Northern Virginia versus Greater Boston: Closed versus Open Business Systems in High-tech Clusters

Michael H. Best
Working paper
2009

This paper has two parts. The first is a review of Paul Cerruzzi's study of the postwar emergence and development of the high-tech cluster of Northern Virginia to a roughly comparable size to Greater Boston.[1] The second is constituted by a set of self-explanatory tables that apply vTHREAD to draw implications for industrial innovation of two different regional business models and business/government institutional systems.

Until World War Two, Washington DC was a town without industry. The *Washington Post* was the national capitol's largest private employer. Dairy farming was the major sector in the adjacent counties of northern Virginia. Fast forward to the year 2000 and northern Virginia had become the third largest high tech region in the United States. Washington's 426,000 high tech jobs trumped every region in the United States except Silicon Valley's 629,000 and Boston's 526,000 and dwarfed Seattle's 234,000 (Ceruzzi: 15). Two-thirds of Washington's total were in the Virginia suburbs, more precisely along a corridor stretching from the Pentagon via Tysons Corner west to Dulles International Airport.

The growth in employment numbers are not in doubt. But how did it come about? What are the industries and companies that have come to populate the regional economy? Why did the particular industries emerge when they did and grow to employ nearly half a million high tech professionals? In contrast to Silicon Valley and Boston's Route 128, the industrial transformation and growth is an untold story. No longer. Paul Ceruzzi's *Internet Alley: High Technology in Tysons Corner, 1945-2005* fills the void.

Read as a contribution to the comparative research on regional high tech systems the book is highly informative. It offers an account of the wartime origins of America's unique national research management system that profoundly changed the relationship between business and science in postwar America and which is all too often obscured in the regional innovation system literature. A study of high tech in Northern Virginia cannot ignore the 'management' role of the federal government in the nation's research system and in the creation of America's high tech industries.

However, the book is frustrating. The author's stated claim, as suggested by the title, is to offer an account of the internet industry and how it came to be concentrated in Northern Virginia and in the process transformed the region's business system into an innovative regional system like that of Silicon Valley and Boston's Route 128. This claim is not convincing. This is unfortunate as it takes away from the important contributions the book makes both to the unique aspects of

[1] Paul Ceruzzi (2008), *Internet Alley: High Technology in Tysons Corner, 1945-2005*, Cambridge: MIT Press. A version without the tables was published in Business History, Vol. 53, No. 6, October 2011.

Northern Virginia' business system and, indirectly, to the creation of a national science and technology infrastructure that has been central to American leadership in high tech industries and their development in America's innovative high tech industrial districts. I start with the contributions.

Ceruzzi traces the origins of the northern Virginia's high tech industrialization to World War Two and the creation of a technologically advanced weapons industry. Its success inspired the 'golden age of science' in America including the transformation of the nation's research system.

Ceruzzi's key input is an historical account of the creation of an internationally unique three-way, inter-organizational relationships among government, science and business during World War Two that, in turn, established the operational capacity and institutional foundations of America's postwar science and technology infrastructure. Here Ceruzzi is particularly interesting. The story of the embrace of science for strategic military purposes leads straight to Vannevar Bush hailed by *Time* magazine as the 'man who won the war'. Dubbed the 'Engineer of the American Century', Bush's biographer provides an account of how Bush used his position as a leader of the scientific community and his connection with a relative of President Roosevelt's in investment banking to meet with and gain the confidence of the President (Zachary 1999).[2] Bush saw the President as a means of doing an end-run around the military establishment to put himself in charge of science-based weapon systems research and development. The President was easy to convince.

In May 1941, President Roosevelt approved the creation of the Office of Scientific Research and Development (OSRD), composed of scientists, with Bush as chairman. This gave Bush the governmental authority to fund research to design, develop and produce weapons outside the military command structure (Zachary 1999: 129).

Bush's organizational vision was uniquely decentralized. Whereas the German concept was to employ scientists within the military and to make industry subservient to state directives, Bush's concept was to establish a mission-driven agency within the government to administer a three-way partnership amongst the scientific community, industry, and the government subject to the necessary condition that the terms of the partnership respected and leveraged the autonomy and distinctive roles of each.

The revolutionary character of the government's relations with the scientific community were captured in the words of James Conant, President of Harvard University and a member of the OSRD Committee: "I shall never forget my surprise at hearing about this revolutionary scheme…Scientists were to be mobilized for the defense effort in their own laboratories. A man who we of the committee thought could do a job was going to be asked to be the chief investigator; he would assemble a staff in his own laboratory if possible; he would make progress reports to our committee through a mall organization of part-time advisers and full-time staff" (Conant 1970: 236, quoted in Zachary 1999: 115). See also Etzkowitz (2002: ch. 4).

[2]Vannevar Bush, for Ceruzzi, was "…the engineer of Tysons Corner as well" (p21). In this Bush is to northern Virginia what Frederick Termin, Bush's student at MIT, was to Silicon Valley.

Put directly and perhaps crudely, the nation's federal research system (its science and technology infrastructure) is managed from northern Virginia: "The region is… home to institutions serving the management of research, engineering, and military activities…these entities dealing with management are heavily concentrated in Virginia, where their presence gives Tysons Corner its unique character" (p16). Consequently, the origins of Northern Virginia's high-tech economy and the driver of its growth are found in the region's *research management* capability.

Strikingly, the region's enterprises do not engage in production. They specialize in research management and paper. In Ceruzzi's words: "The military's weapons are built and tested elsewhere; the Pentagon's principal product is paper (or its modern equivalent PowerPoint slides)" (p17).

It is this public management on the nation's research capability that is the basis for Ceruzzi's claim that "…a dynamic, technology-driven local economy" can be based on "contracts from government bureaucrats". Ceruzzi would be right if he were describing Greater Boston or Silicon Valley. This infrastructure was and remains an integral element in the American System of High Tech as exemplified by open-system business models of Silicon Valley and Route 128. But it does not describe the closed business system of Northern Virginia.

Greater Boston and SV's advantage was the earlier transition to an "open-systems" business model which could drive the creation and growth of new companies and spawn new sectors. These were the beginnings of a new business system and a bottom-up, sectoral transition model of industrial innovation. A large population of high tech companies established the scale needed to interact with the emerging "third-mission" science-led university such as MIT and Stanford. The national system of innovation was largely funded by the Pentagon and the federally funded but independently managed research labs.

An entirely different business system and institutional complex was built in Washington. The region lacked an MIT or Stanford type of research intensive university that could become a partner with both industry in fostering industrial change and industry could become a partner with government in the design, development, and production of advanced weapon systems. Lacking both production engineering capabilities and a research intensive university, the economic structure of Washington's high tech industry lacked the industrial innovation capabilities of the other regions. What emerged, instead of an open-system business model, was a contractor or government business form of business organization with little commercial involvement.

While the companies that populate northern Virginia many are high-tech in terms of systems engineering and operations research, the companies in both major industries (defense and IT) in Greater Washington could not be more different in another way. They operate within a 'top-secret' environment that is not conducive to openness. They are organized for a single purpose: acquisition of government contracts. Many have only one customer and are notoriously weak in marketing. Most have government officers, usually retired, on their Boards.[3] While this is doubly

[3] In a 2008 report titled "Post-Government Employment of Former DoD Officials Needs Greater Transparency," the Government Accounting Office found that thousands of senior Pentagon officials take refuge in the corporate world.

true of the military technology companies doing classified, weapon-systems design and development, it is also a characteristic of the IT service providers, which remain the second largest industrial concentration in the region.

Ceruzzi describes many of these companies and what they do. He does not disguise the "iron triangle" of military, industry, and politics in which the region's firms operate. He references the intimate relations not only between companies and government departments, particularly the Pentagon, but the behind the scenes complex of company and industry lobbyists, lawyers, politicians, civil servants, and government contracts. He leaves the murky details to others.

The problem with the book is this: Ceruzzi's major claim is that Northern Virginia's business system has undergone not one but two transformations both of which are traced to the military's institutionalized embrace of scientific research which began during World War Two. The second transformation, captured by the title to the book, was the emergence and rapid growth of "Internet Alley" triggered by the government's act of allowing commercial access to the Internet in 1992 after which Northern Virginia became the 'world center for the management and operation of the Internet" (p3). His major claim is that the Pentagon-inspired invention of ARPANET, the predecessor to the Internet, fostered a new business system in northern Virginia much like mission-driven innovations in computer-related technologies had done in Boston and semiconductor-related technologies in Silicon Valley. With this, Ceruzzi claims the region took on the "kind of dynamism" of the high-tech regions of Silicon Valley, Boston's Route 128, and the Dallas-Fort Worth Metroplex.

Tysons Corner is mid-point in the 30 mile corridor between the Pentagon and Dulles Airport. The eastern section is populated by government contractors. The western section from Tysons Corner to Dulles Airport is where commercially-oriented companies, venture capital and Wall Street funding came into play to create a new, post military-industrial complex business system. "If this region is less dynamic and prosperous than Silicon Valley, it cannot be far behind" (Ceruzzi: 15). The term Techtopia was coined by real estate agents to encompass both sections (p3).

Ceruzzi was not alone in making this claim. The pace at which the values of area companies skyrocketed following the IPO of Netscape in 1995 and the Telecommunications Act of 1996 gave the appearance of the emergence of population of entrepreneurial, technology developing, commercially-oriented companies. It was short-lived. Suddenly and without warning the dotcom bubble burst for Internet Alley. Perhaps no regional sector has generated so much Wall Street funding and media buzz so fast and crashed as rapidly. In 2001, companies that had been worth billions the year before were bust. NASDAQ crashed from its 2000 high of over 5000 to less than 1500 in 2003. The decision by AOL, the homegrown company that exemplified Internet

---

In fact, of the almost 2,500 former Pentagon officials analyzed, almost two thirds of them went on to senior positions at just seven companies – SAIC, Northrop Grumman, Booz Allen Hamilton, L-3 Communications, Lockheed Martin, General Dynamics and Raytheon. Except for the consulting firm Booz Allen, all seven are on the Pentagon's list of top ten contractors. Together, they received more than $87 billion in contracts from the DoD in 2007 (GAO, May 2008).

Alley, to move its headquarters to New York City was described as the 'AOL exodus effect'. Remarkably, Ceruzzi tells this story as well.

But, as noted, the book's content and the title do not match. By Ceruzzi's own facts, organized differently, Internet Alley was a brief interlude between the end of the Cold War and September 11, 2001. The boundary between the two sub-regions on either side of Tysons Corner no longer separated the private-commercial from the government-contractor business systems. The commercial telecommunications business units were either gone or no-longer headquartered in the region.

Strikingly, the region's high tech employment and economic fortunes were largely immune to the dotcom bubble burst of 2000 and the rash of area bankruptcies that decimated "Internet Alley". The terrorist attack on September 11, 2001, altered the region's business environment profoundly. The crash of the venture-capital driven economy was more than compensated by a dramatic increase in federal spending. The wars in Iraq and Afghanistan combined with homeland security programs and the outsourcing of the Pentagon's workforce reinvigorated and expanded the government-business sector. [4] The old government-contractor economy was reinvigorated.

The book offers less as a study of the Internet industry than of the regional specialization impacts on business organization of the establishment of a federally funded but privately administered science and technology infrastructure. Here the book makes a valuable contribution to a neglected area of research: the interplay between the postwar science and technology infrastructure and business organization.

The book makes a second major contribution: Many of the tenants in the endless and anonymous office blocks along Dulles Corridor in Northern Virginia are filled with "…tenants [that] did not want anyone to know who they were or where they were located" (p74). The author does an extraordinary job of casting light on this dark corner of American business where public scrutiny is shielded by 'classified research', the companies that inhabit it, how they came to do what they do and where they do it. Perhaps this explains the strange title.

References:

Conant, J. (1970), *My Several Lives: Memoirs of a Social Inventor*, New York: Harper & Row.

Etzkowitz, H. (2002), *MIT and the Rise of Entrepreneurial Science*, New York: Routledge.

Zachary G. (1999), *Endless Frontier: Vannevar Bush, Engineer of the American Century* (Cambridge: MIT Press).

[4] Following the 2001 terrorist attacks the proportion of private contractors grew to 39% of the Pentagon's workforce. In addition 291,000 metropolitan Washington jobs were estimated to be tied to Pentagon contracting in 2009 (see Dana Hedgpeth, *Washington Post*, April 7, 2009).

Table 1. High-tech Business Units in Virginia and Massachusetts 2000: Enterprise Location Quotients by Sector

	High tech business units in Virginia and Massachusetts 2000:										
		enterprise location quotients by sector									
		Virginia	MA		VA	MA		Virginia	MA		
		Units	Units		ELQ	ELQ	ELQ ratio	ELQ	ELQ	ELQ ratio	
	AUT	70	343		0.5	2.9	6	0.53	2.94	5.5	
	BIO	29	157		0.7	4.3	6	0.7	4.29	6.1	
	CHE	23	95		0.5	2.4	5	0.51	2.37	4.6	
	COM	280	470		1.7	3.2	2	1.71	3.24	1.9	
	DEF	101	58		4.8	3.1	one-half	4.83	3.12	0.6	
	ENR	45	103		0.8	2.1	3	0.83	2.14	2.6	
	ENV	80	210		1	3.1	3	1.04	3.09	3	
	MAN	124	443		0.9	3.5	4	0.87	3.5	4	
	MAT	47	159		0.6	2.5	4	0.65	2.5	3.8	
	MED	25	253		0.4	4.2	12	0.36	4.19	11.6	
	PHA	19	95		0.6	3.8	6	0.64	3.75	5.9	
	PHO	39	239		0.7	4.8	7	0.69	4.82	7	
	SOF	444	1080		1.5	4	3	1.46	4	2.7	
	SUB	84	505		0.4	3	7	0.45	3.05	6.8	
	TAM	81	376		0.7	3.5	5	0.66	3.47	5.3	
	TEL	554	944		1.8	3.4	2	1.75	3.35	1.9	
	TRN	52	88		1.3	2.6	2	1.34	2.57	1.9	
		2097	5618								
Companies		1188	3576		0.9	3.1	3	0.94	3.18	3.4	
Population 2002		7187734	6379304								
Companies in US 2000								50162			
vTHREAD for year 2000, based on CorpTech historical series											

Table 2. Innovation Indicators

Innovation Indicators									
	Boston		**Washington**		**Silicon Valley**				
High Tech Employment	526,000	*Second*	426,000	*Third*	629,000	*First*			
	MA		**VA**		**CA**				**US**
Per capita Fed R&D (2004)	$827	*Second*	$829	*First*	$503				$337
Gross R&D GSP (2003)	5.26	*First*	2.49		4.15	*Second*			2.68
Corp. R&D per $1000 sales (2005)	$82	*First*	$3		$78	*Second*			
Venture Capital (2004)	$2,847M	*Second*	$265M		$10,270M	*First*			
Patents per capita 2003-2005	59	*First*	15		59	*First=*			31
Ave. growth of Manu. Xs 2001-2005	6	*First*	1.2		2.3	*Second*			5
SBIR awards per 100,000 people (2005)	12	*First*	5	*Second*	3				

Source: Index of the Massachusetts Economy, Massachusetts Technology Collaborative, John Adams Innovation Institute, 2006 and 2007.

Table 3. Deloitte Fast Growing High Tech Companies by Sector and Region, 2002-2006

	Virginia	Maryland	MA	SV	LA	San Diego
Biotech/Pharmaceutical		4	10	8	1	4
Communications/Networking	3	5	6	12	3	4
Computers/Peripherals				1	3	2
Internet	1	1	4	12	9	
Media/Entertainment			1	2	2	
Medical Equipment			5	7	5	2
Sci/Tech Instrumentation	1		4	5	3	2
Semiconductor			1	14	3	
Software	19	8	11	8	7	3
Total companies	24	18	42	69	36	17
Total sales ($billion)	1.2	0.8	6.4	47.9	4.6	1.9

Source: Compiled from 2007 Deloitte Technology Fast 500 covering the 2002-2006 period.

Table 4. Illustration of CorpTech company data for 2005 in vTHREAD database for Virginia used to derive comparative ELQs with Massachusetts for Table 1 above

Company Name	Employee	Year Form	Goveri	Sales -	Industr	Primary SI	Products - Major Codes	Products -	City	Description 1-255	De	Parent Name	Zip	Type of O	Source of
Agent Logic, Inc.	12	1999	S	1.9	SOF	7372	SOF-UT	7372	Arlington	Developer of Enterprise Agent Server(tm) (EAS) sof		real-time alerts, infc	22209-212	PR	P V
AgilQuest Corporation	25	1994	P S	5	SOF	7372	SOF-OA SOF-SR TEL-IF	7372 7375	Richmond	Developer and provider of software that allows mol		organizations the ab	23236-142	PR	V C
Amazing Media, Inc.	13	1998		2.8	SOF	7375	SOF-SM TEL-IF TEL-IZ	7372 7375	Herndon	Developer and provider of Advarian(tm), proprietar		advertisers, publish	20171-340	PR	V
American Systems Corp. / App	850	1999	S	105.7	TEL	8742	MAN-SV TEL-SV	8711 8742	Chantilly	Provider of T-3 consulting services, systems engineerin		American Systen	20151-227	PRu	V
Anystream, Inc.	50	2000		8.2	SOF	7372	SOF-ME SOF-UT	7372	Sterling	Developer of software for automating the productic		a scalable platform t	20164-556	PR	V
Approva Corporation	95	2002		5	SOF	7372	SOF-AI	7372	Vienna	Developer and provider of enterprise controls mani		financial executives	22182-398	PR	V
Arc Second, Inc.	15	1990	P	2.6	AUT	3829	AUT-ME SOF-TS TAM-ME	3545 7372	Dulles	Manufacturer of laser-based position measurement		industrial measuren	20166-954	PR	P V
Astron Wireless Technologies	22	1979	P S	5	TEL	3663	DEF-CC DEF-SV TEL-SV TEL-TR	3812 8700	Sterling	Manufacturer of wireless and cellular phone antenr		antennae. Company	20164-444	PR	P V
BearingPoint, Inc.	15,500	1997		1554	SOF	7375	SOF-SV TEL-IZ TEL-SV ZZZ-HC	7379 7371	Mc Lean	Provider of business consulting and systems integra		value-added compu	22102-483	PU	V
BenefitNation, Inc.	149	1998			TEL	7375	TEL-IF	7375	Sterling	Provider of online software and business solutions. Prc		Bertelsmann AG	20166-850	FOu	V
Biotage, Inc.	135	1989		17.4	BIO	3826	BIO-EQ TAM-SC	3826	Charlottes	Manufacturer of chromatography equipment, including		Pyrosequencing	22911-584	FOu	P V
Biotraces, Inc.	14	1990			TAM	3820	TAM-DE	3820	Herndon	Researcher and developer of multiphoton instrume		capitalized by privat	20171-329	PR	P V
Biovista, Inc.	7	1996		1	TEL	7375	COM-SV TEL-IA TEL-IF	7374 7375	Charlottes	Provider of online biotechnology industry informati		are sold to the biote	22902-822	PR	P V
BIZNET Internet Services, Inc.		1995			TEL	7375	SOF-OA TEL-IF TEL-IW	7372 7375	Richmond	Provider of web page design and graphic develop		industries. This com	23228-203	PR	V
BNX Systems Corp.	66	1997		6.7	SOF	7372	SOF-UT	7372	Vienna	Developer of identity management solutions for ce		platform. Products a	22182-400	PR	V
BuyerFactory	18	2000		2.5	TEL	4813	TEL-IM TEL-IZ	4813 8742	Arlington	Provider of e-mail services including list creation, camp		Pantheon Softwa	22201-251	PRu	V
Cgi-Ams	5,117	1970	P S	961.6	SOF	7372	COM-SV SOF-AC SOF-BA SOF-E	7373 7372	Fairfax	Developer and provider of web-based software app		cor CGI Group, Inc.	22033-286	PUu	V C
comScore Networks, Inc.	200	1999		25	TEL	7375	SOF-UT TEL-IF TEL-IZ TEL-SV	7372 7375	Reston	Developer and provider of a web-based Internet au		global Internet user	20190-523	PR	V
Comtex News Network, Inc.	20	1981		9.3	COM	7375	COM-SV	7375	Alexandri	Provider of real-time news and content services use		capitalized by privat	22314-193	PU	P V
Convera Corp.	214	1980		29.3	SOF	7372	SOF-UT	7372	Vienna	Developer of search and categorization software cal		venture capital.	22182-390	PU	P V
Current Analysis, Inc.	65	1997		15	TEL	7375	SOF-AI TEL-IA TEL-IZ ZZZ-HC	7372 7375	Sterling	Developer and provider of Internet-based competit		tactical competitive	20164-556	PR	V
Cvent, Inc.		1999			TEL	7375	TEL-IF TEL-IZ	7375 8742	Arlington	Developer and provider of an online campaign/eve		customized online i	22203-375	PR	V
Cyveillance, Inc.	50	1997		11.4	TEL	7375	SOF-CS TEL-IW TEL-IZ	7372 7375	Arlington	Provider of online risk monitoring and management		its proprietary techr	22209-240	PR	V
DanChem Technologies, Inc.	135	1942		15	CHE	8711	CHE-SV MAN-SV MAT-TX	8711 8999	Danville	Provider of custom chemical manufacturing services. The company speci			24543-040	PR	V
DiamondBack Vision, Inc.	40	1998		5	SOF	7372	SOF-UT	7372	Reston	Developer of video card software for streaming video		applications. Softv	20191-141	PR	V
Digital Sandbox, Inc.		1998			SOF	7372	SOF-AI SOF-WD	7372	Herndon	Developer of enterprise risk management strategie		enterprise risk mani	20170-439	PR	V C
e-Numerate Solutions, Inc.	23	1998		4.3	SOF	7372	SOF-ME SOF-UT TEL-IW	7372 7375	Mc Lean	Developer and provider of online data publishing a		Internet. The compa	22102-331	PR	P V
e-Security, Inc.		1999	S		SOF	7372	COM-SV SOF-UT	7373 7372	Vienna	Developer and provider of Open e-Security(tm), sec		provider of eSMD(tr	22182-399	PR	V
Engenia Software, Inc.	25	1998		4.6	SOF	7372	SOF-OA SOF-UT TEL-IF	7372 7375	Reston	Developer and provider of enterprise applications a		telecommunicatior	20191-438	PR	V
eNIC Corporation		1997			TEL	7375	TEL-IW	7375	Dulles	Provider of domain name registration services for the p		VeriSign, Inc.	20166-650	PUu	V
epipeline inc.	10	1999			TEL	7375	TEL-IF TEL-IW	7375	Herndon	Provider of software solutions to federal governme		response. The comp	20170-547	PR	V C
Expression Networks, LLC	55	1996	P	7.5	TEL	7375	COM-SV SOF-SV TEL-IF TEL-IW	7373 7371	Charlottes	Provider of Internet hosting, applications hosting, w		services. Products ai	22902-537	PR	P V
FOLIOfn, Inc.	65	1998		14.3	TEL	7372	SOF-BA TEL-IF TEL-IZ ZZZ-HC	7372 7375	Vienna	Developer and provider of online financial investm		Products and service	22182-621	PR	P V
Free Scale, Inc.	50	1998		7.9	SUB	3674	SUB-SE	3674	Vienna	Developer of wireless system semiconductor soluti		settop boxes, etc.) t	22182-273	PR	V C
Genesant Technologies, Inc.		1999			SOF	7375	SOF-HL SOF-SV SOF-ZA TEL-IF T	7372 7371	Dunn Lori	Provider of online health and fitness information also well as Internet-b			22027-103	PR	V
gomembers, Inc.	65	1983	S		SOF	7372	SOF-AC SOF-CS SOF-ED SOF-MI	7372	Herndon	Developer of membership management and fund-r		asset management,	20170-548	PR	P V
Headstrong Corp.	900	1981	P S	170.5	TEL	8742	COM-SV SOF-SV TEL-IZ TEL-SV	7373 7379	Fairfax	Provider of business and technology consulting serv		and manufacturing i	22030-740	PR	V
Howmet Corp. / Hampton Cast	700	1957	S	100	TRN	3724	TRN-MA TRN-PR	3812 3724	Hampton	Manufacturer of structural components for marine,		inv Alcoa Inc.	23661-138	PUu	P V
Icode Inc.	325	1991		51.9	SOF	7372	SOF-AI SOF-CS SOF-SM SOF-SV	7372 7379	Sterling	Developer of Everest Enterprise(R), a software suite		paperless informati	20166-661	PR	P V
Identix Public Sector, Inc.	150	1980	P S	25.6	SOF	7371	DEF-SV SOF-SV TRN-SV	8700 7371	Fairfax	Provider of naval engineering, systems engineering sol		Identix Incorpor	22033-291	PUu	V C
Ikimbo, Inc.	45	1999		5	SOF	7375	SOF-ME SOF-OA SOF-UT TEL-IW	7372 7375	Herndon	Provider of an Internet community platform that ca		archiving and file re	20170-514	PR	V
iLumin Software Services, Inc.	75	1996	P S	14.7	TEL	7372	COM-SV SOF-CS SOF-UT TEL-IF	7373 7372	Reston	Developer and provider of online enterprise messa		mailbox manageme	20191-152	PR	V
iMPAQ Corp.	30	1992		5	TEL	7375	COM-SV TEL-IW TEL-IZ TEL-SV Z	7373 7375	Virginia Be	Provider of network and Internet systems consultin		management hardw	23452-783	PR	V
Induslogic Inc.	331	2000		6.7	SOF	7372	SOF-DM ZZZ-HC	7372 6719	Vienna	Developer of business process integration software		are sold to multiple	22182-240	PR	V
Induslogic, Inc. / SynapseSoft	10	2000		1	SOF	7372	SOF-AI SOF-SV TEL-IF	7372 7379	Vienna	Developer and provider of high-impact, hosted turn	wit	Induslogic Inc.	22182-240	PRu	V
Infozech Software, Inc.		1991			SOF	7372	COM-SV SOF-AC SOF-SV TEL-IF	7373 7372	Sterling	Developer and provider of web-based applications	cus	Infozech Softwar	20164-851	FOu	P V
INSMED Inc.	45	2000		6.7	PHA	2834	BIO-IM PHA-HO	2836 2834	Glen Aller	Research and development organization specializing	in of	products inter	23060-923	PU	V
Intellitactics, Inc.	80	1996		13.1	SOF	7372	SOF-UT	7372	Reston	Developer of information security management sof		these incidents with	20191-547	PR	V
Invertix Corporation	20	1999		4.9	TEL	3661	TEL-CI TEL-SV TEL-TD	3661 8742	Annandal	Developer of stand-alone platforms for wireless car		The IM-Anywhere(t	22003-324	PR	P V
Javien Digital Payment Solutic	5	1999	S	1	TEL	7375	TEL-IZ	7375	Arlington	Provider of online buying and selling transactions inclu		Javien, Inc.	22209-319	PRu	V
JP Morgan Chase Vastera	670	1992		86.1	SOF	7372	SOF-ZA	7372	Dulles	Developer of international trade logistics software. Sof		J.P. Morgan Chas	20166-751	PUu	V
Kaeser Compressors, Inc.	331	1982			SUB	3563	MAT-OL SUB-EM SUB-ME TAM-	2992 3564	Frederick	Manufacturer of vacuum pumps, portable compressors		Kaeser Kompres	22408-733	FOu	V
KSB, Inc. / Energy Division	12	1983		1.8	SUB	3561	SUB-ME	3561	Richmond	Manufacturer of boiler feed pumps designed for nuclea		KSB Ag	23231-442	FOu	V
LinkSpot Networks, Inc.	10	2002		1	TEL	4813	TEL-II	4813	Reston	Provider of wireless Internet access services. Services are provided to RV			20191-153	PR	P V
Lumenos, Inc.	4	1999		0.8	SOF	7375	SOF-FN SOF-OA TEL-IF TEL-IW	7372 7375	Alexandri	Provider of online web site that offers health and financial services. Ser			22311-170	PR	V
Luna Innovations Incorporatec	148	1990	P S	15	PHO	3661	BIO-SV CHE-SV MAN-SV MAT-S	8731 8711	Blacksbur	Manufacturer and custom developer of fiber optic c		fiber optic sensing i	24060-665	PR	P V C
Luna Technologies	13	2001		1.5	TAM	3825	TAM-AN	3825	Blacksbur	Designer, developer and manufacturer of instrumentat		Luna Innovations	24060-656	PRu	P V
MarketSwitch Corporation / Ex	50	1996		15	SOF	7372	SOF-AI SOF-UT TEL-IF	7372 7375	Herndon	Developer and provider of marketing, credit risk ma	bu	GUS plc	20171-485	PUu	V
mindSHIFT Technologies, Inc.	80	1995		10	TEL	7375	TEL-IS TEL-SV	7375 8742	Fairfax	Provider of comprehensive managed IT services, from desktop to netwo			22033-292	PR	P V
Mobile Computing Corp. USA	34	1977		5	SOF	7372	COM-SV SOF-AC SOF-CS SOF-SI	7374 7372	Charlottes	Developer of mobile computing solutions including	arc	Mobile Computi	22903-580	PRu	V
Monitoring Technology Corp.	25	1984	S	8	AUT	3826	AUT-AT TAM-AN	3829 3825	Fairfax	Manufacturer of 20/20 Hindsight high speed video c		food and beverage,	22031-433	PR	P V C
NetASPx, Inc.	148	1999			TEL	7375	COM-SV SOF-SV TEL-IF TEL-IZ T	7373 7371	Herndon	Provider of online hosted integrated business servi		Products and service	20171-467	PR	V
NetCom Solutions Internation	75	1995		15.2	SOF	7375	COM-SV SOF-SV TEL-IZ TEL-SV	7373 7379	Leesburg	Provider of network consulting, integration, networ		education markets.	20176-181	PR	P V
NetSec, Inc.	115	1998	P	2.5	TEL	7375	TEL-IF TEL-SV	7375 8742	Herndon	Provider of online security services which include fi		was capitalized by v	20171-341	PR	V
Network Storage Solutions, In	10	2004	S		COM	7372	COM-CM SOF-UT	3572 7372	Herndon	Developer and marketer of network storage softwa		device that attaches	20170-523	PR	P V
New World Apps, Inc.	18	1999	P S	4.2	TEL	7375	COM-SV TEL-IF TEL-IW TEL-IZ TE	8742 7374	Leesburg	Provider of digital transaction-based Internet servic		services. Services ar	20175-291	PR	P V
Nextel Communications, Inc.	15,000	1987		10820	TEL	4813	TEL-II TEL-IM TEL-IZ TEL-SV ZZZ-	4813 7375	Reston	Provider of digital wireless voice, data mobile cellu		paging, Internet pro	20191-342	PU	V
NII Holdings, Inc.	2,570	1996			TEL	4832	TEL-SV	4832 4812	Reston	Provider of wireless services to Latin America and A	are	Nextel Commun	20191-542	PUu	V
Optimos, Inc.	300	1993	P S	62.3	SOF	7379	COM-SV SOF-SV TEL-IW TEL-IZ	7373 7379	Chantilly	Provider of software consulting and custom applica		consulting services a	20151-167	PR	P V
OROS, Inc.	69	1995	P S	10	TAM	3829	ENV-CP TAM-ME TEL-SI	3829 3669	Dulles	Manufacturer of noise and vibration analyzers. Appl	cap	OROS SA	20166-943	FOu	P V C
Outtask, Inc.	65	1999			SOF	7372	SOF-TR TEL-IF	7372 7375	Alexandri	Developer and provider of web-based travel manag		involved in corporat	22314-176	PR	V
Packexpo.com	17	1999		3.9	TEL	7375	TEL-IS TEL-IZ	7375 8742	Falls Chur	Provider of B-to-B marketplace for e-commerce, pa		capital.	22042-453	PR	V
Pantheon Software, Inc.	18	1994		2	TEL	7375	COM-SV SOF-SV TEL-IW TEL-IZ	7374 7379	Arlington	Provider of software consulting and programming, e		e-mail services. Pro	22201-251	PR	P V
Payerpath, Inc.	60	1998		5	SOF	7372	SOF-HL SOF-IN TEL-IF TEL-IZ	7372 7375	Richmond	Developer of claims processing software, and medi		provided to the hea	23235-194	PR	V
Phonom, LLC		2003			TEL	4813	TEL-IM	4813	Richmond	Provider of VoIP telephone services. Products and services are sold to m			23227-434	PR	V
PromiseMark, Inc.	10	1997		2.1	TEL	7375	TEL-IF	7375	Fairfax	Provider of a suite of Internet and data related serv	cor	GUS plc	22033-290	PUu	P V
QED Solutions, Inc.	11	1998		1	SOF	7372	BIO-SV MED-SV PHA-SV SOF-AI	8731 8071	Reston	Developer and provider of web-based lifecycle drug		cross-reference exis	20191-153	PR	P V
QuadraMed Corp.	850	1993		130.5	SOF	7371	SOF-AI SOF-CS SOF-HL ZZZ-HC	7372 6719	Reston	Developer of health information management soft		optimum efficiency.	20190-322	PU	V
ScholarOne, Inc.	58	1999	P	10.1	SOF	7372	SOF-AC SOF-DM SOF-ME TEL-IF	7372 7375	Charlottes	Developer and provider of Internet-based content r		users to download a	22901-160	PR	V
ServiceBench, Inc.		1995			SOF	7375	SOF-UT TEL-IF	7372 7375	Fairfax	Developer and provider of online documentation a		and venture capital.	22030-742	PR	P V
SkyBitz, Inc.	43	1995		10.7	TEL	3663	TEL-SM	3663	Sterling	Developer of global satellite location systems that p		venture capital.	20164-444	PR	V
Sonic Telecom, Ltd	69	1996		5	TEL	4813	TEL-II TEL-IZ TEL-NW TEL-SV TEL	4813 7375	Chantilly	Developer of videoconferencing systems and route	cap	General Motors (	20151-168	PUu	P V C
StarBand Communications Inc	148	2000			TEL	4813	TEL-II	4813	Mc Lean	Provider of leasing services of satellite capacity for broadband Internet a			22102-432	PR	P V
TechLaw, Inc.	148	1983	P S	15	COM	7389	COM-SV ENV-SV	7374 8742	Chantilly	Provider of litigation support, environmental consu		venture capital.	20151-111	PR	P V
TECSEC, Inc.	30	1990	S	3.3	SOF	7372	SOF-OA SOF-UT	7372	Vienna	Developer of standards-based, cryptographic access		This company was ca	22182-400	PR	V
telezoo.com Corporation		1997			TEL	7375	TEL-IZ	7375 8742	Arlington	Provider of a global B-to-B telecommunications marketplace for product			22209-250	PR	V
UHR Technologies, LP	9	1995		1	ENR	8742	ENR-SV ENV-SV	8742	Falls Chur	Provider of power backup systems to residential an		corporate investmer	22042-402	PR	P V C
Upstate		1986			BIO	2836	BIO-GE BIO-IM BIO-MT BIO-NZ	2836 2835	Charlottes	Manufacturer of cell signaling reagents and kits use		ser Upstate Group, I	22903-523	PUu	P V
VCampus Corporation	48	1984	P S	6.1	SOF	7375	SOF-ED SOF-ME TEL-IF	7372 7375	Reston	Developer of online educational course materials fc		Products are sold to	20191-153	PU	V
VIPdesk.com, Inc.	65	1997		3.3	SOF	7372	SOF-UT TEL-IF	7372 7375	Alexandri	Developer and provider of Internet-based personal		Software users may	22314-262	PR	V
Wasabi Systems, Inc.	35	2000			SOF	7371	COM-SV SOF-SV SOF-UT	7373 7371	Norfolk	Manufacturer and developer of a portable operatin		capitalized by privat	23510-220	PR	P V
Wealthcare Capital Manageme	23	1999		5	TEL	7375	TEL-IZ TEL-SV	7375 8742	Richmond	Provider of online financial planning and general		financial services and f	23220-504	PR	P V
webMethods, Inc.	865	1996		194.5	SOF	7372	COM-SV SOF-MA SOF-UT	7373 7372	Fairfax	Developer of web services infrastructure software,		Products and service	22030-742	PU	P V
WebSurveyor Corporation	40	1998		6.6	SOF	7372	SOF-CS SOF-SM TEL-IW	7372 7375	Herndon	Developer of web survey software solutions that all		based PCs. Products	20170-514	PR	V
Whereoware, LLC	20	1999		4.9	TEL	7375	TEL-IW TEL-IZ	7375	Mc Lean	Provider of web-based technical and marketing serv		other Internet comn	22102-513	PR	P V C
YDI Wireless, Inc.	135	1982	P	27	TEL	3669	TEL-BR TEL-II TEL-IM TEL-NW TE	3663 4813	Falls Chur	Manufacturer of broadband wireless access product		wireless equipment	22042-111	PU	P V C
YellowBrix, Inc.	60	1997		10	TEL	4813	SOF-UT TEL-IA TEL-IF TEL-IM TE	7372 7375	Alexandri	Provider of Internet e-mail services, web site conte		applications integra	22314-154	PR	V
YottaYotta, Inc.	65	2000			SOF	7372	SOF-DM TEL-IF	7372 7375	Alexandri	Developer and provider of the NetStorager(tm) Syst		information, improv	22314-264	PR	V
Zope Corporation	40	1997	S	3.3	SOF	7379	SOF-SV TEL-IF	7379 7371	Frederick	Provider of custom solutions for media/telecommu		server, and a conter	22401-574	PR	V
Ztango, Inc.	25	1999		5	SOF	7372	SOF-CS SOF-FM TEL-IF TEL-IM	7372 7375	Reston	Developer and provider of a suite of software that c		and interaction betv	20191-142	PR	V