

## Industrial Clusters in the San Diego Region

**This section provides a comprehensive list of the San Diego region's industrial clusters. Each cluster is profiled and their components listed by four-digit Standard Industrial Classification Code.**

## **Industrial Clusters in the San Diego Region**<sup>1</sup>

- Biomedical Products
- Biotechnology and Pharmaceuticals
- Business Services
- Communications
- Computer and Electronics Manufacturing
- Defense and Transportation Manufacturing
- Entertainment and Amusement
- Environmental Technology
- Financial Services
- Fruits and Vegetables
- Horticulture
- Medical Services
- Recreational Goods Manufacturing
- Software and Computer Services
- Visitor Industry Services

The following is a cluster by cluster examination of the San Diego region's economic drivers. A brief description of each cluster is provided along with additional information including: employment and wage data; inter-industry relationships; examples of firms included in the cluster; a listing of the Standard Industrial Classification Codes of the industries contained in the cluster; and the results of calculations for cluster technical factors.

There are three principal cluster types: emerging, stabilizer, and mature. The most dynamic of the three is that of the emerging cluster types.

Emerging clusters are comprised of young, fast-growing industries that are becoming more integrated and important to the regional economy. Environmental Technology, Recreational Goods Manufacturing, Biotechnology and Pharmaceuticals, Biomedical Products, Communications, and Software and Computer Services are all examples of emerging clusters in the San Diego region.

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<sup>1</sup> In addition to the 15 private sector clusters, the region also supports a Uniformed Military cluster. Because the information we have on the Uniformed Military cluster is more limited than the other clusters we have excluded it from further analysis.

While stabilizing clusters serve a number of purposes, their most important function is to add diversity and economic stability to the region. Stabilizing clusters also provide employment opportunities to those who do not have the training or experience to gain entrance into a high tech-related field. Examples of stabilizing clusters in the San Diego region include Visitor Industry Services, Amusement and Entertainment, Horticulture, and Fruit and Vegetables.

Mature clusters are comprised of industries that have declining or low employment growth, while continuing to be primary economic drivers of the region. These industries provide many high value-added employment opportunities. Defense and Transportation Manufacturing, Business Services, Financial Services, Computer and Electronics Manufacturing, and Medical Services are all examples of mature cluster industries in the San Diego region. Most high technology jobs are concentrated in the mature and emerging cluster groups.

The following cluster summaries include information pertaining to the relationship between clusters and supporting industries. Each section is specific to the cluster being discussed. All of the cluster groups require some support, whether it is maintenance, input supply, construction, education, accounting or other factors of production. The importance of a cluster's support relationship was determined by calculating the Cluster Dependency Factor (CDF). Cluster Dependency Factors are created using an input-output model for the San Diego region. An input-output model is an economic tool used to determine inter-industry relationships. For more information on the CDF, input-output models, and the other technical factors, please visit "[Understanding Cluster Analysis.](#)"

Support relationships can be categorized into three distinct levels: primary, secondary, and tertiary. The relationships are determined by industry analysis and by examining input-output model results. These relationships are individualized and unique for each individual cluster. Thus, a relationship that may be very important to one cluster may be less significant to another. For example, from the perspective of the Communications cluster the Defense and Transportation Manufacturing cluster is a primary demander of its goods. However, when the relationship is examined in reverse, the Communications cluster is only a secondary supplier from the perspective of the Defense and Transportation Manufacturing cluster.

A primary relationship between two industries is quite strong and almost warrants the supplying industry's inclusion in the cluster. This relationship is usually necessary, as the cluster often requires it to survive. For

example, the printed circuit board industry is strongly related to the Communications cluster even though it is not included in its definition. The Communications cluster must have printed circuit boards or it cannot function. The printed circuit board industry is not included in this cluster though, because it maintains an even stronger and more important relationship with the Computer and Electronics Manufacturing cluster. A region that contains both a cluster and its primary support industries has a competitive advantage over regions that do not.

Slightly weaker, yet still very important, are the secondary relationships that often occur between two clusters. It is not a mandatory relationship, but is significant according to input output results and industry analysis. An example of this relationship is the interaction between the Communications and Defense and Transportation Manufacturing clusters. These clusters use similar inputs, are complementary, and borrow technology from one another. However, their co-existence is not mandatory for their individual survival as clusters in the San Diego region.

The tertiary relationship is the broadest and weakest of the three. Examples of this relationship include maintenance, construction, and other goods and services that are needed by most business, but have little to do with the nature of a cluster.<sup>2</sup> The following cluster descriptions intend to highlight the primary and secondary relationships and do not go into detail about these tertiary, general-support relationships exhibited across all industry clusters.

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<sup>2</sup> Tertiary support relationships are based on generalized industry characteristics. Specialized biotech construction and other highly specific firms share stronger relationships with cluster industries.

**Figure 1**  
**San Diego Region's Industry Clusters**  
**Average Annual Employment (1990-1996)**

	1990	1996	Change	
			Numeric	Percent
Recreational Goods	3,152	6,512	3,360	107%
Biotechnology and Pharmaceuticals	11,017	21,725	10,708	97%
Communications	6,890	11,433	4,543	66%
Software and Computer Services	8,804	13,643	4,839	55%
Amusement and Entertainment	10,958	15,823	4,865	44%
Environmental Technology	3,111	4,154	1,043	33%
Business Services	48,159	61,771	13,612	28%
Computer & Electronics Manufacturing	26,531	27,658	1,127	4%
Medical Services	50,757	52,691	1,934	4%
Visitor Industry Services	70,266	70,656	390	1%
Fruit and Vegetables	3,541	3,493	-48	-1%
Horticulture	6,328	6,217	-111	-2%
Biomedical Products	7,363	6,431	-932	-13%
Financial Services	15,750	10,257	-5,493	-35%
Defense & Transportation Manufacturing	39,114	18,571	-20,543	-53%
<i>Total Cluster Employment</i> <sup>3</sup>	311,741	331,035	19,294	6%

Source: Employment Development Department; San Diego Regional Technology Alliance; SANDAG.

<sup>3</sup> Total cluster employment figure excludes Uniformed Military data.

**Figure 2**  
**San Diego Region's Industry Clusters**  
**Average Annual Payroll Per Employee (1990-1996)**  
**(Adjusted to 1996 Dollars)**

	1990	1996	Change	
			Numeric	Percent
Recreational Goods	\$26,512	\$37,713	\$11,201	42%
Software and Computer Services	\$45,515	\$63,543	\$18,028	40%
Financial Services	\$35,424	\$43,595	\$8,171	23%
Computer & Electronics Manufacturing	\$42,313	\$48,800	\$6,487	15%
Biomedical Products	\$35,233	\$39,431	\$4,198	12%
Environmental Technology	\$34,928	\$38,765	\$3,837	11%
Amusement and Entertainment	\$25,388	\$26,997	\$1,609	6%
Fruit and Vegetables	\$13,113	\$13,314	\$201	2%
Horticulture	\$17,308	\$17,478	\$170	1%
Defense & Transportation Manufacturing	\$42,743	\$43,120	\$377	1%
Visitor Industry Services	\$12,692	\$12,798	\$106	1%
Biotechnology & Pharmaceuticals	\$49,120	\$49,109	-\$11	0%
Communications	\$48,385	\$48,004	-\$381	-1%
Business Services	\$30,626	\$30,114	-\$512	-2%
Medical Services	\$40,844	\$36,360	-\$4,484	-11%
<i>Average for All Cluster Employment</i>	\$31,928	\$33,239	\$1,311	4%

Source: Employment Development Department; San Diego Regional Technology Alliance; SANDAG. Total Excludes Uniformed Military.

**Figure 3**  
**San Diego Region's Industry Clusters**  
**Average Firm Size (1990-1996)**

	<b>Total Number of Establishments</b>		<b>Average Size of Firm (# of Employees)</b>	
	<b>1990</b>	<b>1996</b>	<b>1990</b>	<b>1996</b>
Defense Manufacturing	129	134	303	139
Biomedical Products	91	134	81	48
Communications	146	273	47	42
Biotechnology and Pharmaceuticals	367	568	30	38
Environmental Technology	74	109	42	38
Computer & Electronics Manufacturing	541	791	49	35
Recreational Goods	155	223	20	29
Amusement and Entertainment	350	542	31	29
Visitor Industry Services	2,353	3,548	30	20
Software and Computer Services	474	990	19	14
Medical Services	3,640	4,170	14	13
Horticulture	478	513	13	12
Business Services	4,018	5,497	12	11
Fruit and Vegetables	370	407	10	9
Financial Services	493	1,094	32	9
<i>Total Cluster Establishments</i>	13,679	18,993	22	19

Source: Employment Development Department; San Diego Regional Technology Alliance; SANDAG. Total excludes Uniformed Military cluster.

### **Biomedical Products Cluster**

The Biomedical Products cluster is knowledge-intensive, requiring advanced research and development. The San Diego region's cluster produces instruments, medical devices, equipment and other apparatus primarily for consumption by the medical field. Biomedical products have a wide range of uses such as delivering pharmaceuticals, monitoring patients, providing therapy, and serving as artificial human organs. The cluster is often combined with the Biotechnology and Pharmaceuticals cluster and referred to as a "Bio-Sciences" cluster. The narrower, more specific definitions used by SANDAG are preferable because they more accurately reflect the strongest industry relationships and allow for more in-depth trend analysis.

The San Diego region has become a driving force in the field of biomedical products. What began as a single company founded by two University of California, San Diego (UCSD) researchers has now become a successful industry cluster. Local higher education facilities continue to play an important role in this cluster's development and are a major source of innovation. In addition, local organizations such as BIOCOM provide support and foster collaboration within this and other related clusters, such as the Biotechnology and Pharmaceuticals cluster.

The Biomedical Products cluster employed 6,431 people in the San Diego region in 1996.<sup>4</sup> The cluster is highly concentrated in the region with an Employment Concentration Factor (ECF) 2.14 times greater than the national average.<sup>5</sup> The largest employment sectors in the cluster are Surgical and Medical Instruments (2,806 jobs) and Ophthalmic Goods (2,110 jobs). There are approximately 134 firms in the Biomedical cluster with an average firm size of 48 employees. In 1990, there were 32% fewer firms (91 establishments), employing an average of 81 workers. As mentioned previously, an important and substantial part of Biomedical related employment is in research and development (usually shared between private firms, universities and other research institutions). Due to specific data limitations, it is more difficult to quantify the exact employment figure for the research element of the cluster.

The Biomedical Products cluster provides high value-added job opportunities with an average real wage of \$39,431; an increase of 12% from 1990. The Economic Prosperity Factor (EPF) is 1.67 times greater than the

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<sup>4</sup> Unless otherwise noted all employment and payroll data are from the 1996 Employment Development Department ES 202 data files.

regional average. The highest paying industries are X-ray Apparatus and Tubes (\$48,219) and Surgical and Medical Instruments (\$45,394). Wages in the Biomedical Products cluster are lower than wages seen in the Biotechnology and Pharmaceuticals cluster. This occurs because a larger proportion of biomedical product employment, unlike biotech, is in lower paying manufacturing and sales-related.

The Biomedical Products cluster is linked to numerous other industries and clusters in the region. The cluster depends very heavily on local research facilities and educational institutions such as UCSD, SDSU and USD. Although the input-output (IO) model does not clearly represent the importance of this relationship, it is an important primary interaction.<sup>6</sup> Since the Biomedical Products industries are considered manufacturing in nature, they are more closely linked to input suppliers than is the Biotechnology and Pharmaceuticals cluster. The Biomedical Products cluster has primary demand relationships with the Software and Computer Services cluster and with electronic component producers such as semiconductor and printed circuit board manufacturers. The Biomedical Products cluster supplies a large proportion of its products to the Medical Services cluster, which contains hospitals, laboratories and other health practitioners. In particular, the Biomedical Products cluster has secondary supply relationships with the Offices and Clinics of Dentists and Doctors of Medicine industry. Certain components of the cluster also supply to defense-related firms. For example, Optical Instruments and Lenses and Ophthalmic Goods both supply to the defense industry.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
3821	Laboratory apparatus and furniture	Camino Laboratories Incorporated
3827	Optical instruments and lenses	Bio General, Inc.
3841	Surgical and medical instruments	CBS Scientific Co
3842	Surgical appliances and supplies	Laser Power Optics
3843	Dental Equipment and Supplies	SafeSkin Corp
3844	X-ray apparatus and tubes	Thermoscan, Inc.
3845	Electromedical Equipment	
3851	Ophthalmic Goods	

Please send comments to the San Diego Regional Technology Alliance at [www.sdrta.org](http://www.sdrta.org).

<sup>5</sup> Please refer to “Paper 2: Understanding Cluster Analysis” for a full description of the terms Employment Concentration Factor, Economic Prosperity Factor and Cluster Dependency Factor.

<sup>6</sup> The input-output model’s transactions table is matrix of all monetary relationships in the regional economy. Its limitation is that it has difficulty capturing the entire relationship between universities and the private sector. Often a relationship is based on information sharing with no direct monetary compensation. The IO table may not capture the full extent of this type of interaction.

### **Biotechnology and Pharmaceuticals Cluster**

The Biotechnology and Pharmaceuticals cluster includes industries engaged in researching, manufacturing, or processing a broad range of biological, chemical, and medicinal products. Medical and industrial chemicals and preparations are also included in this grouping. According to Collaborative Economics, “biotechnology is an umbrella term for research and product development activities that use organisms or their cellular components to find new therapeutic and diagnostic medical tools.”<sup>7</sup> The Biotechnology and Pharmaceuticals cluster is unique because of the long period of time required to get a product to the commercial market. The process often takes up to ten years before a product is available to the general public. Some firms in the cluster have difficulties in obtaining capital, especially venture capital. Fortunately, a local firm’s recent success in obtaining FDA approval for an AIDS treatment drug has provided a boost to the industry.

A large portion of the region’s biotechnology industry is concentrated in the research and development phase. A strong, adaptable higher education sector is necessary to provide the background, labor force and technical innovation for today’s biotech firms to be competitive. Primary biotech research institutions in the San Diego region include the University of California at San Diego, Scripps Clinic, and the Salk Institute.

The Biotechnology and Pharmaceuticals cluster is often combined with the Biomedical Products cluster and referred to as a “Bio-Sciences” cluster. With respect to cluster analysis, the narrower, more specific definitions used by SANDAG and the SDRTA are preferable because they more accurately reflect the strongest industry relationships and allow for better analysis of industry trends over time. The Bio-Science clusters depend upon many of the same industry organizations such as BIOCUM.

The Biotechnology and Pharmaceuticals cluster employs 21,725 people and has nearly doubled the number of industry employees since 1990. Although employment has increased, real wages over this time period have been stagnant. There are approximately 568 firms in the cluster with an average employment of 38 jobs each. The largest employment sectors are the Biotech and Pharmaceutical portion of the Commercial Physical Research industry (8,611 jobs) and the Non-Commercial Research Organizations industry (5,883). The current average wage for the Biotechnology and Pharmaceuticals cluster is \$49,109. Industrial Organic Chemicals,

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<sup>7</sup> “The Health Care Technology Cluster in San Diego.” Collaborative Economics, Inc. Draft report April 20, 1995. Page 2.

NEC<sup>8</sup> (\$61,657) and Commercial Physical Research (\$61,136) are the highest paying industries in the cluster group. In terms of employment and wages, both the Employment Concentration Factor and the Economic Prosperity Factor are 2.07 times greater than average.

The inter-industry relationships of this cluster show it to be particularly close knit, even when compared to other cluster groups. Many of the industries that supply the cluster with inputs are included in the cluster definition that follows. Moreover, since the cluster is research oriented, it does not require the same level of manufacturing-related input components that the Biomedical Products cluster does.

The cluster has a primary supply relationship with the Medical Services cluster. The healthcare industry, in general, is a primary consumer of the Biotechnology and Pharmaceuticals cluster's products. The Biotechnology and Pharmaceuticals cluster shows strong, secondary demand relationships with numerous specialized support services. There are particularly strong demands from specialized law, investment and financial services firms as well as construction and engineering. The Biotechnology and Pharmaceuticals cluster also has a secondary demand relationship with hazardous waste disposal sites.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
2835	Diagnostic substances	Agouron Pharmaceuticals
2836	Biological products excluding diagnostic	Gensia
8071	Medical laboratories	IDEC Pharmaceuticals
8731	Commercial physical research (60%)	International Enzymes, Inc.
8733	Noncommercial research org. (100%)	Scantibodies Laboratories, Inc.
2833	Medicinals and botanicals	California Institute of Biological Research
2834	Pharmaceuticals preparations	
5122	Drugs, proprietaries, and sundries	
8734	Testing laboratories	
2819	Industrial inorganic chemicals, NEC	
2869	Industrial organic chemicals, NEC	
2899	Chemical Preparations	

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<sup>8</sup> Not Elsewhere Classified (NEC)

### **Business Services Cluster**

This cluster includes industries that provide a variety of professional services to local business establishments, including management, legal and personnel supply services. Many of today's business service industries are developing specialized skills to better serve the region's driving cluster industries. For example, a legal services firm today may require additional skills and expertise in intellectual property law regarding biotechnology-related patent applications than it had only a few years previously.

The Business Services cluster continues to gain importance as an integral part of the region's employment. In 1996, the cluster employed 61,770 people in nearly 5,500 establishments, a 28% increase in six years. The small firm size (averaging 11 employees) reflects the small-business nature of the cluster. The Employment Concentration Factor shows that the Business Services cluster is 1.15 times more concentrated in the San Diego region than across the nation. Many of the individual industries in the cluster contain a relatively large number of employees. The biggest, in terms of employment, are Help Supply Services (20,147 jobs) and Business Services, NEC (10,497 jobs). Temporary employment agencies are included in the Help Supply Services figure. This may distort the true employment figure for the cluster because the temporary workers, while counted as business service employees, may actually work in other areas such as in a manufacturing. Although they are actually working in a manufacturing firm, their employment is credited to a service sector industry. There is presently no reliable method to correct for this inaccuracy. However, even without the addition of the Help Supply Services employment, the Business Services cluster is still one of the region's largest employers.

The average wage for the Business Services cluster is \$30,114. The salary range for the cluster is quite broad with the low-end average wage below \$19,000 a year and the high-end exceeding \$60,000 a year. Real wages have decreased 2% since 1990. The Economic Prosperity Factor is 1.27 times greater than the regional average. The three highest paying industries are Computer Rental and Leasing (\$60,293), Legal Services (\$53,887) and Architectural Services (\$50,898).

The Business Service cluster is actually one of the major support groups for all cluster industries and is almost a universal tertiary support institution. Most firms require some form of this cluster's product, whether it is accounting, advertising, legal counseling or some other form of assistance. Due to the variety of industries included in the Business Services cluster definition, the internal cohesion, represented by low Cluster

Dependency Factors, is not amongst the strongest. Most of the cluster's relationships are singular, usually only occurring between two specific industries.

Beyond the generalized, tertiary support relationships, there also exist numerous above-average inter-industry relationships between both cluster and non-cluster firms. The Real Estate industry exhibits a very strong, secondary relationship with the cluster as both a demander and supplier of goods and services. The Commercial Printing industry is also a major demander of the cluster's services. At a broader level, a particularly strong, secondary cluster to cluster relationship exists between the Business Services and Financial Services clusters.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
2741	Miscellaneous publishing	Certified Folder Display Service, Inc.
7311	Advertising agencies	General Business Services
7319	Advertising, NEC	Hutchinson and Bloodgood CPAs
7361	Employment agencies	Law Offices of Daniel B. Macleod
7363	Help supply services	Phillips Marketing
7375	Information retrieval services	
7376	Computer Facilities Management	
7377	Computer rental and leasing	
7389	Business services, NEC	
8111	Legal services	
8712	Architectural services	
8720	Accounting, Auditing and Bookkeeping	
8741	Management services	
8742	Management consulting services	
8748	Business consulting, NEC	

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### *Communications Cluster*

The region's development of the Communications cluster exhibits characteristics similar to that of the Biotechnology and Pharmaceuticals cluster, i.e. a single firm (Linkabit) founded by two UCSD faculty members that was responsible for much of the region's early telecommunication industry's success. Over the past thirty years, the Communications cluster has experienced rapid growth and increasing profits. Today, firms in the San Diego region are among the leaders of the communications industry, focusing on cellular, satellite, analog and digital product development. The cluster includes industries primarily engaged in researching and manufacturing communications related products. The cluster also includes industries that provide point-to-point communications services such as cellular phone and beeper services.

A shared characteristic of the Communications cluster and other knowledge-based cluster groups is a heavy dependence on local research and higher education institutions. This dependence has sparked the growth of a network of specialized professionals involved in business, universities and other organizations. The link between quality research institutions and the Communications cluster is a strong one and has produced a number of programs including the UCSD Center for Wireless Communications and the SDSU International Center for Wireless Communications. CONNECT also provides industry assistance to the cluster. Shared technology and a strong talent base have contributed to the rise of the Communications cluster in the San Diego region. Presently, a growing concern for the cluster appears to be the increasing shortage of a once abundant specialized labor pool in the region.

The success of the San Diego region's Communications cluster has been recognized here and abroad. The cluster has grown by over 65% in the last six years reaching 11,430 employees in 1996. This figure is slightly underestimated due to a number of temporary workers employed by the cluster. The Employment Concentration Factor of the Communications cluster is 2.3 times greater than the national average. There are approximately 273 firms averaging 42 employees each. The largest employment sector, Radio and TV Communications manufacturing (2,209 jobs), is also the core of the cluster. The cluster's average wage is \$48,000, resulting in an Economic Prosperity Factor 2.03 times greater than the regional average. Real wages have decreased 1% since 1990. The highest paying industries in this cluster are the Telephone and Telegraph Apparatus (\$63,890) and Communications Equipment, NEC (\$62,837) industries.

The Communications cluster has a primary demand for various electronic input components. It follows that the Communications cluster is strongly related to the Electronics & Computer Manufacturing cluster. More specifically, the strongest primary demand relationships are with the Printed Circuit Board industry, the Semiconductor industry, and the Software and Computer Services cluster. The cluster also has primary demand relationships with test and monitoring equipment manufacturers and service providers. Since the Communications cluster is focused on final goods manufacturers, it primarily demands inputs and does not supply to a large number of other industries. However, the Communications cluster does have a secondary supply relationship with the Defense and Transportation Manufacturing cluster.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
3661	Telephone & telegraph apparatus	Cubic Communications, Inc.
3663	Radio & TV communications	MCI Telecommunications, Inc.
3669	Communications equipment, NEC	Palomar Engineers, Inc.
4812	Radio/telephone communications	Qualcomm, Incorporated
4899	Communications services	Systech Corp
8711	Engineering services (10%)	
8731	Commercial physical research (25%)	

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### **Computer & Electronics Manufacturing Cluster**

The Computer and Electronics Manufacturing cluster plays a vital role in the regional economy because it produces essential input components for numerous high-tech industries. The Computer and Electronics Manufacturing cluster includes industries that manufacture and assemble electronic components and products. The emphasis of this cluster is on high technology and computer-related products and their input components. The San Diego region's proximity to Mexico and the maquiladora factories residing on the border make for a robust regional cluster. The North American Free Trade Agreement (NAFTA) should increase the demand for US-made electronic components and equipment.

Overall, traditional manufacturing employment in the region has been decreasing over the last six years. However, due to the high tech, computer and electronics focus of this cluster, its employment has increased over 1,100 jobs during the same time period. The cluster is highly concentrated in the region, with an ECF 1.83 times greater than the nation. There are approximately 790 firms in this cluster with an average of 35 employees. The three largest industries are Household Audio and Video Equipment (4,500 jobs), Computer Peripheral Equipment, NEC (3,827 jobs), and Electronic Components, NEC (3,315 jobs). The Economic Prosperity Factor of 2.06 shows that the average wage for the Computer and Electronics cluster (\$48,800) is well above the regional average. Real wages increased 15% from 1990 to 1996. The highest paying industry in the cluster is Electronic Computers (\$103,000) followed by Computer Peripheral Equipment, NEC (\$56,700).

The Computer and Electronics Manufacturing cluster is integral to the region's high technology industries. Not only does it provide high value-added job opportunities, the electronic components produced by the cluster are also an integral part in the production process of numerous clusters. Primary supply relationships exist between the Computer and Electronics Manufacturing cluster and the Communications cluster, Defense and Transportation Manufacturing cluster, Biomedical Products cluster, and Software and Computer Services cluster. The Computer and Electronics Manufacturing cluster does not exhibit many demand relationships with other industries. The cluster requires raw materials, such as various metals and plastics, and numerous chemicals for its production process. Another industry that the cluster demands from on a secondary, perhaps tertiary, level is the Electric Services industry.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
3571	Electronic computers	AEM, Inc.
3572	Computer storage devices	Brooktree Corporation
3577	Computer peripheral equipment, NEC	Greco Systems
3629	Electrical industrial apparatus, NEC	Industrial Computer Source
3651	Household audio & video equipment	Moore Printed Circuits, Inc.
3671	Electron tubes	Skyway Magnetics
3672	Printed circuit boards	
3674	Semiconductors and related devices	
3675	Electronic capacitors	
3676	Electronic resistors	
3677	Electronic Coils and Transformers	
3678	Electronic connectors	
3679	Electronic components, NEC	
3695	Magnetic & optical recording media	
3699	Electrical equipment & supplies, NEC	
3825	Instruments to Measure Electricity	
5045	Computers, peripherals and software (Wholesale)	
5065	Electronic parts & equipment, wholesale	

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### **Defense and Transportation Manufacturing Cluster**

The San Diego region's lack of economic diversification took its toll in the late 1980s and early 1990s when defense cutbacks, coupled with a recession, resulted in massive layoffs. The region's defense-based economy had been struck a blow, leaving a significant number of residents who had held high value-added, high paying positions unemployed.

Despite massive defense cutbacks, today's Defense and Transportation Manufacturing cluster continues to be highly concentrated when compared to the rest of the nation. Moreover, many of the firms that had previously focused on military-related goods and services are now exploring consumer, non-military types of products. The expertise and specialties that were once applied to the defense industry are now being used for commercial production in this cluster as well as the Communications cluster, Recreational Goods Manufacturing cluster, and the Software and Computer Services cluster. The region's high technology and manufacturing intensive clusters have all benefited from the sudden availability of a highly skilled workforce.

The Defense and Transportation Manufacturing cluster includes industries engaged in manufacturing or assembling aircraft, ships, boats, and defense related products such as guided missiles. As a result of decreased defense spending, the cluster's focus has shifted away from defense and military related goods to more commercial and high technology products. Computer-aided design (CAD) has reduced production costs and increased efficiency, especially in modern marine construction. Within the cluster, non-defense activities include boat and ship construction, aircraft part manufacturing, and navigation equipment production. Potential collaborations with Mexican firms could be an additional benefit to the local cluster, especially in the assembly stage of the production process.

The Defense and Transportation Manufacturing cluster experienced the largest decrease in employment from 1990 to 1996 than any other regional cluster. Over the six-year period, more than 20,000 jobs were lost. This represents a 52% decrease from a total of 39,114 jobs in 1990 to 18,571 in 1996. Interestingly, the overall number of firms actually increased during this period. The loss of employment is explained by the average firm size dropping from over 300 employees in 1990 to 139 in 1996. Despite the employment decrease, the cluster continues to be highly concentrated in the San Diego region. The Employment Concentration Factor is 2.6 times greater than the national average. Ship Building and Repairing (6,912 jobs) and Aircraft Parts and

Equipment, NEC (4,558 jobs) employ the most people. Real average wages in the cluster (\$43,120) have remained stable and continue to be high with an EPF 1.82 times greater than the regional average. The highest paying industries are Guided Missiles and Space Vehicles (\$87,060) and Aircraft (\$53,120).

The Defense and Transportation Manufacturing cluster continues to play a significant role in the region and maintain many of the same relationships it once had. These relationships have changed and are now more focused towards consumer goods as opposed to defense products. The cluster shows strong, primary demand relationships with the electronic input component industries in the Computer and Electronics Manufacturing cluster. It has secondary demands from the Electric Services, Radio and TV Communications Equipment, and Motor Freight Transport industries. The cluster has primary supply relationships with the water transportation industry and secondary supply relationships with the commercial fishing and air transportation industries. There exists a significant two-way relationship between this cluster and the Communications cluster. The San Diego Regional Technology Alliance is working to assist the cluster.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
3511	Steam Engines and Turbines	Chromalloy San Diego
3721	Aircraft	Loral Conic-Terra Com
3724	Aircraft engines & engine parts	Precision Marine
3728	Aircraft parts and equipment, NEC	Rohr, Inc.
3731	Ship building & repairing	TRW, Inc.
3732	Boat building & repairing	
3761	Guided missiles & space vehicles	
3769	Space vehicle equipment	
3812	Search & navigation equipment	

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### **Entertainment & Amusement Cluster**

The San Diego region's natural resources, proximity to Mexico and Los Angeles, and ideal climate provide a strong competitive advantage to the visitor and entertainment industry. Desert, mountains, wet lands, parks and the Pacific Ocean are all part of the region's natural attributes. The region contains many world class attractions including the San Diego Zoo and San Diego Wild Animal Park, Sea World, and Balboa Park. Between 1965 and 1975, the visitor industry experienced unprecedented growth and the region made significant investment in tourism related infrastructure. The tourism and entertainment industry has continued to grow and it is now estimated that \$4 billion dollars is spent annually in the San Diego region.

The Entertainment and Amusement cluster includes industries engaged in arranging and providing amusement, recreation and entertainment services. The Entertainment and Amusement cluster, combined with the Visitor Industry Services cluster, together are a highly successful tourism industry, bringing new money to the regional economy. The Entertainment and Amusement cluster is a stabilizer, providing entry level and low-skilled employment opportunities. The cluster diversifies the economy and was a primary factor in helping the region through the recession in the early 1990s. The Entertainment and Amusement cluster and the Visitor Industry Services cluster are also becoming more and more specialized over time. One niche industry in particular, Ecotourism, is gaining importance and recently warranted a regional summit meeting to discuss the industry's future. Ecotourism related employment has doubled over the last six years to over 9,000 jobs. It is important to note that the Amusement and Entertainment cluster serves both tourists and local residents. For example, the region contains more than 80 golf courses and hundreds of public and private tennis courts.

The Entertainment and Amusement cluster employs 15,823 people, an increase of 44% in six years. The cluster's Employment Concentration Factor is 1.5 times the national average. The number of establishments has increased from 350 in 1990 to 542 in 1996. The current average firm size is 29 employees. Botanical and Zoological Garden's ECF is 10.88 times greater than the national average and the highest of any cluster industry. The Botanical and Zoological Gardens industry has an average annual employment over 1,800. Other large cluster industries include Amusement and Recreation, NEC (6,657) and Amusement Parks (2,201).

The average wage of the cluster is \$26,997, an Economic Prosperity Factor 1.14 times greater than the regional average. Real average wages have increased 6% since 1990. High paying industries include Sports Clubs,

Managers and Promoters (\$135,751), Radio and TV Broadcasting Stations (\$50,389), and Racing, Including Track Operations (\$31,753). Sports Clubs, Managers and Promoters is the highest paying industry of all the cluster groups.

The Entertainment and Amusement cluster’s primary demand relationship is with the Visitor Industry Services cluster, the backbone of this cluster’s prosperity. The Entertainment and Amusement cluster also has a secondary demand relationship with marketing and multimedia service industries. Aside from these interactions, the inter-industry relationships both within the Entertainment and Amusement cluster and with other non-cluster sectors are mainly single-industry specific. Thus, the industries that comprise the cluster lack internal cohesion. One cluster industry will exhibit a relationship to an outside industry that is not important to any of the other cluster components. For example, the golf course industry has a primary demand relationship with landscape and horticultural maintenance services. None of the other cluster industries share this primary demand relationship. Fortunately, local support organizations provide identity to the cluster and facilitate group consensus. Agencies such as the San Diego Convention and Visitors Bureau (CONVIS) and the North County Convention and Visitors Bureau (North County CONVIS) play an important support role for the cluster.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
4725	Tour operators	
4830	Radio & TV Broadcasting Stations	Del Mar Balloons
7922	Theatrical producers and services	Del Mar Thoroughbred Club
7941	Sports clubs, managers & promoters	Morey Bodyboards
7948	Racing, including tract operations	San Diego Mini Tours
7992	Public Golf Courses	San Diego Wild Animal Park
7996	Amusement parks	Torrey Pines Golf Course
7999	Amusement & recreation, NEC	
8400	Museums, art galleries, botanical, zoological gardens	

Please send comments to the San Diego Regional Technology Alliance at [www.sdrta.org](http://www.sdrta.org).

### **Environmental Technology Cluster**

Water purification, pollution prevention and monitoring, waste disposal site renovation, and waste treatment and storage are all characteristic issues of today's environmental marketplace. As landfills reach capacity, disposal costs escalate, and new storage locations become increasingly more difficult to identify, the development and application of environmental technology will play a greater role in solving environmental challenges. US environmental policy has adjusted to the role technology will play in the future. Where previous policy emphasis was placed on clean-up efforts or "end-of-pipe" solutions, today's policies advocate alternative pollution management methods aimed at discouraging the production of waste such as recycling, source reduction, waste treatment and more reliable and efficient disposal.

Securing a reliable, affordable supply of pure water is mandatory for the well being of a region, both in terms of resident's health as well as business vitality. High technology industries, in particular, demand an ultra-pure source of water for their production processes. Reverse osmosis technology may be the solution to this challenge. Reverse osmosis is an environmental technology used for modern water purification in a wide range of applications including electronic component manufacturing, health care, automated car washes, food processing, municipal drinking water and biotechnology and pharmaceuticals manufacturing. Specific examples of its uses include seawater desalination, self-service drinking water vending machines, printed circuit board de-ionization cleaning, and producing process water for power plants. Local reverse osmosis firms may be small in terms of total employment, but when compared to the nation the San Diego region is dominant in the industry. In fact, the region contains several world leaders in the field.

The Environmental Technology cluster is an emerging cluster of industries that manufacture products with environmental applications. Examples of cluster specializations include: environmental engineering services; laboratory analysis; marine sciences; analytical testing; air and water filtration; environmental construction; and toxic, hazardous and radiological waste disposal and monitoring. It is important to note that one component of the industry, independent environmental research and consulting firms, is not represented in the cluster definition. SANDAG focuses on the manufacturing industry sectors for the cluster definition because of their shared characteristics and strong internal cohesion. However, this focus does not exclude all research establishments since many of the firms classified as manufacturing have research and development departments.

Despite efforts by local industry organizations, there continues to be a general misunderstanding of both the definition and the composition of the Environmental Technology cluster. In addition, it is difficult to fully define the cluster because it transcends many industry definitions and does not yet fit properly into the Standard Industrial Classification (SIC) code system. Much of the complication is due to the emerging status of the cluster. However, even without employment information and SIC difficulties, the Environmental Technology cluster is still relatively small when compared to other cluster industries.

The cluster grew 33% from 1990 to 1996 and presently employs more than 4,100 people. The Employment Concentration Factor for the San Diego region is 1.64 times greater than the national average. There are approximately 109 firms with an average size of 38 employees. General Industrial Machinery, NEC (1,172) and Process Control Instruments (960) are the largest employment industries in the cluster. The average wage for the environmental Technology cluster is \$38,765, an EPF 1.64 times the regional average. Real wages have increased 11% since 1990. The highest paying industries are Analytical Instruments (\$48,910) and Measuring and Controlling Devices, NEC (\$46,500).

The Environmental Technology cluster has a primary supply relationship with numerous healthcare industries such as hospitals and biotechnology laboratories. Products related to hazardous waste disposal as well as purification and air filtration are all in demand. The cluster has a secondary supply relationship with the Defense and Transportation Manufacturing cluster. Military base clean-ups also provide a supply opportunity. Finally, there is a supply relationship with the electric service industry for the Environmental Technology cluster's instruments to measure electricity. The San Diego Regional Technology Alliance is working to assist the cluster. In addition, there are numerous regional support institutions providing industry cohesion, including the headquarters for the California Institute for Environmental Technologies at Scripps Institute of Oceanography. Other examples of support agencies are CONNECT and the Border Environmental Commerce Alliance.

The Environmental Technology cluster has a primary demand on consulting firms, engineering firms, and research and development firms. There is a two-way relationship with numerous electronic component manufacturers. The electronic components are demanded as inputs by the Environmental Technology cluster. The manufacturers of the components, such as printed circuit boards, in turn demand reverse osmosis water filtration systems to obtain the ultra-pure water necessary for their deionization process. In addition, the

expanding electronics industry in northern Baja California has increased its demand for water filtration systems and pure water. The border region also presents water treatment, water quality and hazardous waste management challenges. Lastly, there is a two-way relationship with the Biomedical Products and Biotechnology and Pharmaceuticals clusters.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
3564	Blowers & Fans	Advanced Membrane Technology (AMT), Inc.
3569	General Industrial Machinery, NEC	Desalination Systems, Inc.
3589	Service Industry Machinery, NEC	Fluid Systems Corp
3823	Process Control Instruments	Hydranautics
3824	Fluid Meters & Counting Devices	La Jolla Scientific Co
3826	Analytical Instruments	Rhine Air, Inc.
3829	Measuring & Controlling Devices, NEC	Scripps Institute of Oceanography

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### **Financial Services Cluster**

The Financial Services cluster includes industries engaged primarily in deposit banking, extending credit in the form of loans, and the exchange of securities and commodities. Vital to the growth and economic stature of a region is the support provided by financial institutions. The San Diego region, until recently, had a very strong local financial sector including headquarters of many major banking institutions. However, the loss of these major institutions over the last several years has seriously weakened the regional financial services sector. As a result, local firms are unable to establish relationships and do business directly with local banks for a wide range of important services. This is problematic since a number of high tech firms have expressed concerns about lacking access to venture capital firms. A lack of regional venture capital firms also potentially hinders local knowledge-intensive cluster industries.

The flight of the large financial institutions is reflected in the cluster's employment figures. The Financial Services cluster experienced significant decreases in employment from 1990 to 1996. The loss of more than 5,000 jobs in six years dropped the Financial Services cluster's employment to 10,257 workers in 1996. The cluster is still relatively concentrated though, and has an Employment Concentration Factor 1.23 times greater than the national average. The third and fourth largest employers in 1990 are now the biggest industries in 1996. The Mortgage Bankers and Loan Correspondents industry employs 3,000 workers while Federally Chartered Credit Unions employ 1,580. This cluster's trends are similar to that of the Defense and Transportation Manufacturing cluster. Total employment has decreased but the number of establishments has increased. This is possible because the average number of employees per establishment has decreased from 32 in 1990 to nine in 1996.

The average wage for the Financial Services cluster is \$43,595, an Economic Prosperity Factor 1.84 times greater than the regional average. The highest paying industries are Investment Advice (\$93,100) and Mortgage Banker and Loan Correspondents (\$46,330). Despite the decrease in total employment, real wages in the cluster have increased 23% since 1990.

Industries in the Financial Services cluster rely heavily on one another and have strong demand and supply relationships between themselves. In addition, almost all of the other clusters have a significant relationship

with the Financial Services cluster and, more precisely, the Banking industry. The Financial Services cluster has primary demand relationships with the Software and Computer Services cluster. The cluster shows its strongest supply relationships to industries within its own cluster group (such as Accounting, Auditing and Bookkeeping firms). It also has a secondary supply relationship with the Insurance industry. The Financial Services cluster shows strong two-way relationships with the Business Services cluster and the Real Estate industry. A two-way relationship is one where both industries demand and supply products to and from one another.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
6035	Saving Institutions, Federally chartered	Kearny Mesa Federal Credit Union
6036	Saving institutions, not Federally chartered	La Jolla Bank
6061	Credit unions, Federally chartered	Mariner Financial Services
6062	State credit unions	Pacific Rim Lenders
6140	Personal credit institutions	University & State Employees Credit Union
6162	Mortgage bankers & loan correspondents	
6163	Loan brokers	
6282	Investment advice	

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### **Fruits and Vegetables Cluster**

Production of fruits and vegetables has been an important component of the San Diego region's agricultural industry for over 100 years.<sup>9</sup> The region's first known commercial citrus grove was planted in National City in 1860. Although the early fruit and vegetable crops were located in the southern part of the region, today's fruit production, especially orchard crops, is concentrated in the North County. The San Diego region ranks as the top avocado producer in the country. Other important fruit and vegetable crops include lemons and tomatoes. Tomatoes are the only vegetable crop ranked in the ten most valuable crops produced in the region. The avocado crop is the fourth most valuable in the region and the highest ranked of any fruit or vegetable.

The Fruits and Vegetables cluster acts as a stabilizer, providing low-wage employment opportunities that require a different skill set than many other industries in the region. The cluster includes industries engaged in the production and maintenance of fruit, melons, tree nuts and vegetable crops. Due to the seasonal nature of the industry, employment tends to fluctuate throughout the year. Total annual employment for the cluster (3,493 jobs) has decreased slightly more than 1% from 1990 to 1996. A major factor in the decrease in employment is the result of improved technology and agricultural productivity. The Employment Concentration Factor is 1.83 times greater than the national average. There are approximately 407 firms in the region with an average annual employment of nine people. Annual employment is highest in the Vegetables and Melons (1,640 jobs) and Fruits and Tree Nuts, NEC (863 jobs) industries. Avocado and tomato production is included in those industries.

The Fruits and Vegetables cluster has the second lowest average wage (\$13,314), above only the Visitor Industry Services cluster. The Economic Prosperity Factor of .56 is lower than the regional average of one, although real wages in the cluster have increased 2% since 1990. The highest paying industries are Wood Containers, NEC (\$18,711), Farm Management Services (\$16,507), and Fruits and Tree Nuts, NEC (\$14,497).

The Fruits and Vegetables cluster has primary demand relationships with the paperboard containers and boxes industry and, in particular, with the Sanitary Food Container industry. The cluster has a secondary demand relationship with several greenhouse and nursery products and services industries, many of which are included

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<sup>9</sup> The County of San Diego's Department of Agriculture, Weights, and Measures provided most of the historical and qualitative information for the Fruit and Vegetable and Horticulture cluster sections.

in the Horticulture cluster. It also has secondary demands with transport and warehousing providers. The Fruits and Vegetables cluster has a primary supply relationship with the firms in the Eating and Drinking Establishments industry. The cluster also has a secondary supply relationship to the frozen foods industry. Primary inputs included fertilizer, insecticides and a sufficient supply of freshwater.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
0161	Vegetables and Melons	Bate's Nut Farm
0171	Berry Crops	Lilac Farm Management, Inc.
0172	Grapes	Munemitsu Farms
0174	Citrus Fruits	Sam's Juice Co
0175	Deciduous Tree Fruits	Valley Box Company, Inc.
0179	Fruits & Tree Nuts, NEC	
0762	Farm Management Services	
2033	Canned Fruits and Vegetables	
2449	Wood Containers, NEC	

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### *Horticulture Cluster*

The Horticulture cluster includes industries engaged in the production and maintenance of ornamental plants, nursery crops and food crops grown under cover. Unlike the Fruit and Vegetables cluster, the Horticulture cluster is not as adversely affected by high water and land prices and the temperate climate keeps greenhouse cooling and heating costs low. In terms of value, the Horticulture cluster comprises the majority of the San Diego region's agricultural industry. Four of the region's top ten crops, including the top three, are part of the cluster.

The temperate climate of the region is a large factor in the agricultural industry's success here. The region's level of efficiency, in terms of water use and production, is extremely high when compared to other agricultural areas in California. While the value of agriculture continues to rise, the amount of water used continues to decrease. In addition, the region ranks first in the nation in number of small farms and the value of nursery and greenhouse crops.

The Horticulture cluster has an average annual employment of 6,217 workers, almost two times that of the Fruit and Vegetables cluster. The overall change in employment in the cluster from 1990 to 1996 was fairly stagnant, decreasing 2%. There are approximately 513 establishments in the region, averaging 12 employees each. The Employment Concentration Factor of the cluster is 2.53 times greater than the nation. The industries with the highest employment are Ornamental Nursery Products (4,451 jobs) and General Farms, Primarily Crop (672 jobs).

Average wages in the Horticulture cluster (\$17,478) are also higher than in Fruits and Vegetables. Horticulture crops, in general, have a higher value per acre. The Economic Prosperity Factor of .74 is below the regional average. Real wages have increased 1% since 1990. High paying industries include Landscape Counseling and Planning (\$26,987), Ornamental Shrub and Tree Services (\$20,387), and Food Crops Grown Under Cover (\$17,473).

The Horticulture cluster has primary demand relationships with the Farm Management Services industry (included in the Fruits and Vegetables cluster) and on freight transport and warehousing providers. The cluster

has a primary supply relationship with horticultural product wholesalers. Primary inputs include fertilizer and a sufficient supply of freshwater.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
0181	Ornamental Nursery Products	Flynn Rainbow Nurseries
0182	Food Crops Grown Under Cover	S & M Nursery, Inc.
0191	General Farms, Primarily Crop	De Lorenzo, Inc.
0781	Landscape Counseling and Planning	Nordquist Associates, Inc.
0783	Ornamental Shrub and Tree Services	

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### **Medical Services Cluster**

The Medical Services cluster includes industries primarily offering health services to the general public through hospitals and other such medical facilities. The aging of the US population, health care reform, and the emergence of new markets such as home health care will continue to drive the Medical Services cluster. In addition, pressures for cost containment and high quality service will fuel the demand for increased productivity and integration of new technologies. Increased interaction between the Medical Services cluster and the rest of the local economy generally benefits both parties. For example, hospitals, a core cluster industry, are used as testing sites for many cutting-edge, local biotechnology firms (for product innovations and research).

Implementing new technology is an important way to decrease the Medical Services cluster's cost of doing business. Health care providers realize that better access to patient and financial information is improving patient services and decreasing the costs of doing business. Computer networks, advanced software applications and communications systems are presently being widely implemented. Network systems are designed to increase response times and facilitate the widespread sharing of data (often between facilities in different regions). These automated patient care systems are proven to increase efficiency and demonstrate the interaction between this cluster and the Software and Computer Services cluster.

The Medical Services cluster is the third largest of the San Diego region's clusters, with a total employment of 52,700 jobs. There are over 4,100 establishments averaging 13 employees each. Despite the large overall employment, the Medical Services cluster has a low, overall Employment Concentration Factor of .83. This is primarily a result of the weak ECF of the General Medical and Surgical Hospitals industry (.55). While not highly concentrated, the General Medical and Surgical Hospitals industry is the largest employer (17,740 jobs) in the cluster. The Offices and Clinics of Doctors of Medicine industry is the second largest employer (15,160 jobs) in the cluster.

The Medical Services cluster's average wage (\$36,360) is above the regional average with an Economic Prosperity Factor of 1.54. Real wages in this cluster have decreased 11% since 1990, the largest decline of all the clusters. The highest paying industries are Offices and Clinics of Doctors of Medicine (\$52,150) and Medical and Hospital Equipment (\$41,230).

The Medical Services cluster is has a primary demand relationship with various cluster groups, most importantly, the Software and Computer Services, Biomedical Products, and Biotechnology and Pharmaceuticals clusters. The cluster also has a secondary demand relationship with the waste treatment disposal industry, the Environmental Technology and the Communications clusters. Sophisticated telecommunications can be used to create a medical network capable of globally transferring computerized medical information. Many Medical Services cluster industries require air and water filtration systems and environmental control products. The Medical Services cluster does not supply a great deal of its service to other industries since it is a final goods and services producer. Therefore, it has more demand relationships than supply relationships. The Medical Services cluster also has a two-way relationship with health care related Management and Consulting services. The supply of the Medical Services cluster’s expertise appears to be stronger in this situation than the demand on the Management and Consulting industry.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
5047	Medical and hospital equipment	Children’s Hospital and Health Center
7352	Medical equipment rental	Grossman Dental Laboratory, Inc.
8011	Offices and clinics of doctors of medicine	Innovative Medical Suppliers
8021	Offices and clinics of dentists	Pomerado Hospital
8049	Offices of health practitioners, NEC	Southwood Psychiatric Center
8062	General medical and surgical hospitals	
8063	Psychiatric hospitals	
8069	Specialty hospitals, except psychiatric	
8072	Dental laboratories	
8092	Kidney dialysis centers	
8093	Specialty outpatient facilities, NEC	
8099	Health and allied services, NEC	

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### **Recreational Goods Manufacturing Cluster**

New material advances, many of which originated in the aerospace and defense sectors, are changing nearly every technology and manufacturing industry. One of the clusters that has greatly benefited from these advances is the Recreational Goods Manufacturing cluster. The Recreational Goods Manufacturing cluster includes industries that manufacture recreational goods, sporting and athletic goods, and toys. Due to high performance benefits, new composite materials are becoming more common in goods produced for the golf, tennis, biking, surfing, and scuba diving industries.

Recreational Goods Manufacturing cluster sales are frequently seasonal in nature, often due to lower demand in the retail market during winter months. The market is highly competitive and is served by a number of well-established and well-financed companies with recognized brand names. However, widespread imitation of popular designs is common in the industry. The golf manufacturing industry in particular has displayed phenomenal growth in the 1990s. In fact, the San Diego region now contains the nation's largest manufacturer of golf clubs.

Recreational Goods Manufacturing employment has expanded significantly over the last few years making this cluster the fastest growing of all others in the region. Total cluster employment grew by 107% from 1990 to 1996. There are 223 establishments in the Recreational Goods Manufacturing cluster with an average size of 29 employees. A large portion of the cluster's 6,510 employees work in the golf industry, but many other forms of sporting goods are represented in the total as well. Sporting and Athletic Goods, NEC is the largest industry and the core of the cluster, providing 5,100 jobs regionally.

Not only did the employment growth in Recreational Goods Manufacturing exceed all other clusters, so did the real average wage. The cluster's real average wage increased 42% over the six-year period to \$37,713. The Economic Prosperity Factor is 1.59 times greater than the regional average. Sporting and Recreational Goods, Wholesale had the highest average wage at \$40,098 followed by Sporting and Athletic Goods, NEC at \$36,903.

The Recreational Goods Manufacturing cluster has a primary demand relationship with numerous composite material industries. The materials are the primary inputs in the cluster's production process. The cluster has a secondary supply relationship with Amusement and Recreation Services industries, including golf driving

ranges, tennis clubs, and recreational product rental stores. The increased use of technology in the toy industry places a demand on some electronic component industries such as semiconductors. The San Diego Regional Technology Alliance is working to assist the cluster.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
394	Toys and sporting goods	Aldila, Inc.
5091	Sporting and recreational goods, wholesale	BZ Pro Boards, Inc. Cobra Golf Dynaflite Planet Earth Skateboards, Inc. San Diego Divers Supply, Inc.

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### **Software and Computer Services Cluster**

The Software and Computer Services cluster includes industries that provide services such as computer programming, prepackaged software, and software development. The cluster is relatively young and has only been prominent in the region as an industry sector for approximately 10 years. The cluster began as a support institution to the local defense companies. As more and more workers were displaced because of defense cutbacks, a growing number became entrepreneurs. Many launched their own small software companies leading in part to the expansion of this cluster.

The cluster is still in the early stages of its growth, reflected by the average size of the local firms. Many of these start-up companies continue to employ fewer than 20 people. According to the Software Industry Council, the small firm size is a regional characteristic, differentiating us from other software centers. For example, in Silicon Valley, firms have had 20 to 25 years of growth and are typically larger than the firms in this region. It should be noted that there have been indications that the small-sized firm dominance may gradually be changing in the region.

The Software and Computer Services cluster has grown very quickly and offers the highest wages of all 15 clusters. From 1990 to 1996, cluster employment has grown from 8,804 jobs to 13,640 jobs, an increase of 55%. The total number of establishments (990 firms) has nearly doubled since 1990. The average firm size has decreased over this time period to an average of 14 employees. The largest employment industry, Computer Programming Services, is also the fastest growing and the highest paying with average wages of \$85,570. The Employment Concentration Factor for the San Diego region's Software and Computer Services cluster is 1.29 times greater than the national average. The Economic Prosperity Factor of 2.68 is the highest of all the clusters. In addition, the Software cluster's real average wages have increased 40% over the six-year period. Along with Computer Programming Services, other industries with high average wages are Prepackaged Software (\$58,248) and Computer Related Services, NEC (\$53,208).

The Software and Computer Services cluster is a tightly knit group of industries with high levels of interdependency. The cluster also has numerous ties to other industries and clusters in the region, usually playing the role of supplier. The Software and Computer Services cluster is a major supplier to the Defense and Transportation Manufacturing cluster, the Communications cluster, the Biomedical Products cluster, and the

Electronics Manufacturing cluster. The Software and Computer Services cluster has a primary supply relationship with the banking industry as well as the accounting, auditing and bookkeeping industries. The Communications cluster is also a weak, secondary supplier to the cluster. There are numerous specialized, community-based support groups dedicated to aiding this emerging group including the Software Industry Council, UCSD CONNECT, and the San Diego Regional Technology Alliance.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
7371	Computer programming services	Accel Technologies
7372	Prepackaged software	ImageWare Software, Inc.
7373	Computer integrated systems design	Science Applications International Corporation
7374	Computer processing and data prep. services	Sharper Executive, Inc.
7379	Computer related services, NEC	Template Graphics Software, Inc.
8711	Engineering services (5%)	Visicom Laboratories, Inc.
8731	Commercial physical/biol. research (15%)	

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### **Visitor Industry Services Cluster**

The Visitor Industry Services cluster includes industries, such as Hotels and Motels, which provide services to the entertainment and visitor industry. Primary focus of the cluster is the hotels and other lodging places sector. Having a strong tourism industry was a great asset to the region, in terms of providing employment, during the recession of the early 1990s. It is a stabilizing cluster, adding diversity and entry-level employment opportunities that require a different set of skills than many of the jobs in other clusters. The Visitor Industry Services cluster is similar to the other stabilizer clusters in that it is not comprised of knowledge-based industries.

As discussed in the Entertainment and Amusement cluster section, the San Diego region's natural resources, existing tourism and entertainment infrastructure, proximity to Mexico and Los Angeles, and ideal climate provide a strong comparative advantage for the visitor and entertainment industry. The Visitor Industry Services cluster, combined with tourism related infrastructure, is the backbone of the regional visitor and entertainment industry.

Although the wages in the Visitor Industry Services cluster are the lowest of all the other groups, its employment is the largest. The cluster employs 70,650 people and has an Employment Concentration Factor 1.24 times greater than the nation. The cluster's employment remained stable from 1990 to 1996, and now contains over 3,500 firms averaging 30 employees each. The largest industries are visitor industry related Eating and Drinking Places (43,560 jobs) and Hotels and Motels (22,625 jobs).

The Visitor Industry Services cluster's average wage is the lowest of all cluster groups. The cluster's average wage is \$12,798, an Economic Prosperity Factor (.54) half the regional average. The real average wage has increased 1% since 1990. High paying cluster industries include Passenger Car Rental (\$22,243), Travel Agencies (\$21,847), and Water Transportation Services, NEC (\$21,262).

The Visitor Industry Services cluster's primary supply relationship is with the Entertainment and Amusement cluster. Aside from that interaction, the inter-industry relationships both within the cluster and with other sectors are mainly single industry specific. The Visitor Industry Services cluster, much like the Entertainment and Amusement cluster, lacks cohesiveness. One industry will exhibit a relationship to an outside industry that

is not important to most or all of the other cluster components. Examples include the Passenger Car Rental and the Eating and Drinking Places industries. Rental cars have a primary demand relationship with Automobile Dealers and Service Stations and restaurants have a primary demand for fresh fruits and vegetables. None of the other cluster industries share these primary demand relationships. There are, however, a few exceptions. The cluster has a secondary demand relationship with Electric Services and Automobile Parking and Car Wash services. There is a primary demand relationship with Management and Consulting services. The relevant component of this industry being Hotel and Motel Management services.

<u>SIC</u>	<u>Industry Description</u>	<u>Examples of Regional Firms in the Cluster</u>
4489	Water passenger transportation, NEC	Balboa Travel, Inc.
4499	Water transportation services, NEC	Bay Club Hotel and Marina
4724	Travel Agencies	Campland on the Bay
5800	Eating and Drinking Places (55%)	San Diego Harbor Excursions
7011	Hotels & motels	Tom Ham's Lighthouse Restaurant
7021	Rooming & boarding houses	
7032	Sporting & recreational camps	
7033	Trailer parks and campsites	
7041	Organization hotels & lodging house	
7514	Passenger Car Rental	

Please send comments to the San Diego Regional Technology Alliance at [www.sdrta.org](http://www.sdrta.org).

## **Emerging Cluster Watch List**

The following industries have the potential to become future industrial clusters in the San Diego region. Some of these industries are already included in existing cluster definitions as sub-components, others are not currently in any definition of clusters. If the industries continue to grow and integrate themselves into the local economy, they may be establish their own identities as export-oriented, economic clusters in the region.

### *Emerging Cluster Candidates*

Advanced Materials

Advanced Transportation Technologies

Eco Tourism

Higher Education

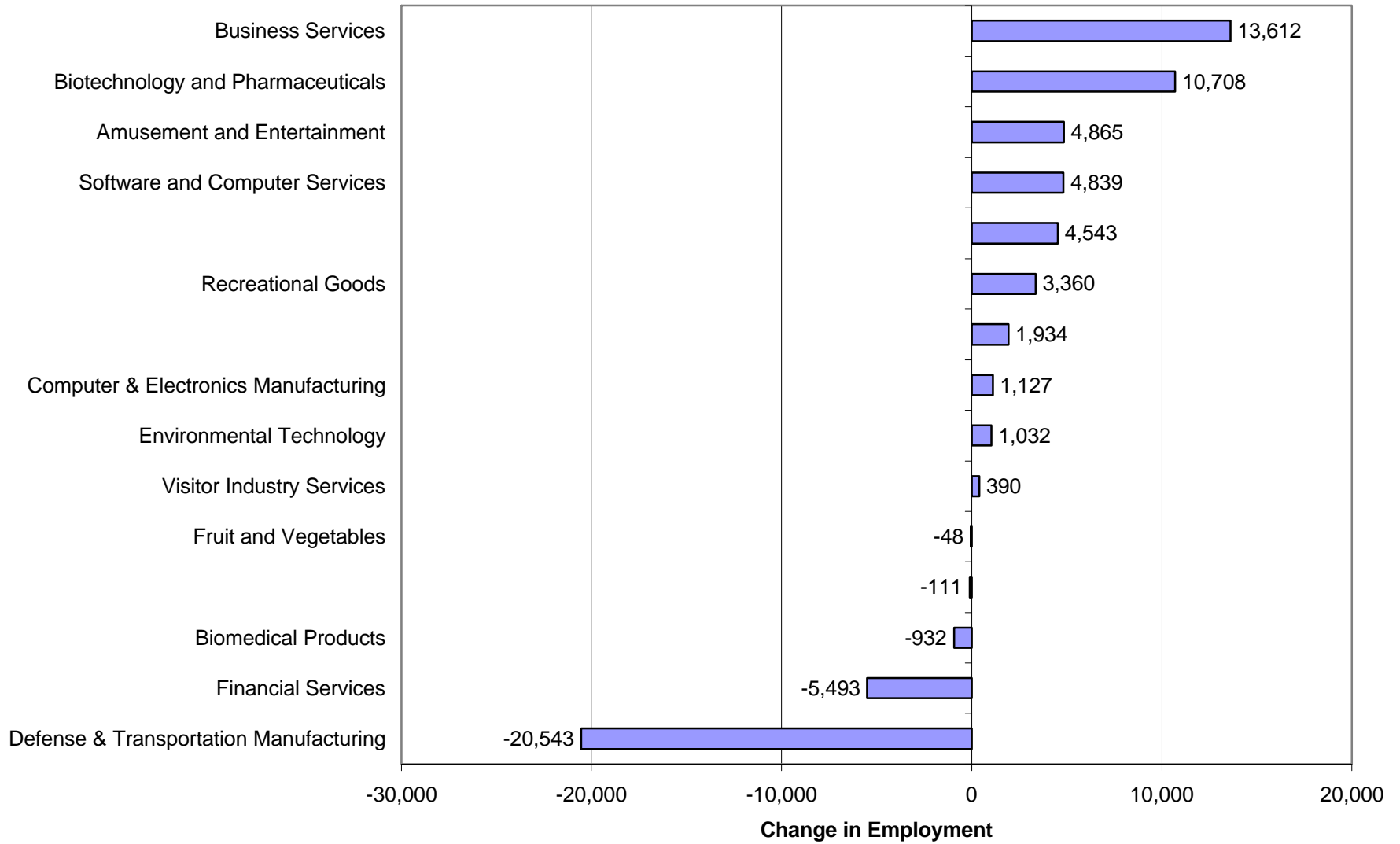
Optics and Lasers

Reverse Osmosis Water Treatment

Please send suggestions to the San Diego Regional Technology Alliance at [www.sdrta.org](http://www.sdrta.org).

<b>Cluster Name</b>	<b>Total Employment 1996</b>	<b>Annual Pay (\$1000)</b>	<b>Average Wage</b>	<b># of Firms</b>	<b>Average Size of Firms</b>	<b>ECF</b>	<b>EPF</b>
<b>Biomedical Products</b>	6,431	253,580	\$39,341	134	48	2.14	1.67
<b>Biotechnology &amp; Pharmaceuticals</b>	21,725	1,066,893	\$49,109	568	38	2.07	2.07
<b>Business Services</b>	61,771	1,860,201	\$30,114	5,497	11	1.15	1.27
<b>Communications</b>	11,433	548,828	\$48,004	273	42	2.30	2.03
<b>Computer &amp; Electronics</b>	27,658	1,349,697	\$48,800	791	35	1.83	2.06
<b>Defense Manufacturing</b>	18,571	800,771	\$43,120	134	139	2.60	1.82
<b>Entertainment &amp; Amusement</b>	15,823	427,179	\$26,997	542	29	1.50	1.14
<b>Environmental Technology</b>	4,154	161,031	\$38,765	109	38	1.64	1.64
<b>Financial Services</b>	10,257	447,158	\$43,695	1,094	9	1.23	1.84
<b>Fruit and Vegetables</b>	3,493	46,505	\$13,314	407	9	1.83	0.56
<b>Horticulture</b>	6,217	108,663	\$17,478	513	12	2.53	0.74
<b>Medical Services</b>	52,691	1,915,839	\$36,360	4,170	13	0.83	1.54
<b>Recreational Goods</b>	6,512	245,584	\$37,713	223	29	4.34	1.59
<b>Software &amp; Computer Services</b>	13,643	866,918	\$63,543	990	14	1.29	2.68
<b>Visitor Industry Services</b>	70,656	1,252,848	\$12,798	3,548	30	1.24	0.54
<i>Total</i>	<i>331,035</i>	<i>11,351,695</i>	<i>\$33,239</i>	<i>18,993</i>	<i>19</i>	<i>1.31</i>	<i>1.4</i>

### Change in Cluster Employment (1990 and 1996)



## San Diego Industrial Cluster Average Wages

