at least the minimum standards set by *WorkSource*, offer benefits, and provide opportunities for advancement?
5. Appropriate for targeting by the workforce system. Are there multiple entry points below a 4-year college degree for skilled, trained workers?

We sought to assess the potential for industry engagement on the basis of three items:

1. Cluster group in existence. Do industry representatives from this cluster have an association or other group meeting so that initial outreach and analysis can be conducted through existing channels?
2. Recognized need by the industry cluster. Do employers in the cluster acknowledge shortages in critical skills occupations, although they may not be aware of the scope of the problem sector-wide? How have they demonstrated their recognition of need?
3. Willingness to contribute to solutions. Are at least some employers willing to participate in the project from the beginning, to share information for analysis, and to help define and contribute to development of solutions? Who will work with us? What is the commitment?

Our analysis of candidate clusters began with an investigation of the economic development targeting of the GACC and the State of Texas. We conducted interviews with TWC staff. We attended meetings of the State cluster groups and spoke with individual group members. We obtained documents, support materials and reports from consultants to GACC and the State of Texas.

Project staff familiarized themselves with relevant activities and initiatives currently underway in Austin, such as the LMI survey and the Workforce Intermediary effort. We reviewed reports regarding the Austin economy as well as available labor market information and employment trends for each of the candidate industry clusters.

We conducted an information search on each of Austin's nine identified industry clusters. We gathered the available names and contact information for Austin-area firms in each cluster. We searched for reports and Internet-based materials regarding how other areas had approached clusters in the same industries. In each cluster, we conducted field interviews by telephone and in person, with key industry informants. We interviewed GACC staff and followed up on their leads. We attended meetings of industry groups in the industry clusters that held special promise for this project.

We interviewed school officials, especially relevant officials at Austin Community College and at The University of Texas at Austin. We examined enrollment trends and graduation levels in education programs related to workforce preparation. We interviewed staff from community organizations with experience working with the candidate industries, focusing especially on workforce issues.

Results of Our Research

Our findings are summarized in the chart on the next page. Behind this chart, the details of our findings are presented in a standard format for each of the nine targeted industry clusters. The attached appendices contain details by sector from labor market information on 2002 employment and projected 10-year growth by industry cluster.

In brief, we found that *automotive parts manufacturing* for the San Antonio Toyota plant scheduled to open in August 2006 has not materialized in Austin. To date, only one firm, TASUS, has located in Georgetown. However, Austin does have strong capabilities in developing automotive applications of information technology. Especially appealing is the emerging field called telmatics, which involves wireless communications to and from automobiles.

The GACC targeted cluster, *product manufacturing*, is simply too diverse and unwieldy to organize. The National Association of Manufacturers does not have an active local chapter here, nor are there other suitable general manufacturing organizations with which to partner. The decline in semiconductor jobs during the past four years has dominated manufacturing employment statistics in the area; but *semiconductor* manufacturers are beginning to hire again. Given large numbers of workers with semiconductor experience in Austin, there are no labor shortages yet. However, if Samsung decides to build one of its new 300mm fabs in Austin, the situation could quickly change. Negotiations between Samsung and Texas are reportedly underway, and the outcome could be announced soon. Austin's semiconductor cluster is the strongest in the U.S. and it remains a possible backup candidate for further work on this project.

Although the GACC has listed *Transportation and Logistics* as a targeted cluster, it is pursued not so much as a generator of jobs but as support to other clusters considered "economic drivers" for Austin. The Transportation and Logistics cluster in Austin will provide construction jobs in constructing toll road and light rail system.

Clean energy is still in an early stage of development and as yet has generated enthusiastic support but few jobs.

The Greater Austin Chamber separately targeted three sectors that the State of Texas classifies within its information technology cluster: *computer software*, *digital media*, and *wireless technology*. Computer software has come through rough times under the tech decline. Both computer software and digital media continue to have need for high-end workers with strong technical and creative skills. But digital media employers have been difficult to organize and the Austin Software Council renamed itself the Austin Technology Council because it found the term "software" too confining.

Wireless technology, on the other hand, is emerging with broad and diverse commercial applications and a growing need for trained technicians at a variety of skill levels. The wireless technology cluster in Austin has considerable strength to build on and we recommend it as one of the two clusters to be selected for further work on this project.

We recommend the *biosciences/biomedical products* cluster for this project as well. The University of Texas has substantially increased student enrollments and research devoted to biotechnology. Some Austin-area firms are reaching the commercialization stage and have growing needs for workers in jobs such as technicians and distribution packaging operators. Austin Community College already has staff and capacity in this area and could be a substantial partner in filling these needs.

Table 3: Targeted Clusters

Industry Clusters Considered for Targeting	Automotive Manufacturing	Biosciences/ Biomedical/ Pharmaceutical Products	Advanced Manufacturing	Wireless Technology	Transportation & Logistics	Computer Software	Clean Energy	Semiconductors	Digital Media
<i>First Level Criteria - Labor Market Suitability</i>									
Critical to Economic Development Targeted by the Chamber or other Economic Development entity	●	●	●	●	◐	●	●	●	●
Strong Employment Demand Employers are hiring and have ongoing projected openings	○	◐	◐	◐	◐	◐	○	◐	◐
Experiencing Key Occupational Shortages Demand figures show shortages; significant numbers of job are involved	○	◐	○	◐	◐	◐	○	○	◐
Appropriate for Targeting by Workforce System There are multiple entry points below a 4-year college degree for skilled, trained workers	●	●	●	●	◐	◐	?	●	○
Good Earnings, Benefits, and Opportunities for Advancement Positions pay at least minimum standards set by <i>WorkSource</i> , offer benefits, and provide opportunities for advancement	●	●	●	●	◐	●	?	●	●
<i>Second Level Criteria - Potential for Industry Engagement</i>									
Industry Cluster Group in Existence Industry representatives from this sector have an association or other type of group meeting so that initial outreach and analysis can be conducted through existing channels	○	◐	○	●	◐	◐	◐	●	○
Recognized Need by Industry Cluster representatives Employers in the cluster acknowledge shortages in critical skills occupations, although they may not be aware of the scope of the problem cluster-wide	◐	●	○	●	◐	?	○	◐	◐
Willing to contribute to solutions Some employers in the sector are willing to participate in the project from the beginning, to share information for analysis, and to help to define and contribute to development of solutions	?	●	?	●	?	?	?	●	?
Best prospects for this project		👍		👍				?	

*Key: ● Strongly meets criteria ◐ Partially meets criteria ○ Does not meet criteria ? Status is uncertain 👍 - recommended cluster

*Key: ● Strongly meets criteria ● Partially meets criteria ○ Does not meet criteria ? Status is uncertain 👍 - recommended cluster

Industry Sector Considered for Targeting:

Automotive

First Level Criteria - Labor Market Suitability

Critical to Economic Development

Automotive/transportation manufacturing is viewed by the GACC as a target industry. A key focus is attracting parts suppliers to the new Toyota truck assembly plant scheduled to open in San Antonio in August 2006. Manufacturing is considered a "high value" target for economic development by GACC and other economic development entities.

In state-level economic development efforts, Texas targets automotive manufacturing as part of the broader "Advanced Technologies and Manufacturing" cluster, one of six industry cluster targets in the Governor's Cluster Initiative.

Strong Employment Demand

There is not much hiring in Austin yet, but it could develop, pending location decisions yet to be made by suppliers. To date, only one automotive parts supplier to Toyota has located in the Greater Austin area, beginning manufacturing operations in early 2005 in Georgetown, Texas. TASUS Corporation specializes in injection molded plastic parts. Reportedly, this firm was able to make this location decision because it has other customers in the area in addition to Toyota. TASUS Texas is expected to create more than 200 jobs.

Although the Greater Austin Chamber is currently talking with prospects, many Toyota suppliers are likely to take a "wait and see" attitude toward locating new manufacturing facilities in Texas until Toyota-San Antonio reaches full-scale production (about 400,000 trucks per year) and considers adding a second production line, or until Toyota or another automobile manufacturer decides to locate another assembly plant in Texas.

Experiencing Key Occupational Shortages

At this time, San Antonio may be facing significant near-term shortages in staffing the new Toyota truck assembly plant with the skilled personnel they desire. San Antonio Community College was concerned about its own capacity to meet the need and contacted ACC to participate in the meeting. However, at this point, it is unclear how much Austin will be affected by the San Antonio developments, particularly in the near term; better information will emerge over the next few months.

Appropriate for Targeting by Workforce System

Manufacturing jobs in the automotive sector are well-suited for targeting by the Workforce System

Good Earnings, Benefits, and Opportunities for Advancement

Production jobs in automobile manufacturing generally pay well and offer benefits.

Second Level Criteria - Potential for Industry Engagement

Cluster Group in Existence

Toyota has called a meeting with a group of community colleges across the region (including San Antonio and Austin) to be held on June 16, 2005 to discuss their needs. At this point, it is unclear whether this will be an *ad hoc* effort or become a lasting organization.

Recognized Need by the Cluster

The meeting of community colleges called by Toyota indicates recognition of need by Toyota. It is not yet clear how this will translate to Toyota's future network of suppliers.

Willing to contribute to solutions

Unknown at this time

Assessment and Recommendations:

Depending on location decisions, this cluster could spurt in employment growth and create sudden occupational skill shortages. But we are at too early a stage in Austin to determine this. A curriculum redesign has been undertaken by Austin Community College with industry input to serve a variety of manufacturing needs, including automotive manufacturing. The new structure offers a core curriculum in advanced manufacturing with specializations in semiconductor manufacturing, biomedical, robotics and control, and others. The new structure gives ACC greater flexibility to adapt to changes in the labor market rapidly. The curriculum design makes sense for students and for ACC—and hopefully will serve industry needs as well.

A closer examination of Austin's potential and its comparative advantage in automobile manufacturing lies in the application of information technology to automobiles and transportation, especially in the emerging field called *telematics*. Telematics involves wireless (often two-way) communications between automobiles and home, personal digital assistants (PDAs), phone, gas stations, and dealer service departments. Several Austin firms are involved in telematics. IBM Austin sponsors a "Solutions Laboratory" to work with its clients to envision applications of Telematics, develop "proof of concepts," and prototypes of future products. Freescale is currently the largest producer of semiconductor chips for automotive applications. 3-M Corporation, a major supplier to automobile manufacturers, has an interest in wireless automotive applications as well. This is definitely a cluster to watch, but it is premature to focus specifically on this cluster for the Critical Skill Shortages project under the current timeline, particularly when there are also opportunities to look at crossover needs in telematics from the perspective of the Wireless cluster.

Industry Sector Considered for Targeting:

Biomedical Products

First Level Criteria - Labor Market Suitability

Critical to Economic Development

The GACC targeted this Cluster as the "Medical Products industry, including Biomedical Products and Pharmaceuticals Manufacturing." However, the Chamber's cluster directory, *Biosciences Guide for the Austin Area: Where Biology Meets Technology*, lists numerous companies in a broader cluster that encompasses biotechnology, bioscience, bioinformatics, and even overlaps with parts of semi-conductor manufacturing.

Examples of companies that the Chamber considers in this cluster include the following:

ALK-Abello	Medical Carbon Research Institute
Ambion	Molecular Imprints
Apogent	Optive Research
CarboMedics	PPD Development
CEDRA Corporation	SACHEM
Cerilliant Corporation	SCIREX Corporation
Encore Medical	Spinal Concepts
Esoterix	Starkey Laboratories
Hopira	Stratagene
Introgen Therapeutics	TOPAZ Technologies
Luminex	

In 2005, the Milken Institute included Austin in its ranking of the top 12 biotech and life science centers. Texas has also targeted biotechnology as part of both the Governor's Industry Cluster initiative and in the State Strategy on Advanced Technology.

Strong Employment Demand

Currently about 100 companies in this cluster are located in the Greater Austin area, with workforce demand in the following broad categories and areas:

- BS, MS Chemists and Ph.D. Biologists for Biotech
- Pharmaceutical R & D Offices
- Pharmaceuticals or Biomedical Device Engineering and Manufacturing

Courtney Ross of GACC described these needs for "talent," as expressed by the companies with which she is in contact:

- Executives
- Administrative staff (preferably with some experience in the industry to be familiar with terminology, as well as having administrative skills)
- Engineers

- Product Managers (and Associate Product Managers)
- Marketing people, from managers to specialists
- Communications people (typically there is a manager of communications who manages in-house or contracted workers for product marketing)
- Technicians (in a 120-size company, an estimated 15-20 technicians are needed)
- Distribution/Packaging managers and operators who get products ready to go to market

GACC noted that manufacturing technicians require training in community college programs. One company contacted reported specific difficulties finding qualified technicians who were willing to work at their facility in Bastrop. There is a range of employment demands at many levels in the field; however, some advancement opportunities, particularly in biotechnology, require advanced degrees beyond 2-year or 4-year college preparation.

Experiencing Key Occupational Shortages

The current Targeted Occupations List for the Capital Area includes two health care occupations that are related to Biosciences:

- Medical Lab Technicians
- Pharmacy Technicians

In fact, Austin Community College uses the same laboratories to teach both medical laboratory technicians and biotech laboratory technicians.

As bioscience moves from the research and development laboratories to the commercialization stage, there could be an upsurge in the need for technicians and packaging managers and operators.

Appropriate for Targeting by Workforce System

The following types of jobs look especially promising:

- Technicians
- Distribution/Packaging Operators - need to be at least high school graduates up to having a 2-year degree. Companies are willing to provide some job training on site.

The Greater Austin Chamber already has referred some companies to *WorkSource* and/or Austin Community College to develop customized training or regular classes.

Good Earnings, Benefits, and Opportunities for Advancement

According to GACC staff, there are particularly good prospects for Technicians and Packaging/Distribution managers and operators, with estimated annual earnings are in the range of \$30K-\$40K plus benefits.

Second Level Criteria - Potential for Industry Engagement

Sector Group in Existence

While there is not yet an official Bioscience cluster group that meets with a consistent purpose, the “Bio Bash” is a recurring networking event organized by the Chamber, in partnership with the Texas Healthcare and Bioscience Institute (THBI), a statewide nonprofit policy organization that is also a membership organization. Bio Bash events were “on hiatus” for several years, but GACC and THBI have reinstated it, and two events have

been held this year, one breakfast and one happy hour. Each event was attended by about 75 representatives from industry or potential partner organizations (including government, education/training, commercialization, etc.).

The Bio Bash events generally run two hours, with networking prior to a presentation (about 30 minutes), and followed by more networking opportunities. Companies have expressed interest in having presentations from a panel of representatives from venture capital (VC) firms. The Greater Austin Chamber is currently planning to organize a more formal Biosciences Advisory Group to advise and guide economic development efforts.

Recognized Need by the Sector

Firms attending the Bio Bash events talk among themselves about a need for “talent” at several levels, and turning Austin into a recognized, branded Bioscience hub, which they believe would help them attract talent. These conversations typically have focused on talent broadly, rather than on specific occupations or specific types of skills.

Willing to contribute to solutions

While no group currently exists to actually commit to work with us at this point, the planned Chamber Biosciences Advisory Council has potential. In fact, Courtney Ross of the GACC suggested that it might attract companies to become involved if there were some issues on the table to work on, related to attracting and developing workforce talent, and expressed willingness to work jointly with us on this project by presenting these options to an advisory group. Susan Davenport of GACC also thought that companies wanted to focus on a strategy for attracting and developing talent at many levels.

Courtney Ross had mentioned the names of several industry representatives who had expressed interest in serving on a Biosciences advisory council, including Dick Martin (OriGen BioMedical), Doug Brown (HP), and Brooke Campbell (Calictec Biosolutions). Other candidates in Austin with expertise in the biosciences include Linnea Fletcher (Austin Community College), Tom Kowalski (Texas Healthcare and Bioscience Institute), Jack Hart (The University of Texas at Austin), and Barbara Cambron (Texas Workforce Commission).

Assessment and Recommendations:

Target this cluster for further work under the Critical Skill Shortages Project. We propose to work with the expanded definition of the Biosciences industry cluster, which includes Medical Products and Pharmaceuticals. This cluster has some overlap with Advanced Manufacturing.

To help staff the need for university-prepared talent in the biosciences, The University of Texas at Austin has substantially increased student enrollments and research efforts devoted to biotechnology. UT recently began a new program in molecular biology, and its enrollments are rising, as have enrollments in bio-engineering, biology, and biochemistry.

An important aspect of biopharmaceutical manufacturing is that it requires not only workers with advanced degrees, but also lab and production technicians, and packaging managers and operators, and those needs are expected to grow as more firms reach the commercialization stage. Austin Community College already has staff and capacity in this area and could be a substantial partner in this endeavor, and the Chamber has already connected some company contacts with WorkSource to address workforce development needs.

Industry Sector Considered for Targeting:

Product Manufacturing

First Level Criteria - Labor Market Suitability

Critical to Economic Development

“Product Manufacturing” is specifically targeted by Opportunity Austin and is considered by GACC as a “high value added target.” GACC has identified a base of 400 manufacturing firms located in Greater Austin. Yet, no Opportunity Austin staff member has been assigned to work specifically with the manufacturing industry cluster. This target cluster overlaps with two other industry clusters targeted by Austin—semiconductors, automotive, and pharmaceutical manufacturing.

At the state level, “Advanced Technologies and Manufacturing” is one of the six major clusters targeted by the Governor’s Cluster initiative and micro-electrical-mechanical systems (MEMS) was targeted as an underlying technology in the State Strategy on Advanced Technology. This appears to be a more restrictive and selective definition of this target sector than “product manufacturing” which is used by Austin.

Strong Employment Demand

Manufacturing employment has dropped substantially since the tech bust 2000. Much of this has come in the sectors manufacturing semiconductors and computers and peripherals (see accompanying graph).

Except for semiconductors and computer peripherals, Austin’s manufacturing base is small relative to other cities. It is also diverse, including food products and furniture manufacturing.

Experiencing Key Occupational Shortages

ACC faculty reports that there are developing shortages for highly skilled technicians.

Appropriate for Targeting by Workforce System

Maybe it will be appropriate in semiconductors, if the labor market continues to improve. Advanced manufacturers in many product areas have a need for highly skilled technicians at the Associate Degree level or higher.

Good Earnings, Benefits, and Opportunities for Advancement

Varies by type of manufacturing. In advanced manufacturing, beginning operators are paid in the range of \$10-\$12 per hour. Technicians are paid up to \$30 per hour.

Second Level Criteria - Potential for Industry Engagement

Cluster Group in Existence

The National Association of Manufacturers does not have an active local chapter in Austin. Many firms identify more with their specific industry (e.g., semiconductors or food products) rather than with manufacturing as a whole.

Recognized Need by the Cluster

We found no effective cluster-wide group organized in “product manufacturing.”

Willing to contribute to solutions

Unclear at this point

Assessment and Recommendations

A broad-scale effort covering all of “product manufacturing” is likely to be ineffective. However, there is crossover for a slightly reframed cluster description of “Advanced Manufacturing” with both the Wireless and Biosciences clusters recommended for inclusion in the project.

Industry Sector Considered for Targeting:

Wireless Technology

First Level Criteria - Labor Market Suitability

Critical to Economic Development

The GACC targets Wireless Technology specifically and considers the cluster to include telecom, computer software related to wireless, and digital media related to the emerging visual technology for camera phones and other wireless devices. The focus includes the major wireless phone carriers and their network of suppliers as well as wireless Internet services provided by a number of Austin companies such as Wayport and Alereon.

The Chamber includes numerous companies within the cluster of Wireless Technologies, some of which are also listed under other clusters (such as AMD in Semiconductors), including these examples:

Alereon	Silicon Labs
Metrowerks	Dell
AMD	SoloMio
Motion Computing	Freescale Semiconductor
AT&T Wireless	T-Mobile
SBC Labs	IBM Pervasive Labs
Axalto	Wayport
SigmaTel	Intel Corporation
Bandspeed	Wireless Valley

The Texas State Cluster Initiative includes Wireless Technology within the broader category of Computer and Information Technology.

Strong Employment Demand

An IC² Institute study identified 91 wireless firms in Austin in 2003. Wireless companies with 100 or fewer employees had approximately 3,400 employees among them, with this number expected to more than double to nearly 8,000 employees by 2008 (IC² Institute, January 2004). Among 39 firms responding to a survey for the IC² study, fully 80 percent anticipated hiring additional staff within the next year. Only 2 firms out of the 39 did not anticipate hiring within the next five years.

Experiencing Key Occupational Shortages

Officials at Austin Community College report that they have received numerous requests from the wireless firms to start new training programs for technicians and to address wireless networks through training programs for network administration which were initially developed with a focus on wired technologies.

Appropriate for Targeting by Workforce System

The wireless cluster has occupations and skill development needs that are well suited for strategic intervention by the workforce system. Technicians are needed, as are approaches to upgrade the skills of individuals who have learned to manage wired networks so that they can install, troubleshoot, or manage wireless networks.

There is currently a void in training opportunities to prepare to work as a technician in the wireless industry in Austin. Associate degree programs for wireless technicians are offered by Houston Community College, Dallas Community College, and Texas State Technical College (TSTC) in Waco, but are not yet available in Austin.

A current funded special project on wireless training, administered by Capital IDEA, is developing three levels of pre-baccalaureate technician training for the industry. In order of rising skill levels, the three training approaches are as follows:

(a) Technicians to install, maintain and trouble-shooting residential wireless systems for broadband carriers, such as Time Warner, Grande Communications, and SBC. This training has a large component of employer-specific training and can largely be delivered through on-the-job training (OJT).

(b) Technicians with generalized skills to install, maintain and trouble-shoot office wireless networks, including "hot spot" commercial locations. Training for this level has been identified to include COMPTIA's training and certification, the Cisco Computer Network Associate (CCNA) certification, and "Planet 3" certification. The later training, which is newly offered in Austin, prepares trainees to conduct site surveys to choose, plan and install wireless networks. As currently organized by Capital IDEA staff, the training involves a total 9-month program of study, involving learning through classes and components of volunteer "hands on" practical experience with non-profit organizations such as Austin Free Wireless.

(c) Technicians with theoretical as well as practical understanding of the wireless to enable them to work in such technical areas as supporting chip design for companies, such as Dell and Freescale. This will require training in a two-year associate's degree.

Good Earnings, Benefits, and Opportunities for Advancement

Pay for technicians ranges from \$10 to \$20 per hour, depending on level of skill and knowledge.

Second Level Criteria - Potential for Industry Engagement

Cluster Groups in Existence

The Chamber is working with a Wireless Advisory Council to help guide its efforts, connected to the Austin Wireless Alliance (www.austinwirelessalliance.org), a non-profit membership organization whose primary objective is to develop, sustain, and promote Austin as a global leader in business activity, technical innovation, and community participation within the wireless industry. The Alliance actively aims to brand Austin as "the wireless capital," believing that such an image would be good for wireless businesses.

The Wi-Fi Alliance (www.wi-fi.org), a different organization, is a global non-profit industry association, based in Austin, devoted to promoting the growth of wireless Local Area Networks (LANS). Their focus is on testing and certification programs for wireless devices to ensure interoperability.

Other groups in the wireless cluster include those focused on increasing the number of free wireless networks (public hotspots) in Austin, and on sharing technical information about developments in wireless (e.g., Austin Free Wireless). To date, these other groups have not addressed workforce development issues.

Recognized Need by the Cluster

Capital IDEA staff report that all wireless industry representatives with whom they have come into contact to date have been quite responsive, recognizing the need for training initiatives in this industry.

Numerous representatives from firms in the wireless industry have contacted Austin Community College requesting that training programs be established for wireless technicians. The initial meeting of an advisory committee of wireless industry representatives has been scheduled with Austin Community College faculty on June 20, 2005. Discussion will focus on a proposed new curriculum for wireless.

Willing to contribute to solutions

The previously indicated efforts to establish training strongly suggest the industry's willingness to work on solutions.

Assessment and Recommendations:

We recommend that the wireless be selected for further work under the critical skills project. The wireless industry needs greater definition and its workforce skill requirements need further clarification. The wireless cluster is emerging, technically challenging, rapidly changing, and populated by many newly established small firms. It also has active involvement of larger firms. For example, IBM-Austin has a Solutions Laboratory which works with client enterprises to develop a variety of new wireless products for home, office and automobile. The wireless cluster includes numerous categories and components, many of which overlap with Advanced Technology and Manufacturing, Computer Software and/or Digital Media Clusters, which the Greater Austin Chamber of Commerce is also targeting. These components include hardware development and manufacturing, software development, semiconductor chip design, and a variety of uses and applications, which vary according to bandwidth and radio frequency spectrum allocations.

Industry Sector Considered for Targeting:

Transportation & Logistics

First Level Criteria - Labor Market Suitability

Critical to Economic Development

GACC has listed Transportation and Logistics as a targeted economic development cluster. But this cluster receives attention not so much as a generator in itself but as a means to support other “economic driver” clusters. The concerns of CEOs interviewed by the Chamber staff have focused primarily on getting more direct flights to the East Coast, improvements in air cargo transportation, and alleviating the congested traffic on Austin area roads.

Greater Austin Chamber activities in this cluster seem more directed to supporting the development of the other clusters considered “economic drivers” than to developing the transportation and logistics cluster as a generator of jobs. Of course, Transportation and Logistics cluster can generate jobs, such as the large Walmart Distribution Center located off IH 35 near New Braunfels. But no Chamber staff member has as yet been assigned to work on this sector to generate new jobs.

Transportation and logistics were not specifically targeted as an industry cluster by the state of Texas; but issues regarding transportation and logistics have risen in several of the discussions of various clusters.

Strong Employment Demand

There is significant and growing demand for workers in highway construction and in trucking.

Experiencing Key Occupational Shortages

The occupations involved here are truck drivers and various types of heavy equipment operators.

Appropriate for Targeting by Workforce System

These occupations in truck driving and heavy equipment operation are appropriate to be addressed by the Workforce system.

Good Earnings, Benefits, and Opportunities for Advancement

Skilled jobs in highway construction generally pay moderately well, in the range of \$10 and up. Health benefits are available with a few employers. Working conditions, job safety concerns, the need to travel to maintain employment, and uncertain opportunities for advancement deter many job seekers.

Over-the-road truckers can earn in the range of \$10 to \$20 per hour. Jobs in warehousing and distribution work typically pays less.

Second Level Criteria - Potential for Industry Engagement

Cluster Group in Existence.

The Associated General Contractors-Heavy/Highway Division is perhaps the most relevant organization for road-building. Different businesses have convened around certain initiatives, such as requesting more direct flights or addressing customs issues, but these have often been companies from other clusters trying to address their own economic development needs affected by transportation and logistics issues, not the other way around.

Recognized Need by the Sector

Industry representatives have approached officials of Austin Community College Continuing Education Division for assistance in training heavy equipment operators. Efforts are currently underway to develop a proposal for a grant to be submitted under the recent Department of Labor solicitation to community colleges. Industry officials have also met with staff of Capital IDEA.

Willing to contribute to solutions

Unknown at this time

Assessment and Recommendations

This industry cluster offers some attractive employment prospects, especially in the short and medium term. However, while there is certainly a growing demand for skilled heavy equipment operators in highway construction, the construction industry itself is not considered an "economic driver" in the traditional sense by economic development specialists.

Industry Sector Considered for Targeting:

Computer Software

Cluster Descriptions and Perspectives

First Level Criteria - Labor Market Suitability

Critical to Economic Development

Computer Software is specifically targeted by the Greater Austin Chamber of Commerce for recruitment and retention, and by the state of Texas under the broader mantle of Computer and Information Technology (IT). There is a great deal of crossover and overlap between computer software and other Austin-targeted clusters, such as wireless, digital media, semiconductors, and biotechnology.

Although the Greater Austin Chamber of Commerce has identified software companies as a special Opportunity Austin target for 2005, the Chamber has not yet assigned staff to work specifically with this cluster. Nor has the Chamber established an Advisory Committee to help guide recruitment and retention activities in computer software. As part of its general recruitment and retention activities, the Chamber does include computer software firms.

Strong Employment Demand

There is strong employment demand. In fact, to accommodate laid-off experienced computer programmers who could be re-employed after taking short courses to obtain specialty certifications or update their skills, *WorkSource* recently added four computer occupations related to computer software to its list of 2005 Target Occupations in the Capital Area. Available labor market information revealed that these four occupations have among the highest expected 10-year growth rates (2002-2012) in the Capital area of any occupation on the list:

- Computer Software Engineers, Applications (52.2%)
- Computer Software Engineers, Systems Software (54.5%)
- Computer Security Specialists (emerging)
- Computer Support Specialists (74.6%)

Experiencing Key Occupational Shortages

While there may not be general shortages at this point, companies are again talking about the need for "talent" at several levels.

Appropriate for Targeting by Workforce System

Some jobs are appropriate for targeting by the Workforce System, but there are some unique circumstances and limitations. While individuals can be trained in beginning programming skills, those skills tend to be useful to companies when they are combined with more advanced skills in working on projects and in teams, and generally require a more seasoned employee. Thus, now that Austin's economy is picking up after the recent tech bust, there may be opportunities to train experienced workers who have related skills and background for selected occupations in computer software. However, the concept of multiple entry points below a 4-year college degree is probably too strong for the restricted

area of computer software, unless that definition is expanded to a broader category which includes wireless or all of information technology.

Good Earnings, Benefits, and Opportunities for Advancement

Jobs in the software industry provide good earnings, benefits, and opportunities for advancement, with the exception being certain types of “code jockey” positions for programmers who work on legacy systems or less complex programming tasks.

The occupations related to computer software on WorkSource’s list of targeted occupations provide a clue to the good earnings possible in the computer software field.

Table 4: Computer Software Occupations

Occupations related to computer software	Average Hourly Wage 2004
Computer Software Engineers, Applications	\$38.19
Computer Software Engineers, Systems Software	\$40.94
Computer Security Specialists	Emerging
Computer Support Specialists	\$20.73

Second Level Criteria - Potential for Industry Engagement

Cluster Group in Existence

The Chamber has not assigned a staff member to develop a software group at this point. The Chamber’s former Chair, Susan Dawson of the Athens Group, served as Chair of the Chamber’s Software Cluster group in 2000, when industry representatives were facing severe workforce shortages.

The Austin Technology Council (ATC) actually changed its name several years ago from the Austin Software Council, because they felt that the term “software” was too restrictive, since they were really focusing on software related to several crossover industries in information technology, as described above. ATC member firms run the gamut from software development and software consulting firms to wireless networking and telecom organizations to other companies that provide some level of support to the software industry, such as banks, leadership training and management consulting firms, and public relations/communications firms. The Austin Technology Council lists an “HR Peer Forum” on its website as one of its programs and services, an indication that some companies are focusing on staffing issues.

The Austin Wireless Alliance is a separate group which includes software companies as members.

Recognized Need by the Cluster

This area’s “recognized need” is likely to be more focused on the search for “talent” for the kinds of occupations that are not appropriate targets for the Workforce System.

Willing to contribute to solutions

It is not clear whether firms and individuals in the software cluster (as contrasted with the wireless cluster or an IT cluster) would be willing to contribute to solutions with the cluster narrowly specified as Computer Software.

Assessment and Recommendations:

It may be possible to include representatives from software firms that deal with wireless, by choosing the wireless cluster or a broader information technology cluster for further study, thereby permitting inclusion of software companies and occupations without focusing on them exclusively.

Industry Sector Considered for Targeting:

Clean Energy

First Level Criteria - Labor Market Suitability

Critical to Economic Development

Clean Energy is specifically targeted by GACC as part of its Opportunity Austin campaign. Keen interest in developing Clean Energy has been expressed by Austin Mayor Will Wynn, by Kirk Watson, former mayor and president elect of the Greater Austin Chamber, and by Austin Energy, a major investor in the Opportunity Austin Campaign. Austin Energy is working to achieve the “20-20” goal set by the Austin City Council to meet 20 percent of Austin’s energy needs by renewable sources of energy by the year 2020.

At the state level, energy production from renewable or sustainable sources is one of the three energy sub-sectors identified under the Governor’s Industry Cluster Initiative. Texas defined its cluster target more broadly to include the entire field of energy. In Texas terms, the energy field divides into three subgroups: (1) oil and gas, (2) electrical power generation through coal and nuclear, and (3) renewable or sustainable energy sources. In addition, Texas has an additional cluster specifically focused on Petroleum Refining and Chemical Products.

Strong Employment Demand

This cluster is at an early stage of development; and the long-term future is unknown. At the present time, strong demand does not exist for an Austin workforce in this cluster. The Austin Clean Energy Incubator is part of the National Alliance of Clean Energy Business Incubators. Altogether this national network of incubators has just 99 clean energy client businesses. According to the National Renewable Energy Laboratory, through 2005, 38 companies had graduated from incubators and hired 1158 employees for an average of 30 employees per company. The Austin Clean Energy Incubator currently houses six firms, none of which employ workers beyond the founders of the firms.

Experiencing Key Occupational Shortages

At this time, there are not significant numbers of jobs involved, and no shortages are reported.

Appropriate for Targeting by Workforce System

Too early to determine

Good Earnings, Benefits, and Opportunities for Advancement

Unknown at this time

Second Level Criteria - Potential for Industry Engagement

Cluster Group in Existence

The Greater Austin Chamber of Commerce has created the Austin Clean Energy Development Council to grow the energy technology industry in the region. Led by Ward

Tisdale of AMD, this council met for the first time in January 2005 and is scheduled to meet again on June 15, 2005. On June 1, the Chamber brought a new staff member, Laura Valentine, on board to focus on economic development initiatives for Clean Energy.

The Clean Energy Incubator is a program of the Austin Technology Incubator (ATI) and IC² Institute with financial support from the Texas State Energy Conservation Office. The Clean Energy Incubator offers an environment dedicated to helping young clean energy companies to succeed and compete in the free marketplace. Companies currently in the incubator include the following:

- **Austin Biofuels** produces renewable clean-burning fuel for diesel engines made from vegetable oils
- **E60 Vision** develops data management techniques using publicly available software to display environmental data in 3D and 4D visualizations. This technology has proven useful in Superfund toxic cleanup sites.
- **Power Tube Inc.** is developing low-cost geothermal power generation devices that can make electrical power available to rural areas without electrical service.
- **RSET, Inc.** is developing Rotating Liner Engines to improve efficiency and durability and reduce pollutants in internal combustion engines. RSET, Inc. is initially aiming at the heavy-duty diesel engine market.
- **WindKraft, Inc** develops and produces small-to-medium-sized wind turbine electrical generation systems.

Recognized Need by the Sector

No significant workforce needs in evidence to date

Willing to contribute to solutions

It is too early to determine this. Over time, Austin Clean Energy Development Council could grow into an appropriate group to address workforce issues; but at this early stage, the clean energy cluster is still emerging.

Assessment and Recommendations:

The definition of this cluster may be the most problematic of any of Austin's targeted clusters. The Greater Austin Chamber of Commerce specifically targets "Clean Energy" and Austin's Clean Energy Incubator seeks "clean energy firms." However, the definition of "Clean Energy" is a little fuzzy and still evolving. As one may see from the descriptions of the five firms currently in Austin's incubator (see above), a variety of activities are covered under this rubric. At this point, the term "clean energy" includes generation of sustainable or renewable power (wind, solar, biomass, geothermal, and fuel cells) as well as improved efficiency in the management, storage and use of energy.

The clean energy industry cluster is in an early stage of development. Currently the cluster includes great diversity and is not even well defined. The wide diversity of firms in the Clean Energy Incubator raises questions: what brings this cluster together besides a sense of environmental consciousness? Is this a coherent cluster?

With stronger incentives in much of the rest of the world due to higher gasoline prices and concurrence with provisions of the Kyoto accords, the development of clean energy is

receiving worldwide attention and investment. What is Austin's unique comparative advantage in this arena?

Eliza Evans, a lead author of the publication, *Enriching Economy and Environment: Making Central Texas the Center for Clean Energy* (IC², November 2002) is currently conducting a technology forecasting process to address some of these questions and to help focus Austin's future efforts in this arena.

If firms in this cluster do reach a significant commercialization stage, it may generate substantial mid-skilled employment in the Greater Austin region, but this development does not appear likely to happen any time soon.

Industry Sector Considered for Targeting:

Semiconductors

Cluster Descriptions and Perspectives

The semiconductor industry is specifically targeted by the GACC. At the state level, Semiconductors are specifically mentioned as one of the Advanced Technologies that are the focus of the Texas Technology Initiative. Semiconductors are also included as an element of the Texas State Targeted Cluster on Information Technology.

ACC has established a program for training Semiconductor Manufacturing Technicians; but it is under-enrolled due to the drop in semiconductor employment since 2000. Thus, ACC has moved to a training model providing more generalized manufacturing technician training capped with a sequence of three or four specialization courses in semiconductor manufacturing

First Level Criteria - Labor Market Suitability

Critical to Economic Development

The semiconductor cluster has been specifically targeted by both the Chamber and by the State of Texas. At the State level, semiconductor technology is an important target of the Texas Technology Initiative and semiconductors are in the targeted cluster on Computer and Information Technology.

By any definition, the Greater Austin area has a well-established semiconductor cluster. This cluster includes several important manufacturing fabrication facilities (Samsung, AMD, Freescale, National Instruments, Cypress Semiconductor, etc.), key customers (Dell, IBM), semiconductor chip design and R & D expertise (Intel, AMD, IBM), key suppliers of semiconductor manufacturing equipment (Applied Materials and Tokyo Electron which are ranked #1 and #2 in the world, and others, such as Dupont Photomasks, etc.) industry groups (SEMATECH, SEMI), knowledgeable staffing agencies with experience and track records with specific firms (Addeco with Applied Materials, Manpower with Freescale and Samsung, Volt with AMD), attorneys specialized in the needs of the industry (patent applications, H-1b visa processing, etc.), conventions (including the World Congress on Information Technology coming to Austin in May 2006), and educational institutions (College of Engineering, The University of Texas at Austin; Semiconductor Manufacturing Technician Program, Austin Community College).

GACC activities have focused on maintaining and expanding this strong economic cluster, including specific efforts to keep SEMATECH and retain Freescale's headquarters in Austin.

Strong Employment Demand

After a major downturn in employment from 2000 through 2004, some employers are beginning to hire again. For example, Freescale and its partner staffing agency, Manpower, Inc., are working with ACC to develop a "pipeline for technicians" to Freescale. Also, several recent semiconductor technician graduates (at Associate Degree level) referred by ACC in May 2005 to Samsung were hired to staff the recent expansion of the Samsung fab.

Reportedly Samsung is hiring a total of 300 workers in connection with this expansion, which went into operation only weeks ago.

Experiencing Key Occupational Shortages

There are no clear indications of key occupational shortages at this time. However, that situation could change if Samsung decides to build a 300mm plant in Austin and needs to hire an additional 1,000 workers.

Austin currently has a large reserve of workers who have some accumulated experience in semiconductor manufacturing and have been laid off. Whether many of these workers would be willing to return to work in this industry is unknown, but possible. If so, they may need minimal or short-term update training. In another indicator of no shortage, semiconductor employers in the Austin area appear to be raising their educational attainment requirements of job applicants.

Appropriate for Targeting by Workforce System

Entry points exist for workers without a 4-year college degree. However, there are some indications that employers in this industry have been raising educational standards in their recent hiring. (This may be a sign that there are not currently occupational shortages facing this industry). Austin semiconductor employers prefer to hire workers with at least an associate's degree if possible.

Good Earnings, Benefits, and Opportunities for Advancement

Employment in this sector pays above average manufacturing wages and provides benefits.

However, much of the actual production work is available only through temporary/staffing agencies, job security is lacking, and opportunities for advancement are uncertain.

Second Level Criteria - Potential for Industry Engagement

Cluster Groups in Existence

The Central Texas Technology & Education Executive Council (TEEC) was initially established as the Semiconductor Executive Council in 1997, instigated by the Capital Area Training Foundation (recently renamed Skillpoint Alliance). TEEC has been the most successful of Skillpoint's efforts to form "industry steering committees." The organization in Central Texas became the model for the Dallas-Fort Worth Semiconductor Executive Council. TEEC has been continuously active since its inception and has learned much from both its failures and its successes. The Council is currently staffed by Heath Hignight of Skillpoint Alliance.

TEEC's employer representatives are primarily executives from the semiconductor industry and its suppliers; TEEC is currently reaching out to other technology firms, including IBM. Half of the Council's members are school superintendents or administrators from area postsecondary educational institutions.

TEEC's interest in workforce development has been focused on working with schools, students and especially teachers to help assure a workforce of the future. Keen emphasis is placed on mathematics, science, and technology. Although initial efforts were placed mainly on preparation for technicians, the emphasis has grown over time to encompass postsecondary education, especially engineering. TEEC has established three subcommittees: (1) Grade K-8, (2) Grades 9-12, and (3) Postsecondary. Current strategies/activities include an emphasis on sponsoring Summer Educator Institutes for

teachers. TEEC and the Dallas-Fort Worth Semiconductor Executive Council currently co-sponsor a website (www.destinationdigital.org) for students interested in a career in semiconductors.

Recognized Need by the Cluster

The Central Texas Technology & Education Executive Council sees a need to influence students and teachers to assure a long-run workforce supply for the industry.

Willing to contribute to solutions

Firms participating in the Central Texas Technology & Education Executive Council have contributed significant funds to finance its activities. Annual dues levels are \$40K per year for the largest firms.

Assessment and Recommendations:

Semiconductor manufacturing in Austin is beginning to rebound after a major drop during the past four years. If Samsung decides to locate one of its new generation 300 mm fabs in Austin, workforce issues will become prominent once again.

Semiconductor manufacturing is a fast-moving industry with very short product life cycles. There are several diverse and growing markets for semiconductors (which include computer memory and RAM chips, cell phone, automobiles, appliances, etc.) If this industry cluster is selected for further work, we will need to gain perspective on the markets for various types of semiconductors, where portions of this industry are moving (e.g., toward foundry fabrication facilities, mostly located in Asia) and why and how this is likely to affect Austin. Also, we will need to gain a better understanding of temporary/staffing firms, their capabilities and their roles and relationships with firms in this industry. Such firms often have strong proprietary concerns and we will need to develop a research strategy that addresses these concerns. Also, we will need to verify whether there is an available reserve of experienced workers in this cluster available in Austin who are willing to be re-employed if business improves.

Industry Sector Considered for Targeting:

Digital Media

First Level Criteria - Labor Market Suitability

Critical to Economic Development

The Greater Austin Chamber of Commerce identified Digital Media as a targeted cluster for Opportunity Austin. The Chamber's website describes the Opportunity Austin priority for this cluster as "creating linkages between digital media and game producer groups and the high-tech industry, the University of Texas at Austin and the film industry." Digital film and multimedia (including games and web design) are core sectors of this Chamber cluster.

Andy Carlson (GACC) commented that Austin has many small, home-grown companies, but only has branches of larger digital media companies, and that the Chamber is interested in building a critical mass of digital media companies so that Austin is seen as more of a hub for gamers and other technical creative workers. He also acknowledged that the GACC is still formulating its economic development strategy with this cluster, and is in the process of holding a series of meetings with digital media entrepreneurs and executives.

Texas includes Digital Media within its broader Computer and Information Technology cluster.

Strong Employment Demand

Certainly there is a strong demand for top-performing people with both creative and technical skills. Multimedia Specialist is on the Targeted Occupations list at \$22.95/hour. However, the growth rate is projected to be less than ten percent.

Experiencing Key Occupational Shortages

Andy Carlson of GACC noted that these firms tend to talk about a lack of "seasoned" talent, especially at the executive level. Multimedia developers, particularly gamers, are not at the level that employers are seeking. Carlson reported that Richard Garriott (NC Soft) and Rodney Gibbs (Fizz Factor) were interested in programs that produce that type of talent.

Appropriate for Targeting by Workforce System

The priorities are for training to produce people with a combination of creative development skills, technical skills, and business acumen. In interviews with GACC staff, Richard Garriott (NC Soft) noted two schools that he believes fulfill such training needs:

- 1) Full Sail (www.fullsail.com) in Winter Park, Florida promotes itself as a media arts college (offering Associates and Bachelors Degree programs) that has graduated award-winning music, production and design professionals over the last 25 years. Degree programs include Computer Animation, Digital Media, Entertainment Business, Film, Game Design & Development, Recording Arts and Show Production & Touring. The gaming press has publicized Full Sail's creation of a Gamer's University.
- 2) DigiPen Institute of Technology (www.digipen.edu) in Redmond, Washington, offers degree programs at various levels (Associates, Bachelors of Arts and Sciences, and Masters) in Game Development, Real-Time Interactive Simulation, Computer

Engineering, Computer Science, 3D Computer Animation, and Production Animation, along with summer workshops, and outreach programs to high schools and technical centers nationwide. As does Full Sail, DigiPen emphasizes that students not only learn the skills for making games and animations, but they also learn how to perform in teams, design complete projects, and produce on a schedule.

These programs offer a major focus on integrating the skills needed for success in the industry, rather than training in separate multimedia applications. The programs require mastery of a range of multimedia tools, project-based learning, teamwork, presentation skills, and work in a simulated production environment. Some jobs are appropriate for targeting by the Workforce System; however, these program descriptions offer some insight into the integrated training elements considered necessary for success in this cluster area.

Good Earnings, Benefits, and Opportunities for Advancement

Good earnings are available for “flexible, highly skilled talent.” As noted above, the occupation “Multimedia Specialist” is on the Targeted Occupations list at \$22.95/hour.

Second Level Criteria - Potential for Industry Engagement

Cluster Group in Existence

IC² Institute has been trying to organize firms in the Digital Media cluster for several years, with a special interest in gaming. Deputy Director Alex Cavalli is hosting an upcoming conference on “digital convergence” at the University of Texas Club on June 20, 2005. Digital Convergence is perhaps most easily understood as the trend for businesses and industries based in the digital realm, including hardware developers, Internet providers, entertainment industries, and others to produce new formats and types of content by working together. As with the term for “Digital Media cluster,” the Convergence concept includes content and application development for film, video games, music, advertising and mass media, distribution, broadband wireless, Voice-Over IP, and other elements. It is not yet clear what follow-up is planned for after the conference.

Salsa.Net (<http://server1.salsa.net/about>), a group located in San Antonio that promotes Digital Convergence, has several active members in the Austin area, including Alex Cavalli.

The IT and Digital Media Council, first organized by the Skillpoint Alliance in February 2005, seems to have lost much of its industry attendance by its third meeting, perhaps because its focus was not on the talent needs as expressed by industry – for seasoned people with business and technical skills.

Chris Sherman is working on the Austin Gaming Initiative and is holding conferences to help brand NCSOFT, and Austin, as a place for talent.

Recognized Need by the Sector

There is recognition of a need for “talent” but less interest in specific occupational training.

Willing to contribute to solutions

Unclear at this point. While it is likely that they would be willing to contribute to solutions, those solutions may be less focused on skill shortages and occupations appropriate for targeting by the Workforce System.

Assessment and Recommendations:

The workforce system is more geared to training in specific types of skills and multimedia applications, rather than a comprehensive approach that makes participants responsible for producing a product under circumstances that simulate an industry production environment. The approach identified by Richard Garriott (which is similar to what the Chamber's Multimedia Industry Cluster members were saying in 2000, before the "tech bust") is that "talent" in the multimedia industry needs to be holistically trained, with a range of technical, creative and business skills and the ability to learn on the fly, integrate conceptual and skill-based work, and produce under tight deadlines.

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- WorkSource Website, www.worksourceaustin.com
- GACC Website, www.austin-chamber.org
- Bureau of Labor Statistics Website, www.bls.gov
- Websites for numerous local cluster/industry sector initiatives, noted throughout the report

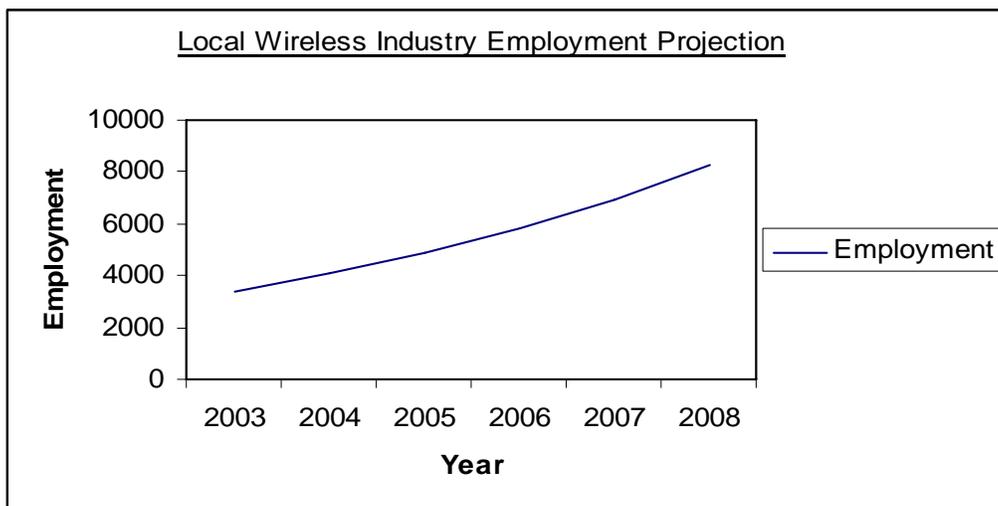
Appendices

Appendix A: Wireless Technology

NAICS (3-digit)	NAICS (4-digit)	NAICS (6-digit)	Description ¹	Employment ² 2002	Projection ³ (2002-2012)
	3342*	334220	Radio & Television Broadcasting & Wireless Communications Equipment Manufacturing	2,100	4.8 %
	3342*	334290	Other Communications Equipment Manufacturing	2,100	4.8 %
	3344*	334413	Semiconductor and Related Device Manufacturing	2,100	-14.8 %
443*		443112	Radio, Television & Other Electronics Stores	2,350	38.3 %
515*			Broadcasting (except internet)	2,450	12.2 %
516*			Internet Publishing and Broadcasting	200	25.0 %
	5172*		Wireless Telecommunications Carriers (except Satellite)	1,700	17.7 %
	5173*		Telecommunications Reseller	750	0.0 %
517*	5174		Satellite Telecommunications	5,050	1.0 %
517*	5175		Cable and Other Program Distribution	5,050	1.0 %
517*	5179		Other Telecommunications	5,040	1.0 %
	8112*	811213	Communication Equipment Repair and Maintenance	700	14.3 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.
 2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).
 3. Projection of job growth rate by industry, Capital Area Workforce Development Area.
- * Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)



Source: Workforce Projections. August 2003. IC²

Appendix B: Biosciences/ Biomedical and Pharmaceutical Products

NAICS (3,4-digit)	NAICS (5-digit)	NAICS (6-digit)	Description ¹	Employment ² 2002	Projection ³ (2002-2012)
3254*			Pharmaceutical and Medicine Manufacturing	1,650	15.2 %
3333*		333314	Optical Instrument and Lens Manufacturing	50	100 %
3345*		334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	2,100	-11.9 %
3345*		334516	Analytical Laboratory Instrument Manufacturing	2,100	-11.9 %
3345*		334517	Irradiation Apparatus Manufacturing	2,100	-11.9 %
3391*			Medical Equipment and Supplies Manufacturing	1,500	-13.3 %
4234*	42345		Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	8,550	19.9 %
4234*	42346		Ophthalmic Goods Merchant Wholesalers	8,550	19.9 %
4242*	42421		Drugs and Druggists' Sundries Merchant Wholesalers	450	22.2 %
446*	44611		Pharmacies and Drug Stores	2,200	13.6 %
446*	44613		Optical Goods Stores	2,200	13.6 %
5417*	54171		Research and Development in the Physical, Engineering, and Life Sciences	3,650	-9.6 %
5417*	54172		Research and Development in the Social Sciences and Humanities	3,650	-9.6 %
5419*		541940	Veterinary Services	2,450	16.3 %
6215*			Medical and Diagnostic Laboratories	1,000	35.0 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.
 2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).
 3. Projection of job growth rate by industry, Capital Area Workforce Development Area.
- * Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)

Appendix C: Transportation and Logistics

NAICS (3, digit)	NAICS (4-digit)	NAICS (5-digit)	Description ¹	Employment ² 2002	Projection ³ (2002-2012)
	2373*		Highway, Street, and Bridge Construction	1,600	15.6 %
	2379*		Other Heavy and Civil Engineering Construction	450	22.2 %
336*			Transportation Equipment Manufacturing	200	0.0 %
4238*		42386	Transportation Equipment and Supplies (except Motor Vehicle) Merchant Wholesalers	1,500	40.0 %
481*			Air Transportation	900	-5.6 %
482*			Rail Transportation	50	0.0 %
483			Water Transportation		
484*			Truck Transportation	2,150	16.3 %
485*			Transit and Ground Passenger Transportation	1,900	15.8 %
486			Pipeline Transportation		
487			Scenic and Sightseeing Transportation		
488*			Support Activities for Transportation	1,100	22.7 %
492*			Couriers	1,800	16.7 %
493*	49311		General Warehousing and Storage	300	33.3 %
493*	49319		Other Warehousing and Storage	300	33.3 %
5311*	53113		Lessors of Miniwarehouses and Self-Storage Units	3,100	4.8 %
5324*		532411	Commercial Air, Rail, and Water Transportation Equipment Rental and Leasing	200	0.0 %
5413*		541614	Process, Physical Distribution, and Logistics Consulting Services	8,550	42.3 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.
 2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).
 3. Projection of job growth rate by industry, Capital Area Workforce Development Area.
- * Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)

Appendix D: Computer Software & Automotive

Computer Software

NAICS (3-digit)	NAICS (4,5-digit)	NAICS (6-digit)	Description ¹	Employment ² 2002	Projection ³ (2002-2012)
334*		334112	Computer Storage Device Manufacturing	32,550	-10.0 %
334*		334611	Software Reproducing	32,550	-10.0 %
	4234*	423430	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers	8,550	19.9 %
443*	44312		Computer and Software Stores	2,350	38.3 %
		511210*	Software Publishers	5,800	16.4 %
516*			Internet Publishing and Broadcasting	200	25.0 %
518*			Internet Service Providers, Web Search Portals, and Data Processing Services	3,350	16.4 %
	5415*		Computer Systems Design and Related Services	9,900	42.4 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.
 2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).
 3. Projection of job growth rate by industry, Capital Area Workforce Development Area.
- * Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)

Automotive

NAICS (3-digit)	NAICS (4,5-digit)	NAICS (6-digit)	Description ¹	Employment ² 2002	Projection ³ (2002-2012)
326*	32621		Tire Manufacturing	750	-13.3 %
336*			Transportation Equipment Manufacturing	200	0.0 %
4231*			Motor Vehicle and Motor Vehicle Parts and Supplies Merchant Wholesalers	750	13.3 %
441*			Motor Vehicle and Parts Dealers	6,750	13.3 %
447*			Gasoline Stations	2,450	0.0 %
532*	5321		Automotive Equipment Rental and Leasing	2,200	15.9 %
	8111*		Automotive Repair and Maintenance	3,600	16.7 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.
 2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).
 3. Projection of job growth rate by industry, Capital Area Workforce Development Area.
- * Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)

Appendix E: Digital Media

NAICS (3-digit)	NAICS (4-digit)	NAICS (5,6-digit)	Description ¹	Employment ² 2002	Projection ³ (2002-2012)
323*		323115	Digital Printing	2,350	-2.1
	3341*	33411	Computer and Peripheral Equipment Manufacturing	11,200	-5.4 %
	3342*		Communications Equipment Manufacturing	2,100	4.8 %
334*	3343		Audio and Video Equipment Manufacturing	32,550	-10.0 %
	3344*		Semiconductor and Other Electronic Component Manufacturing	16,950	-14.8 %
	3345*		Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	2,100	-11.9 %
	3346*		Manufacturing and Reproducing Magnetic and Optical Media	150	33.3 %
	5121*	51211	Motion Picture and Video Production	750	13.3 %
	5121*	51219	Postproduction Services and Other Motion Picture and Video Industries	750	13.3 %
516*		51611	Internet Publishing and Broadcasting	200	25.0 %
	5171*	51711	Wired Telecommunications Carriers	2,450	-8.2 %
	5172*	51721	Wireless Telecommunications Carriers (except Satellite)	1,700	17.7 %
	5173*	51731	Telecommunications Resellers	750	0.0 %
517*		51741	Satellite Telecommunications	5,050	1.0 %
517*		51751	Cable and Other Program Distribution	5,050	1.0 %
517*		51791	Other Telecommunications	5,050	1.0 %
	5181*	518111	Internet Service Providers	950	15.8 %
	5181*	518112	Web Search Portals	950	15.8%
	5182*	518210	Data Processing, Hosting, and Related Services	2,400	16.7%
	5414*	541430	Graphic Design Services	450	22.2 %
	5415*	541510	Computer Systems Design and Related Services	9,900	42.2 %
	5418*	54181	Advertising Agencies	3,150	15.9 %
	5418*	54183	Media Buying Agencies	3,150	15.9 %
	5418*	54184	Media Representatives	3,150	15.9 %
	6114*	61142	Computer Training	550	18.2 %
	8112*	81121	Electronic and Precision Equipment Repair & Maintenance	700	14.3 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.
2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).
3. Projection of job growth rate by industry, Capital Area Workforce Development Area.

* Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)

Appendix F: Advanced Manufacturing

NAICS (3, digit)	NAICS (4-digit)	NAICS (5, 6-digit)	Description ¹	Employment ² 2002	Projection ³ (2002-2012)
325*		32522	Artificial and Synthetic Fibers and Filaments Manufacturing	2,100	9.5 %
325*	3255		Paint, Coating, and Adhesive Manufacturing	2,100	9.5 %
325*		32561	Soap and Cleaning Compound Manufacturing	2,100	9.5 %
325*		32562	Toilet Preparation Manufacturing	2,100	9.5 %
	3259*		Other Chemical Product and Preparation Manufacturing	100	0.0 %
326*			Plastics and Rubber Products Manufacturing	750	-13.3 %
	3271*	327124	Clay Refractory Manufacturing	150	0.0 %
	3271*	327125	Nonclay Refractory Manufacturing	150	0.0 %
	3272*	327213	Glass Container Manufacturing	200	0.0 %
	3272*	327215	Glass Product Manufacturing Made of Purchased Glass	200	0.0 %
327*		32741	Lime Manufacturing	1,300	11.5 %
327*		32791	Abrasive Product Manufacturing	1,300	11.5 %
327*		327992	Ground or Treated Mineral and Earth Manufacturing	1,300	11.5 %
327*		327993	Mineral Wool Manufacturing	1,300	11.5 %
327*		327999	All Other Miscellaneous Nonmetallic Mineral Product Manufacturing	1,300	11.5 %
		33111	Iron and Steel Mills and Ferroalloy Manufacturing		
		33121	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel		
		33122	Rolling and Drawing of Purchased Steel		
	3313		Alumina and Aluminum Production and Processing		
		33141	Nonferrous Metal (except Aluminum) Smelting and Refining		
		33142	Copper Rolling, Drawing, Extruding, and Alloying		
		33149	Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, Extruding, and Alloying		
		33151	Ferrous Metal Foundries		
		33152	Nonferrous Metal Foundries		
332*		33211	Forging and Stamping	900	11.1 %
332*	3322		Cutlery and Flatware (except Precious) Manufacturing	900	11.1 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.
2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).
3. Projection of job growth rate by industry, Capital Area Workforce Development Area.

* Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)

Appendix F: Advanced Manufacturing (continued)

NAICS (3, digit)	NAICS (4-digit)	NAICS (5, 6-digit)	Description ¹	Employment ² 2002	Projectio n ³ (2002- 2012)
332*		332313	Plate Work Manufacturing	900	11.1 %
332*		332322	Sheet Metal Work Manufacturing	900	11.1 %
332*	3324		Boiler, Tank, and Shipping Container Manufacturing	900	11.1 %
332*	3325		Hardware Manufacturing	900	11.1 %
332*		33261	Spring and Wire Product Manufacturing	900	11.1 %
	3327*		Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	400	0.0 %
	3328*		Coating, Engraving, Heat Treating, and Allied Activities	100	0.0 %
332*	3329		Other Fabricated Metal Product Manufacturing	900	11.1 %
	3331*	333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing	100	0.0 %
	3331*	33313	Mining and Oil and Gas Field Machinery Manufacturing	100	0.0 %
333*		33322	Plastics and Rubber Industry Machinery Manufacturing	3,200	-1.6 %
333*		333292	Textile Machinery Manufacturing	3,200	-1.6 %
333*		333293	Printing Machinery and Equipment Manufacturing	3,200	-1.6 %
333*		333295	Semiconductor Machinery Manufacturing	3,200	-1.6%
	3333 *	333298	All Other Industrial Machinery Manufacturing	50	100 %
	3333 *	333311	Automatic Vending Machine Manufacturing	50	100 %
	3333 *	333312	Commercial Laundry, Drycleaning, and Pressing Machine Manufacturing	50	100 %
	3333 *	333313	Office Machinery Manufacturing	50	100 %
	3333 *	333315	Photographic and Photocopying Equipment Manufacturing	50	100 %
	3333 *	333319	Other Commercial and Service Industry Machinery Manufacturing	50	100 %
	3335*		Metalworking Machinery Manufacturing	50	100 %
333*	3336		Engine, Turbine, and Power Transmission Equipment Manufacturing	3,200	-1.6%
	3339*	33391	Pump and Compressor Manufacturing	100	50 %
	3339*	33392	Material Handling Equipment Manufacturing	100	50 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.

2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).

3. Projection of job growth rate by industry, Capital Area Workforce Development Area.

* Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)

Appendix F: Advanced Manufacturing (continued)

NAICS (3, digit)	NAICS (4-digit)	NAICS (5, 6- digit)	Description ¹	Employment ² 2002	Projection ³ (2002- 2012)
	3339*	33399	All Other General Purpose Machinery Manufacturing	100	50 %
	3341*	33411	Computer and Peripheral Equipment Manufacturing	11,200	-5.4 %
	3342*	33421	Telephone Apparatus Manufacturing	2,100	4.8 %
	3342*	33422	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	2,100	4.8 %
334*	3343		Audio and Video Equipment Manufacturing	32,550	-10.0 %
	3344*	33441	Semiconductor and Other Electronic Component Manufacturing	16,950	-14.8 %
	3345*	33451	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	2,100	-11.9 %
	3346*	334611	Software Reproducing	150	33.3 %
	3346*	334613	Magnetic and Optical Recording Media Manufacturing	150	33.3 %
	3351*	33511	Electric Lamp Bulb and Part Manufacturing	500	0.0 %
	3351*	33512	Lighting Fixture Manufacturing	500	0.0 %
335*		33522	Household Appliance Manufacturing	850	5.9 %
	3353*	33531	Electrical Equipment Manufacturing	250	20 %
	3359*		Other Electrical Equipment and Component Manufacturing	100	0.0 %
336*			Transportation Equipment Manufacturing	200	0.0 %
	3371*	337121	Upholstered Household Furniture Manufacturing	600	-8.3 %
	3371*	337124	Metal Household Furniture Manufacturing	600	-8.3 %
	3371*	337125	Household Furniture (except Wood and Metal) Manufacturing	600	-8.3 %
	3371*	337127	Institutional Furniture Manufacturing	600	-8.3 %
	3372*	337214	Office Furniture (except Wood) Manufacturing	150	0.0 %
	3372*	337215	Showcase, Partition, Shelving, and Locker Manufacturing	150	0.0 %
	3379*		Other Furniture Related Product Manufacturing	300	0.0 %
	3399*		Other Miscellaneous Manufacturing	2,100	16.7 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.

2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).

3. Projection of job growth rate by industry, Capital Area Workforce Development Area.

* Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)

Appendix G: Semiconductor

NAICS (3,4-digit)	NAICS (5-digit)	NAICS (6-digit)	Description ¹	Employment ² 2002	Projection ³ (2002-2012)
333*		333293	Printing Machinery and Equipment Manufacturing	3,200	-1.6 %
333*		333295	Semiconductor Machinery Manufacturing	3,200	-1.6 %
333*		333298	All Other Industrial Machinery Manufacturing	3,200	-1.6 %
	3333*	333311	Automatic Vending Machine Manufacturing	50	100 %
	3333*	333312	Commercial Laundry, Drycleaning, and Pressing Machine Manufacturing	50	100 %
	3333*	333313	Office Machinery Manufacturing	50	100 %
	3333*	333315	Photographic and Photocopying Equipment Manufacturing	50	100 %
	3341*	334111	Electronic Computer Manufacturing	11,200	-5.4 %
	3341*	334113	Computer Terminal Manufacturing	11,200	-5.4 %
	3341*	334119	Other Computer Peripheral Equipment Manufacturing	11,200	-5.4 %
	3342*	33421	Telephone Apparatus Manufacturing	2,100	4.8 %
	3342*	33422	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	2,100	4.8 %
	3342*	33429	Other Communications Equipment Manufacturing	2,100	4.8 %
334*	3343		Audio and Video Equipment Manufacturing	32,550	-10.0 %
	3344*		Semiconductor and Other Electronic Component Manufacturing	16,950	-14.8%
	3345*	334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	2,100	-11.9 %
	3345*	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	2,100	-11.9 %
	3345*	334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	2,100	-11.9 %
	3345*	334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	2,100	-11.9 %
	3345*	334514	Totalizing Fluid Meter and Counting Device Manufacturing	2,100	-11.9 %
	3345*	334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals.	2,100	-11.9 %
	3345*	334516	Analytical Laboratory Instrument Manufacturing	2,100	-11.9 %
	3345*	334517	Irradiation Apparatus Manufacturing	2,100	-11.9 %
	3345*	334518	Watch, Clock, and Part Manufacturing	2,100	-11.9 %
	3345*	334519	Other Measuring and Controlling Device Manufacturing	2,100	-11.9 %
335*		335221	Household Cooking Appliance Manufacturing	850	5.9 %
335*		335314	Relay and Industrial Control Manufacturing	850	5.9 %

1. Description is for the lowest level of NAICS (2000) sector-hierarchy.

2. Annual Average Employment (in number) by industry in 2002, Capital Area Workforce Development Area (Travis County).

3. 3 Projection of job growth rate by industry, Capital Area Workforce Development Area.

* Denotes the given employment and projection figures for that digit level.

Source: Texas Workforce Commission (LMI)