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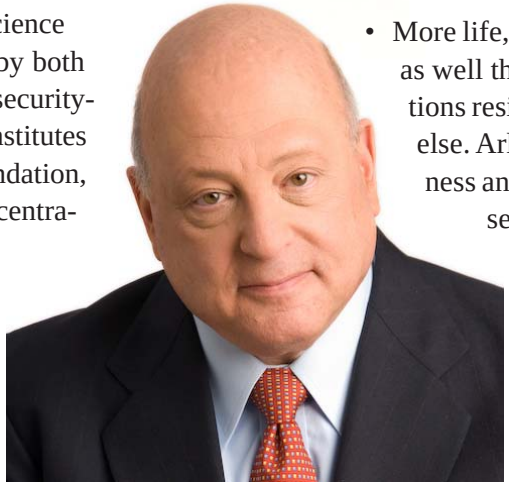
A Snapshot of the Physical and Social Science and Research Industries and Occupations in Arlington, Virginia and the Washington, D.C. Metropolitan Region

The Washington Metropolitan area has a disproportionately high concentration of employment in the physical, engineering and biological research and the social science and humanities research industry sectors. It also has the second highest absolute number of persons employed in life, physical and social science occupations, with the highest median hourly wage among all major metropolitan areas. The region also has the highest educated population, leading the nation in knowledge workers.

Within the Washington Metropolitan area, Arlington, Virginia leads the region on nearly every dimension:

- At the heart of the national science research cluster, represented by both the government defense and security-related extramural research institutes and the National Science Foundation, Arlington has the highest concentration of both private and public physical, engineering and biological research employment in the region, at a rate six times higher than the nation with a location quotient of 6.44.



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- The most concentrated research industry sector in the region is the social science and humanities research cluster. Arlington ranks third in the region, with a concentration in this sector of more than ten times the national average and a location quotient of 10.08.

- More life, physical and social scientists, as well those engaged in legal occupations reside in Arlington than anyplace else. Arlington ranks second in business and financial occupations, second in arts, design, entertainment; and second in sports and media occupations. In addition, Arlington's location quotient for computer and mathematical occupations is 3.50.

- Arlington has the highest educational levels in the region: two-thirds of all adults in Arlington have received a Bachelors degree and some 36 percent have earned an advanced degree.

Introduction

This study provides a snapshot – a one-time view – of the physical, engineering and biological research and the social science and humanities research industry clusters within the Metropolitan Washington region and selected constituent jurisdictions. These two sectors combined employ approximately 50,000 workers, representing the greatest concentration of the highest educated knowledge workers in the regional economy. On the workforce side, the analysis benchmarks the cluster of life, physical, and social science occupations, which overlaps but is not coincident with the two industry clusters. This analysis relies on two concepts common to economic development: cluster analysis and location quotients.

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Clusters represent a concentration of like businesses, those in the same or a related industry, in geographical proximity. Cluster analysis is based on the concept of agglomeration economies: the idea that firms in a business sector gain economic advantages by clustering, thereby attracting other firms in their industry and their supply chain. Specialization induces innovation and all firms within the cluster benefit from knowledge dispersion and intense competition.[1]

The concentration of any industry cluster is typically measured through the location quotient: the ratio of the percentage of employment in that industry within a local market, divided by the percentage of national employment represented by that industry. A local industry that has the same percentage of employment as the entire nation has a location quotient of one (1), indicating that the local economy is not specialized in that industry. A location quotient of four (4) means that the local economy has four times its normal share of employment in the specified industry. In general, location quotients above two represent a noticeable level of specialization.

Any study of the physical, engineering and biological research and the social science and humanities research industry clusters must consider educational attainment. These industries and occupations typically require high levels of education, often advanced degrees. High overall educational attainment levels provide the labor characteristics necessary for the growth of these research-based clusters. Education is also highly correlated with income, and average wage levels within these clusters are well above the overall average. This analysis documents the education and wage levels of the industries and occupations that comprise these target clusters.

Physical, Engineering and Biological Science and Research

The physical, engineering and biological research sector employs some 37,755 persons in the Greater Washington region. This is 3.7 times the concentration of jobs in this industry sector compared to the national average. Arlington has the single highest concentration, if not the highest absolute number of physical, engineering and biological research jobs with a location quotient of 6.44 – nearly 6 ½ times the national average. Remaining jobs are spread throughout the region, with location quotients above

[1] See Michael Porter's (1991) *Competitive Advantage* for a more complete discussion of these concepts.

4.0 found in Washington, D.C., and Montgomery and Fairfax Counties.

The science and research industry sector pays well above average wages: in 2005, the average weekly wage in Arlington for members of the science and research industry was $1,824, with an annual wage of nearly $95,000. Wages within the region ranged from $72,900 in Prince George's County to Arlington's $95,000. The sector's weighted average annual wage was $83,515.

Some specialization within sub-areas of the region is evident. Montgomery County is a known location for life sciences firms including MedImmune, Human Genome Sciences, and Gene Logic. Northern Virginia also has a robust bio-sciences sector; however it is somewhat more focused on sub-regional strengths in bioinformatics and computational sciences. Some of the leading employers include the American Type Culture Collection and the new Howard Hughes Medical Institute.

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Northern Virginia is most strongly characterized by a concentration of defense related employers with research focused on both defense and homeland security. Some of the strongest of these are the non-profit research organizations such as ANSER, and notable defense contractors including Lockheed Martin, Boeing, CACI, SRA, SRI, SAIC and Systems Planning Corporation, all of whom have a significant presence in Arlington.

The economic census from which this data is drawn covers only private and non-profit sector employers and omits the public sector. This creates limitations in the data, as there is a large concentration of scientific research employment represented by the federal extramural research agencies including the Defense Advanced Research Projects Agency (DARPA), the Office of Naval Research (ONR), the Air Force Office of Scientific Research (AFOSR), the National Science Foundation (NSF), and the Homeland Security Advanced Research Projects Agency (HSARPA). These agencies of the federal government have produced applied research such as the internet, stealth technology, and global positioning systems. It is estimated that as many as 15 percent of the 33,000 federal jobs in Arlington are dedicated to physical, engineering or biological research.[2] Many of the 3,265 jobs in this sector reported in the

Table 1: Employment and Wages of Physical, Engineering, and Biological Research Organizations (NAICS Code: 541710)
Washington, DC-MD-VA-WV Metropolitan Area

Area	Total Establishments	Weekly Employment	Location Quotient	Average Weekly Wage ($)
Washington DC-VA-MD-WV MSA	861*	37,755	3.71	NA
District of Columbia	166	9,845	4.92	$1,468
Arlington County, VA	91	3,265	6.44	$1,824
Montgomery County, MD	298	8,539	4.88	$1,531
Fairfax County, VA	184	9,279	4.08	$1,780
Prince George's County, MD	54	1,611	1.51	$1,402
Loudoun County, VA	17	216	0.46	$1,623

*Note: *AED Calculation*
Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2005

[2] See Perrins and Nilsen, *Industry dynamics in the Washington, DC area: has a second job core emerged?* 2006.

Table 2: Selected Federal Agencies and Contractors
Arlington, Virginia - FY1999 - 2003 (August)

Agency	Location	Linkages within Arlington County	Linkages within Same Submarket
DARPA	Virginia Square	18	6
ONR	Ballston	41	9
AFOSR	Ballston	10	1
MDA	Navy Annex	24	15*
NSF	Ballston	7	2

** Crystal City*
Source: Arlington Economic Development

economic census result from contracts or spin-offs of the work conducted by these agencies.

Arlington Economic Development (AED) studied the contract activity of five federal agencies headquartered in Arlington which were believed to be the centers of a research cluster.[3] Based on contract awards over the previous three years, the number of contractors located within Arlington associated with each agency ranged from 7 to 41. For example, there were 18 contracting firms associated with DARPA and 41 contracting firms associated with ONR. Further, many of these firms did not work exclusively for any one agency. This defense-related research cluster proves to be a complex web of public and private inter-relationships.

Academic institutions also represent a group of employers that are not counted by the census. For instance, the Advanced Research Institute operated by Virginia Tech within the Ballston science cluster is comprised of several research centers including the Center for Energy and the Global Environment (CEAGE), Virginia Center for Coal and Energy Research (VCCER), and the World Institute for Disaster Risk Management (DRM). Several additional research centers will be added in the near future.

Arlington is the heart of the national science defense and homeland security research cluster, and has the highest concentration of both private and public physical, engineering and biological research in the region. Although Arlington has only about 10 percent of the region's private employment in this sector, the public assets make this sector much more important than it otherwise would be. Arlington also has the highest concentration of workforce in life, physical and social science occupations.

Social Science and Humanities Research

The most concentrated research industry sector, based on national standards, is social science and humanities research which has a regional location quotient of 9.80. The District and Montgomery County have concentrations more than 20 times the national average. While this sector employs fewer persons than the physical, engineering and biological research sector, it is still significant, providing 12,438 jobs to the region.

Table 3: Employment and Wages of Social Science and Humanities Research Organizations (NAICS Code: 541720)
Washington, DC-MD-VA-WV Metropolitan Area

Area	Establishments	Employment	Location Quotient	Average Weekly Wage ($)
Washington DC-VA-MD-WV MSA	513*	12,438	9.80	NA
District of Columbia	324	5,325	21.28	$1,609
Arlington County, VA	28	638	10.08	$1,601
Montgomery County, MD	37	4,414	20.18	$1,043
Fairfax County, VA	29	345	1.21	$1,572
Prince George's County, MD	20	583	4.19	$1,056
Loudoun County, VA	10	66	1.12	$1,189

*Note: *AED Calculation*
Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2005

[3] See *The Federal Presence in the Urban Village: The Economic Impact of Federal Facilities in Arlington, Virginia*; 2003.
http://www.arlingtonvirginiausa.com/docs/federalpresence.pdf

Jobs in the social sciences and humanities research sector are also relatively highly paid. In Arlington and Washington, D.C., the average annual wage in 2005 exceeded $83,000. The overall weighted average annual wage for the region was $69,552.

The social science and humanities research sector employs approximately 4,400 persons in Arlington – about one-fourth of those within the region. The location quotient for Arlington is 10.08, indicating that the sector size is about ten times the national average, a very high concentration. Examples of local firms in this sector include RAND and Claritas.

Occupations

The Washington Metropolitan area has a higher concentration of occupations in the life, physical, and social sciences than any other major metropolitan area.[4] These occupations are more than 2 ½ times as prevalent in Washington as the nation as a whole, and a full location quotient point above that of the second highest metro, Boston. Some 65,600 persons are employed in life, physical, and social sciences occupations in the Washington region, second only to New York, a much larger region which includes the Northern New Jersey pharmaceutical industry cluster. In addition, the median hourly wage of these occupations was much higher in the Washington Metropolitan area. In 2005, the median hourly wage was $36.13, 25.6 percent above Boston's median wage of $28.77, which was ranked second highest.

The life, physical, and social science occupations represent a significant level of specialization within the Washington region. Their greatest concentration, by place of residence, is in Montgomery County, Maryland where their location quotient is 4.58. This largely represents residents located near the bioscience cluster centered on the National Institutes of Health. The second highest concentration of scientists is in Arlington, where their location quotient is 3.53 and where the research focus is on defense and homeland security.

Table 4: Concentration of Life, Physical, and Social Science Occupations Top Ten Metropolitan Areas in the United States

Metropolitan Areas	Employment	Location Quotient	Average Hourly Wage ($)
Washington-Arlington-Alexandria, DC-VA-MD-WV	65,600	2.59	$36.13
Boston-Cambridge-Quincy, MA-NH	34,860	1.59	$28.77
Philadelphia-Camden-Wilmington, PA-NJ-DE	32,380	1.32	$25.77
Houston-Baytown-Sugar Land, TX	24,340	1.17	$26.52
New York-Northern New Jersey-Long Island, NY-NJ-PA	82,270	1.11	$27.64
Chicago-Naperville-Joliet, IL-IN-WI	34,950	0.88	$24.95
Los Angeles-Long Beach-Santa Ana, CA	41,280	0.82	$27.79
Dallas-Fort Worth-Arlington, TX	17,030	0.69	$21.63
Miami-Fort Lauderdale-Miami Beach, FL	13,100	0.63	$23.38
Detroit-Warren-Livonia, MI	10,180	0.56	$26.14
National Total	1,185,730	1.00	$24.78

Source: Bureau of Labor Statistics May 2005 Metropolitan Area Occupational Employment and Wage Estimates

Only computer, mathematical occupations and legal occupations have a higher regional concentration than the life, physical, and social sciences as represented by location quotients – 2.88 and 2.79 respectively. Computer scientists and mathematicians are centered in Northern Virginia in Loudoun, Fairfax and Arlington Counties which all have concentrations above 3.5. Those in the legal occupations are clustered in the center city and inner suburbs. Arlington has the highest occupational concentration with a location quotient of 7.15 followed by Washington, D.C. at 5.89, and Alexandria at 5.40. The

[4] The occupational data referred to here include workers in both NAICS classes described above as well as those working in these occupations that may be employed by firms with another primary NAICS designation. The Metro area totals include more jurisdictions than selected for this study, therefore, the numbers of employees noted in various tables may differ.

[5] See *Fostering Emerging Technology Sectors in Arlington, Virginia:*

Table 5: Location Quotient by Occupation
Washington, DC-MD-VA-WV Metropolitan Area

Occupations	Arlington County	District of Columbia	Fairfax County	Loudoun County	Prince William County	Alexandria City	Montgomery County	Prince George's County	Washington, DC-MD-VA-WV PMSA
Management occupations	1.76	1.34	1.79	1.91	1.32	1.76	1.56	1.01	1.42
Business and financial operations occupations	2.25	1.69	2.07	1.87	1.54	2.02	1.76	1.54	1.70
Computer and mathematical occupations	3.50	1.84	4.08	4.17	2.99	3.21	2.99	2.35	2.88
Architecture and engineering occupations	1.02	0.64	1.44	1.78	1.26	1.13	1.34	0.82	1.19
Life, physical, and social science occupations	3.53	3.34	2.07	1.24	0.79	2.49	4.58	1.40	2.37
Community and social services occupations	0.79	1.48	0.81	0.59	0.81	0.99	1.09	1.22	0.99
Legal occupations	7.15	5.89	2.82	1.23	1.03	5.40	3.53	1.35	2.79
Education, training, and library occupations	0.98	1.06	0.98	0.89	0.88	0.82	1.17	0.96	1.01
Arts, design, entertainment, sports, and media occupations	2.95	3.10	1.69	1.33	0.98	2.67	1.92	0.96	1.65
Healthcare practitioners and technical occupations	0.54	0.61	0.77	0.70	0.72	0.62	1.21	0.92	0.84

Source: U.S. Census, 2000

legal industry itself is heavily clustered in the District; Arlington's location quotient for legal services is 1.76 compared to D.C.'s 8.06 - it is the workforce, not the industry, that is dispersed.

Arlington is also home to the highest concentration of business and finance workers in the region. The Washington area has a location quotient of 1.70 for these occupations; Arlington's location quotient is 2.25 – significantly above the national level. Arlington also has a relatively high concentration of residents working in arts, design, entertainment, sports, and media occupations – a location quotient of 2.95. All of these are knowledge worker or creative class jobs that link heavily to education.

Educational Attainment

The Washington Metropolitan area has the highest level of educational attainment of any major metro area in the nation: some 46 percent of all adults in the region have at least a Bachelors degree, while 21 percent have an advanced degree beyond the Bachelors level. Within the Washington region, Arlington has the highest educational levels: two-thirds of the adults have received a Bachelors degree and some 36 percent have earned an advanced degree. This level of educational attainment is higher than many well-known as university centers such as Boston, San Francisco and Austin.

Table 6: Percentage of the Adult Population Holding Advanced Degrees
Top Ten Metropolitan Areas in the United States

Rank	Metro Area	Total: BA and Above	Total: Advanced Degrees
1	Washington-Arlington-Alexandria, DC-VA-MD-WV	45.9%	21.4%
2	San Jose-Sunnyvale-Santa Clara, CA	43.8%	18.3%
3	San Francisco-Oakland-Fremont , CA	43.2%	16.6%
4	Boston-Cambridge-Quincy , MA - NH	40.6%	17.8%
5	Austin-Round Rock, TX	39.1%	13.0%
6	Minneapolis-St. Paul- Bloomington, MN-WI	37.0%	11.7%
7	Denver - Aurora, CO	36.8%	12.8%
8	Seattle-Tacoma-Bellevue , WA	35.8%	12.3%
9	New York-Northern New Jersey-Long Island, NY-NJ-PA	34.9%	14.2%
10	Atlanta-Sandy Springs-Marietta, GA	34.3%	11.6%

Source: U.S. Census, 2005

The high incidence of knowledge workers in the Washington area is a result of the exceptional educational levels of the population.

Throughout the region, education levels are nearly uniformly high, with 25 percent or more of the population holding an advanced degrees in Montgomery, Fairfax, and the District as well as Arlington. Many professions require advanced degrees, especially the sciences, and the Washington region is able to support these scientific research industries because of the educated workforce.

Table 7: Percentage of the Adult Population Holding Bechelors and Advanced Degrees Washington, DC-MD-VA-WV Metropolitan Area

Rank	County	Bachelors Degree and Above	Advanced Degrees
1	Arlington County, VA	66.4%	35.9%
2	Montgomery County, MD	56.3%	29.7%
3	Fairfax County, VA	58.5%	27.3%
4	District of Columbia	45.3%	25.2%
5	Loudoun County, VA	55.7%	18.6%
6	Prince George's County, MD	29.2%	12.1%

Source: U.S. Census, 2005

Conclusion

A "perfect storm" of industry, occupational and educational characteristics, compounded by a greater than average sized cohort of 24 to 34 year olds and extraordinary levels of population mobility, has provided the conditions for the growth of Washington's physical, engineering and biological research and social science and humanities research industry clusters. Arlington has developed a substantial competitive advantage within the Washington region in these sectors. The unique combination of private, public and academic resources currently existing and potentially available was first articulated in AED's Emerging Technologies study conducted in 2004.[5] That study was augmented by an analysis of the creative class in Arlington, "Benchmarking the Creative Class in Arlington", which compared Arlington's extraordinary creative class population to the rest of the Washington, D.C. region, in 2005.[6] This current snapshot of the physical, engineering and biological research and the social science and humanities research industry clusters offers further evidence of Arlington's unique position within the region. When combined, these three studies document Arlington's competitive position and can serve as the basis for developing effective strategies for economic sustainability in the long term.

This study was prepared by Terry Holzheimer, Ph.D., Director and Isabelle Xu, Regional Economist, of Arlington Economic Development.

An Economic Development Strategy for Knowledge Creation and Innovation, 2004. http://www.arlingtonvirginiausa.com/docs/EmergingTech_full.pdf

[6] See *Benchmarking the Creative Class in Arlington, VA*, 2005. http://www.arlingtonvirginiausa.com/docs/creativeclass.pdf