Building Entrepreneurial Innovation in the Greater Washington Region

A Report to the 2030 Group

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I. EXECUTIVE SUMMARY

A. IF WE WANT JOB GROWTH, WE MUST GROW NEW INNOVATION BUSINESSES

The Greater Washington Region, which reaches from Baltimore to Northern Virginia and includes the District of Columbia, faces a significant challenge: how to create tens of thousands of new high-paying jobs. Meeting the challenge requires that the region be home to rapidly-growing entrepreneurial businesses, particularly those that apply technology innovation.

Over the last six months, a multidisciplinary team led by Jonathan Aberman undertook a comprehensive study to determine whether the region has the ability to create the entrepreneurial, innovation-based technology businesses it needs. The answer will be a resounding "yes," but only if action is taken. We must look at what has worked in the past in the Greater Washington Region, what its strengths are, and how to correct the misconceptions that limit the region's ability to create a more robust innovation economy.

Patterns of business formation and exit show that the Greater Washington Region is much more entrepreneurial than many currently believe. Comparing the kinds of companies that grew in the region in 1999 with those growing here today reveals the region's entrepreneurs "follow the money" to build new businesses and that venture capital is not essential for the region to thrive. A comprehensive look at Federal research and development spending in the region show that the focus of technology transfer and commercialization activity should be on industry and federal labs (both privately operated and government-owned), rather than on universities. The reality that emerges from a close examination of patterns of business growth and sale is that the region's new businesses are isolated from older, established businesses and that this isolation undermines new business growth across the board. It is particularly damaging to the region's accelerators and incubators.

There is a "Greater Washington Model of Entrepreneurship" that is distinct from that in other regions of the country. Many of our most successful entrepreneurs turn their proximity to Washington, DC into a competitive advantage, by identifying regulatory opportunities, using the large pool of federal funding available for innovation or otherwise benefitting from the clustering of customers that have aggregated due to the particular aspects of the regional economy.

An example of this model is AOL, which benefitted from the development of the World Wide Web which was fostered by federal efforts. Another is Medimmune, which grew out of technology transferred from federal research and development. A recent example is Cvent, which

developed an event coordination business that benefitted from the large concentration of networking events occurring in the Greater Washington Region. Each of these businesses took advantage of specific attributes of the region to quickly grow into a large, profitable business generating thousands of high-paying jobs.

Understanding and celebrating the region's distinct model of entrepreneurship will allow regional leaders to leverage the region's unique entrepreneurial ecosystem to strengthen the regional economy, enhance global competitiveness and increase innovation outputs. The region can create the jobs it needs if its leaders embrace the Greater Washington Model of Entrepreneurship and build the future by growing on the region's strengths.

B. KEY REPORT FINDINGS

1. The region is entrepreneurial

The *Roadmap for the Washington Region's Economic Future*[1] found the region's lack of "entrepreneurial culture" to be a constraint to business growth. The Roadmap reflected the conventional wisdom the region's roots and traditions as a "Federal City," have made it a bureaucratic place, better suited to administration, program management, and consulting than to entrepreneurial, innovative endeavors.

That may be true at some levels. But when the analysis is focused on entrepreneurial technology businesses, the data demonstrate that the region is far more entrepreneurial than its reputation. Since 2004, the Greater Washington Region's pace of new business formation has exceeded other regions generally believed to be U.S. innovation hubs, such as Boston and Silicon Valley. Meanwhile, over the last 20 years, the Greater Washington Region has consistently had more companies on the Inc. 500 list of the nation's fastest-growing businesses than any other region.

2. Many of the most successful businesses leave the region

While the region has demonstrably fostered the growth of many entrepreneurial, innovation-based businesses, it has not been as successful keeping them here. Over the last 20 years, 105 businesses based in the region were sold for more than $1 billion apiece. Of those, only 16 were sold to buyers in the region. More broadly, of the more than 6,000 business sales during that same 20-year period, three quarters were to out-of-region purchasers.

When established, non-local companies buy up the region's successful new businesses, they often shift the purchased business' operations to their home region. This robs the region not only of potentially profitable, job-creating businesses, but also of the management and operational talent that moves with the business. Aggregated into a trend, the purchase of many of

[1] Dr. Stephen Fuller's full report can be found at www.2030roadmap.com.

the region's most promising businesses by outsiders harms the region's entrepreneurial ecosystem both short and long term. It limits opportunities to create and scale high-growth businesses, and it makes the region less attractive as a place for venture capital investment.

3. ***The region's role as a primary partner for national security is in jeopardy***

In the last year, the Department of Defense, Department of Homeland Security, the State Department and the Army have each opened offices in California to seek new innovation from private businesses – particularly entrepreneurial, innovation-based businesses. The Department of Defense also opened an office in Boston with a similar mission. With no such office here in this region, it certainly seems as if these agencies are overlooking this region's entrepreneurs. This is a disturbing trend, especially because the Greater Washington Model of Entrepreneurship often relies on federal funding or customers at some point in their business growth. It is also a significant threat to the larger businesses in the region that serve national security customers.

4. ***Venture capital is not the driver for our innovation economy – federal funding is***

Venture capital is a growth tool for businesses looking to grow more rapidly than their revenue growth can support. Its absence from the region – when compared to other regions in the United States – has caused many entrepreneurs to follow the money coming from the federal government. Federal spending on information technology ($30bn) and research and development ($26bn) significantly outweighs venture capital ($1.4bn). This disparity explains why so many entrepreneurial, innovation-based businesses in the region grow through revenue derived from proximity to Washington, DC, rather than through private venture capital.

The region's venture capital market is the 8th largest in the United States. A comparison with 1999, when the region was at the center of a large industrial wave during the creation of the consumer Internet is highly revealing. It is clear that when the region is at the crest of a major technology wave, venture capitalists invest here. This underscores an important point: venture capital is a *lagging,* not a *leading,* indicator of the vitality of a region's entrepreneurial ecosystem. Rather than aiming to attract venture capital to the region as a first call to action, we should first build conditions that reward investors: a vibrant market for profitable business sales where talent and capital stay in the region.

5. ***Technology commercialization is a high priority, but needs a new focus***

Innovations that form new industries or that are truly unique are often derived from federally funded research and development. Many technologies on which entire industries are based, such as Global Positioning Systems, video teleconferencing, robotics and advanced materials were developed in federal labs or federally funded research and development corporations (FFRDCs) located in the region. The Department of Defense, NASA and the Department of Health and Human Services (the home of the National Institutes of Health) are the dominant research and development funders here. There are 108 federal labs located in the

Greater Washington Region as well as prominent FFRDCs such as MITRE, Institute for Defense Analysis and Johns Hopkins Applied Physics Lab.

Bridging the gap between research and development to commercial product is an essential opportunity for the Greater Washington Region. The region is a leading recipient of federal research and development funding, and most of it goes to industry, federal labs and FFRDCs, not to universities. For new commercial innovation and to seed a larger number of technology startups, regional leaders must broaden their focus to include commercialization of innovation in industry and federal labs.

6. ***Accelerators need the business community's direct engagement to succeed***

The region boasts a wide range of business accelerators and incubators, many of which are well publicized. National rankings of such programs that measure success in subsequent business funding or exits rarely include the region's programs. If success is to be measured in this way, the region must act to create conditions for our accelerators and incubators to succeed.

7. ***The region's business community must act and buy local***

Currently, there is a disconnect between the region's businesses and where they themselves look for innovative businesses to acquire. Software and biotech and healthcare businesses are bought by out-of-region purchasers at roughly the same rate as local companies are purchasing software and biotech and healthcare businesses from other regions. It is as if the region's two entrepreneurial communities are ships passing in the night. Establishing a more collaborative entrepreneurial ecosystem across the region where larger businesses "buy local" will help to attract and retain talent and businesses and accelerate the Greater Washington Region's emergence as a nationally recognized innovation leader.

C. RECOMMENDATIONS

To support the creation of entrepreneurial, innovation-based technology businesses in the Greater Washington Region, regional leaders and the business community must consider:

- Building more connections between large local companies and new innovation businesses, particularly in cybersecurity, government contracting, and precision medicine and biotechnology when making new investments in programs or business attraction.
- Shifting the region's current focus on technology transfer from universities to industry and FFRDCs.
- Establishing an objective regional agency or consortium with the specific mission of advocating for and fostering the connection of entrepreneurial, innovation-based technology businesses with larger companies in the region. This organization must not

have an economic interest in the entrepreneurial businesses it serves, in order to maintain its objectivity and break down barriers between the many existing programs and regional resources currently competing for attention. This organization would further address the challenge by matching experienced entrepreneurs to technologies for commercialization.

- Increasing regional collaboration around technology initiatives and activities. Many existing activities promoting new business formation and growth are supported by a single locality as an adjunct to economic development. These efforts can be effective within their narrow scope, but they have the unwanted ancillary effect of segmenting our innovation community. The business community must take a more regional approach.
- Creating a long-term innovation roadmap, so that the region can lead subsequent waves of new technology adoption, like it did in the 1990s.
- Integrating entrepreneurship and technology into the region's universities and secondary education classrooms to equip our future workforce with the skills necessary to thrive in an increasingly technological world where individual creativity and entrepreneurial skills will be essential.
- Seeing the picture of the region painted by the data and leaving behind the preconceptions that hinder understanding, so that the region can position itself to grow the businesses and jobs that will drive economic growth and provide livelihoods and satisfaction of our citizens for the future.

II. THE REPORT

A. INTRODUCTION

1. The Roadmap

The Greater Washington Region is rich with potential. Some say the region lacks "entrepreneurial spirit" and that we are a region of risk-averse bureaucrats. Others believe that we are a government town, dependent on federal funding and unable to compete in a private sector ecosystem. Our image has attracted the attention of policy-makers who have pushed policies and directed funds to the narrative that resonates with them.

The region is at a crossroads. Are we too reliant on the federal government? Is it time to diversify? Sequestration was a wake-up call for many, and its effect on the region's economy has been thoroughly documented and exhaustively discussed. Recent federal budgets have supported a recovery of federal employment and spending in the region. Recovery allowed us to assume that things are back to business as usual, but this time really is different: now the specter of sequestration and government shutdowns is always a looming possibility.

With the support of a cross-section of regional organizations, Professor Stephen Fuller of George Mason University's Center for Urban Analysis published *The Roadmap for the Washington Region's Future Economy*. As a result of this project, a number of regional initiatives are now being undertaken (collectively, the Roadmap Project), providing insight and guidance into how to grow the region's economy and create high-wage employment that will attract new businesses and educated employees.

As the Roadmap Project becomes part of the region's discussion of how to grow and where to invest, more questions emerge: what role will entrepreneurship and new business formation play in addressing this challenge? How will we create new businesses that drive employment and wealth creation?

This report tells a story that has not been heard before. It explicitly challenges the assumptions and views held by many in the region. This report is not designed to reassure, but to provide clarity.

Rapidly-growing companies often provide the greatest wealth creation potential for founders, employees and investors. The spillover effects make for thriving communities. Regions where entrepreneurship thrives have an ecosystem that regularly creates new, rapidly-growing businesses. Our analysis is centered on evaluating whether the region has this key attribute.

This report focuses on businesses that combine a founding entrepreneur (or founding team of entrepreneurs) with innovation and technology.

2. Research Approach

Amplifier Advisors engaged a multidisciplinary team that included academic personnel, research consultants, data scientists, experienced innovation entrepreneurs, as well as venture capital and technology transfer professionals. American University, University of Maryland and Virginia Tech Applied Research Corporation each supplied personnel. Members of FounderCorps, a regional not-for-profit group comprising prominent serial entrepreneurs, provided valuable insights. The team members' advanced degrees included doctorates, masters of business administrations, masters of science, and both JDs and masters in law.

More than 120 individuals involved in the region's entrepreneurial community were interviewed, either one-on-one or in small focus groups. A focus group was formed in each of four areas: government contracting, cybersecurity, consumer software and life sciences. Amplifier Advisors also formed focus groups along generational and geographic criteria to gain insight on how entrepreneurs view the region.

The underlying research also draws from a broad range of federal government data bases that capture entrepreneurial and innovation activities, as well as reliable non-government data.

B. THE REGION IS CAPABLE OF CREATING HIGH-GROWTH BUSINESSES

1. The Role of Entrepreneurs

Because entrepreneurship is the key to job creation, the research and this report both begin with understanding the region's level of entrepreneurship and business creation. It is estimated that all new net job creation in the U.S. comes from businesses that are less than five years old.[2]

Entrepreneurs are the individuals driven to start new businesses. New business creation is very much a human activity, powered by individual behaviors: the willingness to accept risk, a sense of purpose and a desire for personal advancement. Many entrepreneurs are also driven by a desire to accumulate wealth, but this is not a universal attribute. What is universal is that entrepreneurs are connectors and resource gatherers. Therefore, their ability to succeed, or to even attempt an entrepreneurial journey, is greatly affected by their environment, which includes business conditions, availability of capital, customer opportunities, and social support structures.

The region's ability to support and reward entrepreneurs and their business formation is thus an important factor in assessing our ability to create employment.

2. The Importance of Innovation to Entrepreneurship

Innovation, the process of creating something to satisfy a customer need, is a widely-used and often misused word. Innovation is often confused with creativity, since creativity is a process by which innovation is discovered. This report defines innovation as a process that creates something new and economically valuable to a customer. Innovation is a differentiation tool used to pursue an economic activity, the creation and growth of a business. Innovation used in this context is the "secret sauce" – the novel something that an entrepreneur can sell. Innovation goes beyond invention.

A business using innovation is desirable because it provides something special. This concept of specialness is something we all experience as we decide which products or services to consume. We appreciate that we pay more for something that is truly unique or that answers a specific need significantly better than the alternative. We reward innovation every day.

Businesses based on innovation, therefore, can charge higher prices and enjoy higher profits. And their owners can use the profits to reward themselves and provide high-wage employment in proportions they and the market determine.

[2] "Where Will the Jobs Come From?" Dane Stangler and Robert E. Litan, Ewing Marion Kauffman Foundation, April 2011.

3. Understanding How Innovation and Technology Interact

Generally, innovation-based businesses will provide a new service or a product. Service businesses can be innovative and unique, but their ability to scale and grow rapidly is generally tied to how quickly they can hire and train new people. A product-based business, on the other hand, is often able to grow more rapidly because it can produce its innovative product in quantity through a replicable production process. Intellectual property rights protecting products – particularly patents and trade secrets – can provide a high barrier to competitors. For these reasons, the entrepreneurial, innovation-based businesses that grow fastest tend to provide products and not services.

There are two types of technological innovation. The first type is the most common. It relies on incremental innovation – applying an existing technology in a new way or introducing an incremental change to an existing technology. An example of this type of innovation is , adding a wireless tire pressure sensor to a truck tire. These types of technological innovations can support a rapidly growing business. However, their ability to withstand competitive pressure and stay ahead is limited by the need for continued reinvestment and reinvigoration. It is difficult to build a sustained competitive advantage from an incremental innovation.

The second type of technological innovation – a blue ocean innovation – is much rarer and more valuable. A blue ocean innovation is based upon something truly new that remains unique and difficult to substitute for an extended period of time. Google, Facebook, and an advanced cancer therapeutics are good examples. This is where "big wins" tend to appear in our economy – the combination of technological innovation with something so compelling that consumer demand explodes.

4. The Greater Washington Region Is Entrepreneurial

This report provides objective, verifiable evidence of our population's entrepreneurial bent. Data sets from the U.S. Small Business Administration clearly show robust new business formation in the region.

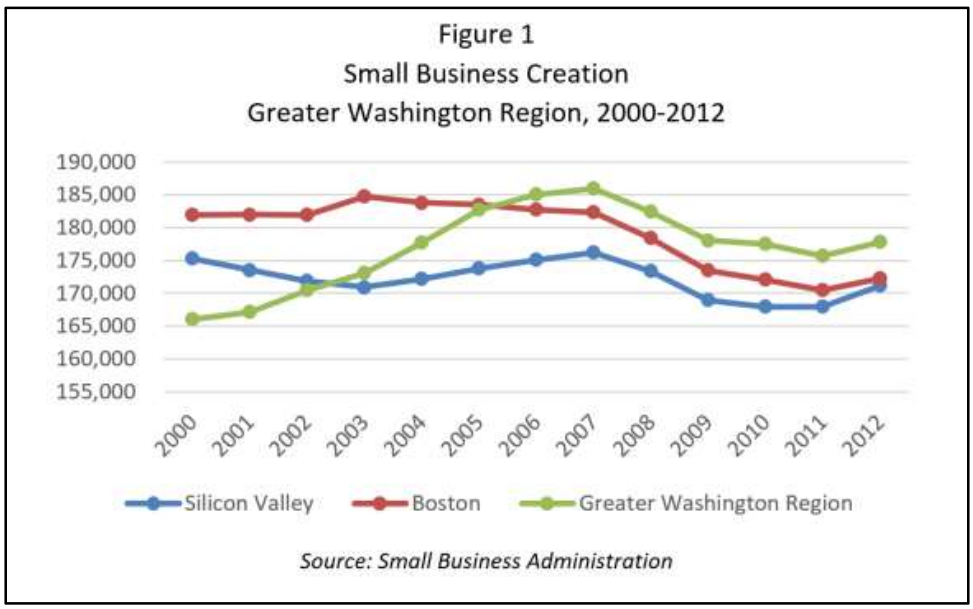


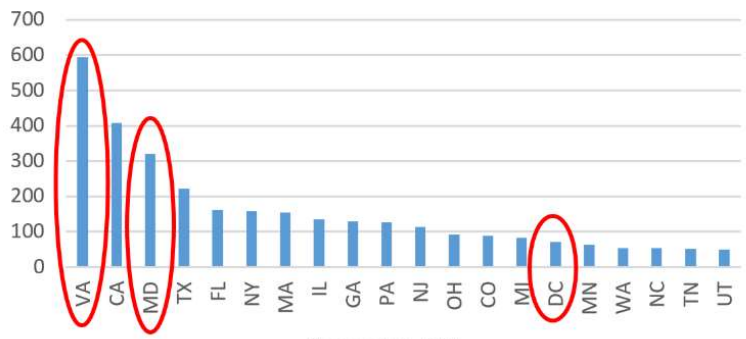
Figure 1 shows that since 2005, the Greater Washington Region has formed more new businesses annually than Silicon Valley or Boston, two regions generally viewed as "hotbeds" of entrepreneurship and new business creation.

Even without specifics on whether the new companies are based on technology or services, the numbers show the region is active and engaged.

5. The Greater Washington Region Creates Rapidly-Growing Businesses

Data aggregated nationally regarding fast-growing new businesses, published annually by Inc. Magazine, provide insight into national entrepreneurial activities (the Inc. 500 list). Each year the Inc. 500 list identifies the 500 fastest growing privately owned businesses in the United States.

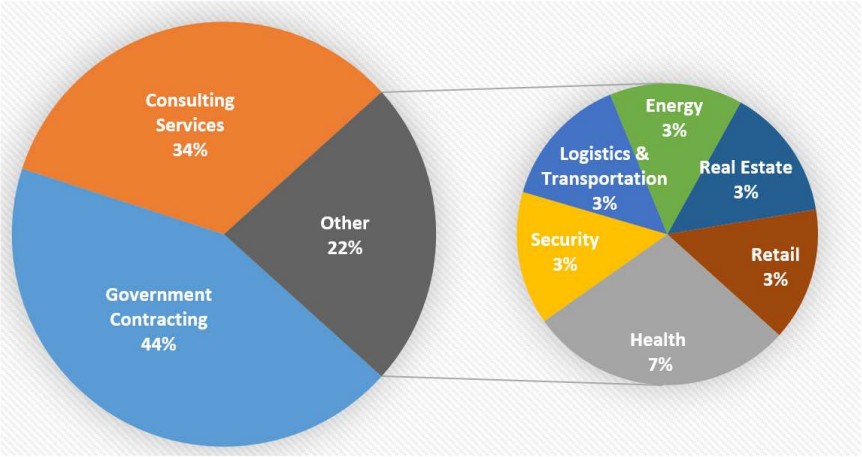
Figure 2
Number of Companies Listed on the Inc. 500
Fastest Growing Companies, 1995-2015



Source: Inc. 500

Figure 2 shows that over two decades, the region had the largest number of businesses on this list. Coupled with the SBA data described above, the region clearly creates significant numbers of rapidly-growing businesses. The Inc. 500 list numbers also show what *types* of rapidly-growing businesses the region is creating.

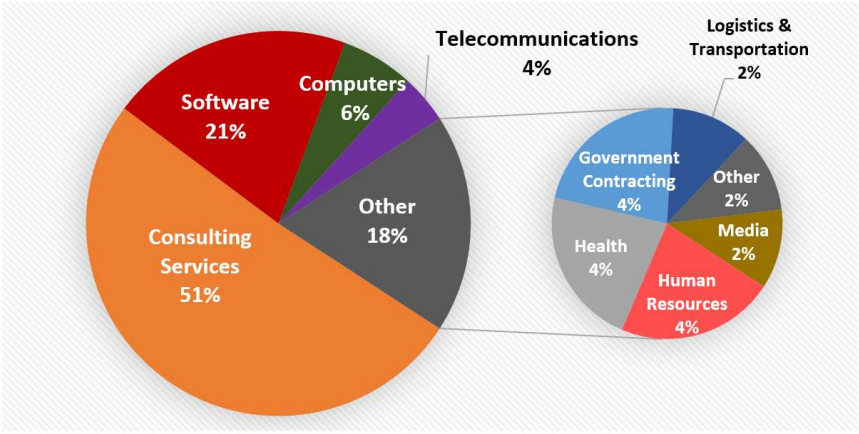
Figure 3
Composition of the Greater Washington Region's
Fastest Growing Companies, 2015



Source: Inc. 500

Figure 3 shows the region's Inc. 500 list companies by industry. Note the prevalence of government contracting and consulting businesses (many of which were involved in healthcare, according to the underlying per company data). None of the region's software or medical technologies companies made the list. They key point: in 2015, businesses in the region with the fastest revenue growth were selling services (which in many cases used technology), rather than technology products.

Figure 4
Composition of the Greater Washington Region's
Fastest Growing Companies, 1999



Source: Inc. 500

Figure 4 shows that in 1999, the composition of the companies from the region on the Inc. 500 list was very different from 2015. There was a high incidence of consulting services (many of which were involved in media services rather than healthcare, according to the underlying per company data). However, there was a much higher incidence of technology innovation products, primarily software, computers and telecommunications. Government contracting was a very small part of the overall group in 1999.

The difference in the types of businesses can be explained by the funding supporting rapidly-growing businesses. In 2015, the availability of federal acquisition dollars in areas of such as cybersecurity and healthcare likely drove entrepreneurs to create businesses in those industries.

The mix of businesses on the 1999 Inc. 500 list reflect economic conditions of the day. It was not a time where federal acquisition dollars drove entrepreneurial activity to the degree it did in 2015. The World Wide Web was growing into the Internet we know today, and the region provided the technological backbone. The region was home to AOL, PSINet, Network Solutions, and others; they attracted even more new businesses and brought venture capital to the region.

Growth was further fueled by the end of the Cold War and the concomitant reduction of federal spending on related technology.

Comparing these two periods and the corresponding data supports the following observations:

- The region has a demonstrable numerical advantage over other regions generally recognized as hotbeds for new business formation.
- The region has a demonstrated ability to create businesses with rapid revenue growth.
- Our entrepreneurs adjust to prevailing opportunities for customer acquisition, funding and exits. Our entrepreneurial class "follows the money" and adjusts to market conditions.

C. THE REGION REWARDS INNOVATION ENTREPRENEURS, EMPLOYEES AND INVESTORS

1. Start-up Finance 101: A Quick Primer

Every new business needs a range of inputs to get started and to keep going; these include a place to operate, personnel, equipment, and outside professional services. Almost every new business is extremely risky at the outset, making outside investment unlikely. For that reason, most entrepreneurs "bootstrap." The founder may support the company by using savings, personal credit cards, or selling personal assets to raise cash and may pay vendors with equity in the company.

To grow past the earliest stages of operation, a business needs resources that exceed what can be accomplished by bootstrapping. Often, the entrepreneur has exhausted his or her personal resources, office equipment cannot be paid for with stock, employees must be hired, and rent must be paid. Cash for an expanding business can come from three sources: revenue from business operations, loans, and outside investment in the business. For many businesses, revenue generates sufficient cash to operate at a steady pace. Growth is matched by revenue, and ideally profit rewards the business owner. Revenue-stable businesses can often get bank loans to keep growing.

For rapid-growth businesses, revenue alone may not be enough to maximize growth. These businesses are unlikely to qualify for loans because their income is unpredictable. They often have no alternative to an investment transaction where capital is obtained for an ownership stake. The investor benefits in the future from the business' explosive growth.

For entrepreneurial businesses, outside investment generally comes from three primary sources: a founding entrepreneur's friends and family, an individual or group of individuals with

no connection to the entrepreneur (angel investors) or professionally managed funds that invest in new businesses (venture capital). The magnitude of cash available from each source is different.

For most entrepreneurs, the amount of cash that can be raised from friends and family is at most tens of thousands of dollars. Angel investors may at times be aggregated into a total investment of $1 to $2 million.[3] Venture capital is the only source of larger infusions of capital at any one time.

Venture capital is a financial asset management business. It is funded by wealthy individuals, family offices endowments, and pension funds or other institutional investors. The manager of a venture capital fund is the venture capitalist. Venture capitalists make their money by generating profits from the investments their funds make. They generally receive 20% of their venture capital fund's investment profits, although they rarely put up more than 1% of the venture capital fund they manage.

In order to generate financial returns, investors must be able to sell their ownership interests. Sales, referred to as "exits," are important to any investor, but especially to a venture capitalist who is compensated and rewarded for generating high returns in a short period of time. For this reason, venture capital (and angel investments) tend to cluster in industries or geographic regions where business growth and exits are frequent.

The availability of venture capital and exits are tightly related. Venture capital supporting high-growth businesses *follows* proven potential for exits. In that sense, it is a lagging indicator – showing past success. Understanding the nature of the Greater Washington Region's exit activity allows us to identify where our entrepreneurial innovation businesses cluster.

2. Initial Public Offering and Beyond: Exiting Through Sales to the Public

An initial public offering (IPO) of a business' common stock is a key indicator of success in growing a sustainable business. The process of becoming a publicly traded company, in particular the role of investment banking underwriters and the Securities and Exchange Commission oversight, means that an IPO is a validation of a business in many respects. It is also an important moment for the company's founders, management, employees and investors, as they have an opportunity to monetize their equity holdings, usually by exercising stock options or selling stock obtained through early investment.

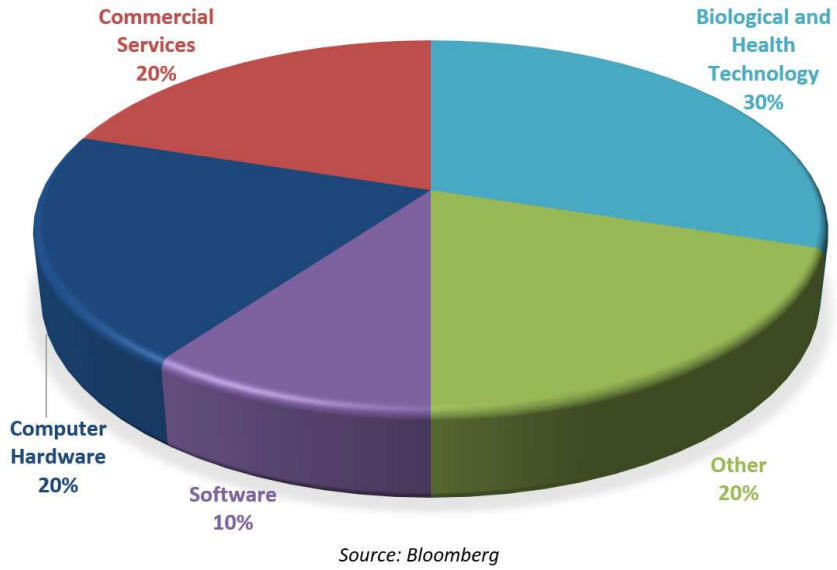
[3] Virginia, Maryland and the District of Columbia have all adopted programs to provide small amounts of capital to help start new entrepreneurial businesses. This Report includes these funding amounts within the context of Angel financings, since the amounts provided are generally in the $25,000 to $100,000 range per company, and the investments generally occur in conjunction with private Angel investments.

An IPO means the company can grow further, whether through cash obtained from selling shares to investors or through its position in the public markets. Once a company goes public, it also gains the ability to acquire other businesses by issuing stock to the owners of the acquired company instead of paying for them with cash.

The Greater Washington Region has been the seventh largest IPO market over the last twenty years. In 2015, of the 351 IPOs in the United States, the Greater Washington Region had 10, or 3%. In comparison, in 1999, during the Internet's expansion phase, of 669 IPOs nationally, the Greater Washington Region had 26, or 4%.

Although the level of participation in the IPOs market were similar on a percentage basis, the natures of the businesses that went public in these two periods were very different.

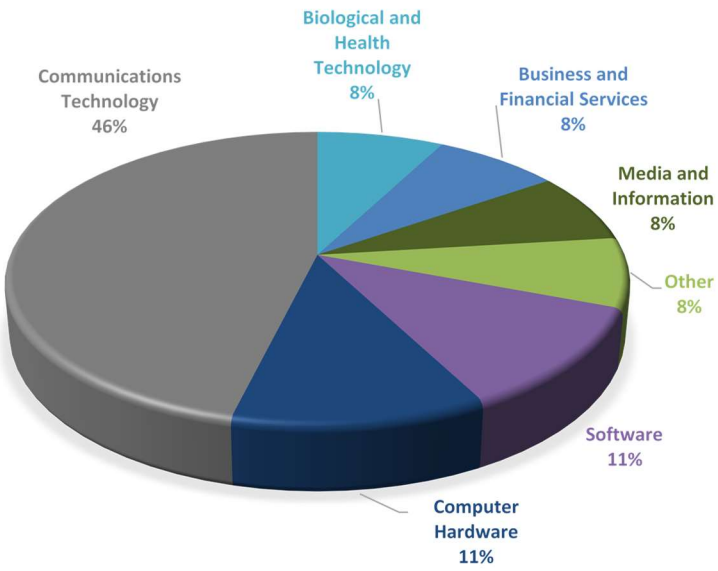
Figure 5
Composition of the Greater Washington Regions' Initial Public Offerings, 2015



Source: Bloomberg

Figure 5 shows the region's IPO activity in 2015. IPOs were exclusively in biological and health technology (30%), computer hardware (20%), commercial services (20%), other (20%) and software (10%).

Figure 6
Composition of the Greater Washington Region's
Initial Public Offerings, 1999



Source: Bloomberg

Figure 6 shows the region's IPO activity in 1999. It is a very different composition. Communications and technology (46%), computer hardware (11%) and software (11%) were more prevalent, and media and information, other, business and financial services and health technology each got 8% of the total.

These numbers demonstrate how a prevailing technology trend can influence exits and how the region is capable of growing innovation companies that go public.

A majority of the companies that went public in both reference years used technology innovation in their business model – clustering in areas such as software, biotechnology and healthcare, computer hardware and communications technology. So although it is possible to build a rapidly-growing revenue-based business without technology (as demonstrated by the preponderance of such companies in the Inc. 500 list in Figure 3), for a company to grow enough to support an IPO, technology innovation appears to be a prerequisite.

IPO data show that the composition of successful companies reflected the primary business activities of the time. The 1990s are widely remembered regionally as a time when IPOs were frequent, and the IPO data from 1999 reflects the broader industrial trends of the day. As venture capital has shifted away from the region, the businesses that have gone public are primarily those that have achieved business growth using regional resources. In this way, the IPO data reflect the change in composition in the Inc. 500 list, a regional change from being in the

middle of the commercialization of the Internet, to being involved more squarely in large federal growth trends such as cybersecurity and healthcare

3. Mergers and Acquisitions – Exiting Through the Sale of a Business

Investors' and business owners' primary rewards are tied to the sale of the business. M&A activity matters a great deal for the vitality of an entrepreneurial business community. M&A data reveals a community's ability to create businesses that larger companies want to own, and also the level of connection between buyers and sellers, whether by industry, geography, or both. Patterns of concentration show opportunities for forming rewarding businesses and where investors looking to benefit from exits could make their bets.

For many buyers, proximity matters. Buying a business is only the beginning of a transaction. The purchased business is generally integrated into the purchaser's other operations to achieve efficiencies and other benefits. This may make a cross-country deal less desirable, because of the integration challenges raised by having to transport parent company personnel across country for an extended integration period. This integration complexity raises the bar on business acquisitions where the business acquired is not particularly large. In situations such as this, it is often better to move the acquired company's personnel to the parent's home office, than to attempt a cross country integration.

This results in a strong correlation between a region's dominant industry and the industries in which acquired local businesses operate. It is easier to sell to a local purchaser, particularly when a business is still small and growing. This reality leads entrepreneurs looking to grow businesses for eventual sale to be very conscious of the desirability of building a business of value to the larger companies in their region.

The next few pages of this report provide hard numbers on the region's M&A activity. The data is presented first, in text and figures. The implications of this data will then be discussed.

A prior study by Amplifier Advisors that looked at M&A in Silicon Valley and the Greater Washington Region measured deals from 2006 to 2011.[4] It supports this correlation. During the five-year period, 48% of deals involving Internet software technology companies and 62% of deals involving semiconductor companies were between buyers and sellers both located in Silicon Valley.

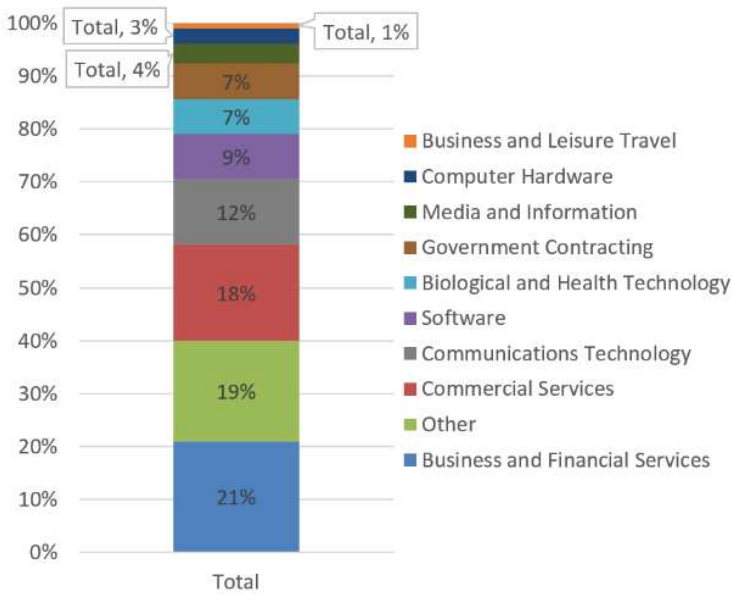
[4] "Merger and Acquisition Trends in Silicon Valley and the Greater Washington Region: 2006 – 2011," Jonathan Aberman, 2012

During the same period, in the Greater Washington Region, 50% of deals involving technology services companies and 40% of media company deals were between buyers and sellers both located here.

Broadening the scope of examination to include all M&A between 1995 and April 2016, we looked at three types of completed M&A transactions: 1) buyer and seller both located in the Greater Washington Region ("intra-market M&A") 2) buyer inside the region and the seller outside the region ("outbound M&A") and 3) buyer located outside the region and the seller inside ("inbound M&A").

During the reference period, there were 11,896 completed transactions with an aggregate transaction value of close to $1.6 trillion involving businesses in the Greater Washington Region. Of these transactions, 1,687 were intra-market M&A ($135 billion in aggregate value), 6,209 were outbound M&A ($801 billion in aggregate value) and 4,000 were inbound M&A ($601 billion in aggregate value). Buyers in the region purchased more companies outside the region, by number and value, then buyers outside the region bought our local companies.

Figure 7
Billion Dollar M&A,
Greater Washington Region 1996 - 2016

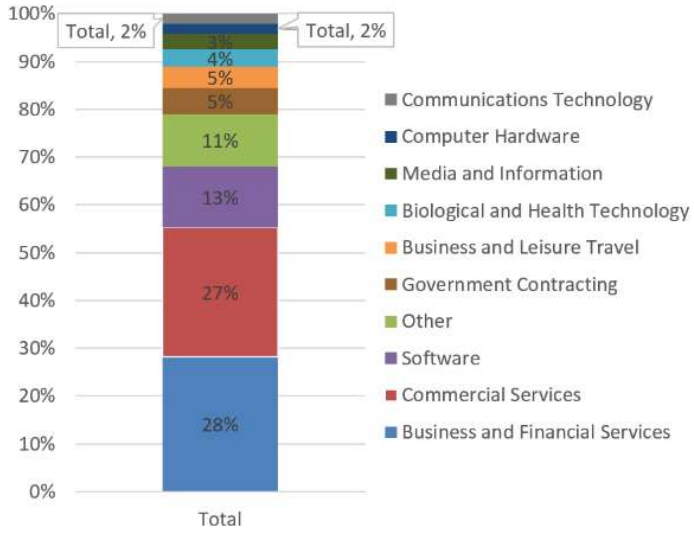


Source: Capital IQ

Figure 7 shows that during the reference period, 105 companies in the region sold for $1 billion or more. It also shows the remarkable number and diversity of these companies. Significantly, 89 of these transactions involved buyers from out of region. The purchased

companies were concentrated in business and financial services (21%), other[5] (19%), commercial services (18%), communications technology (12%) and software (9%).

Figure 8
Intra-Market M&A,
Greater Washington Region 1996 - 2016



Source: Capital IQ

Figure 8 shows the industry concentrations during the reference period for intra-market M&A – deals where the buyer and seller were both located in the region. The data show a significant concentration in business and financial services and commercial service, with software as the next largest sector. The purchased companies were concentrated in business and financial services (28%), commercial services (27%), software (13%), other (11%) and government contracting (5%).

[5] For the M&A data a category that includes commercial businesses not otherwise relating to technology or commercial services.

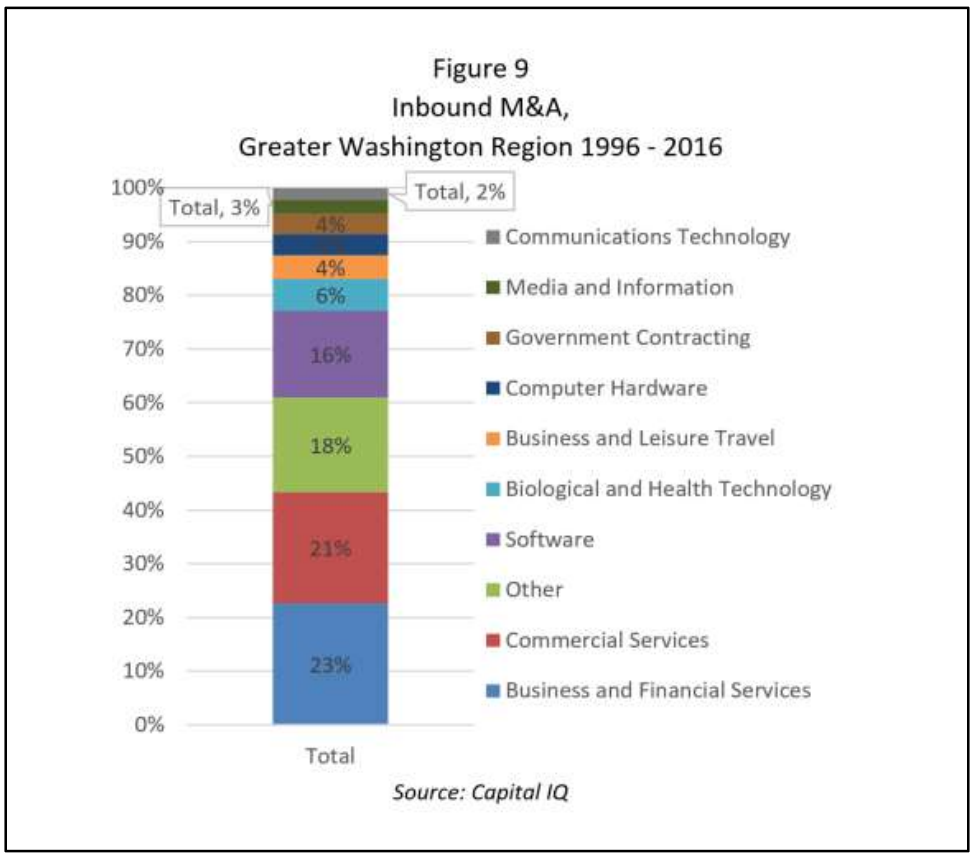


Figure 9 shows the industry concentrations during the reference period for inbound M&A – deals where the buyer comes from outside the Greater Washington Region. The concentration of businesses sold were business and financial services (23%), commercial services (21%), other (18%), software (16%) and biological and health technology (6%).

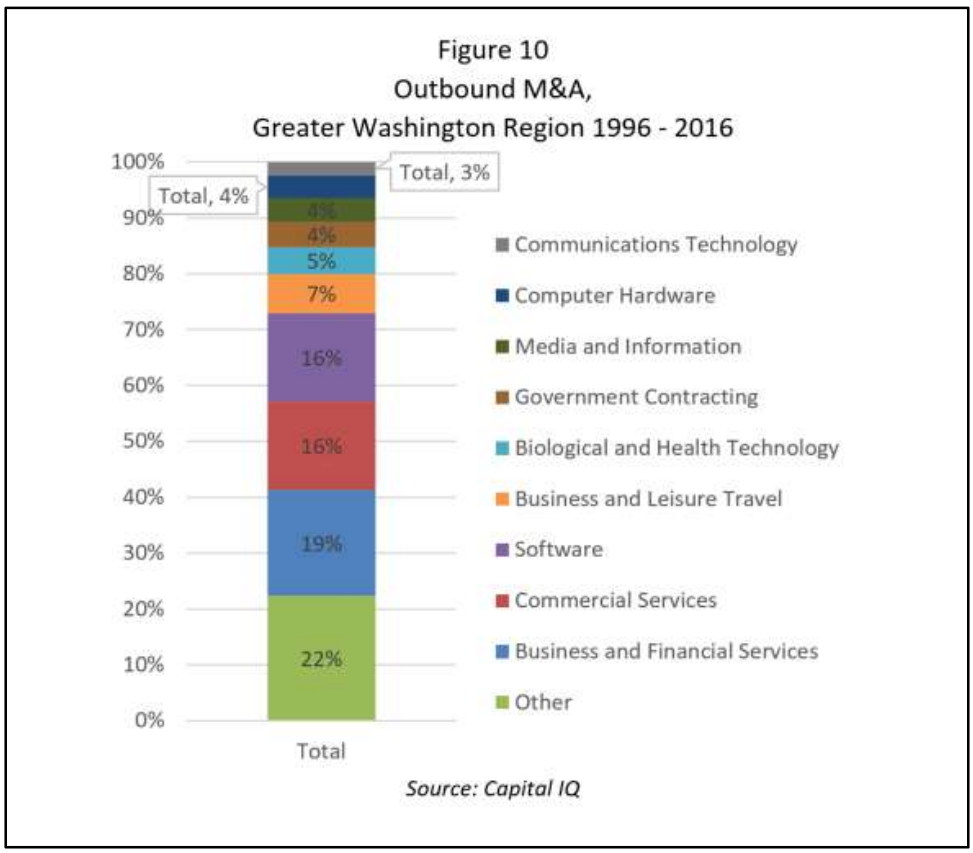


Figure 10 shows the industry concentrations during the reference period for outbound M&A – deals where the buyer is inside the Greater Washington Region. Companies purchased out-of-region were concentrated in other (22%), business and financial services (19%), commercial services (16%), software (16%) and business/leisure travel (7%).

During the reference period, the number of in-region businesses purchased (6,687) was roughly equivalent to the number of businesses purchased by the region's companies in other parts of the United States. It is clear, therefore, that the region has an active M&A market.

Further review of the M&A data leads to these important conclusions:

- Certain regions of the United States pay more attention to the region's business community that do others. Buyers were concentrated in: New York (14%), California (13%), Texas (6%), Massachusetts (6%) and Pennsylvania (5%).
- When a business was purchased in the region, it was highly likely that the purchaser was from elsewhere. During the reference period, 70% of businesses were sold to out-of-region purchasers. Our high tech companies in software and biotechnology were

regularly acquired by out-of-region purchasers, and key positions were moved to other locations.[6]

- The Greater Washington Region is a rewarding location to grow a services or consulting business. The concentration of industry types – particularly in the commercial services, business and finance and other categories – is shown in Figure 8.

- We have a vibrant, homegrown M&A market. Our companies reach out-of-region to purchase software businesses and biotech business at roughly the same rate as inbound purchasers. This strengthens the argument that we should connect the region's software and biotech businesses to our local industrial base. A supply and demand relationship already exists that could serve numerous regional development objectives. "Buy local" should become a mantra for the region.

- There is a high incidence of businesses that owe their uniqueness and success to proximity to the federal government. Note that this concept of proximity is broader than seeing the government just as a customer or a funding source.

Prominent examples of this pattern include Capital One, which was founded in the region to pursue a new approach to consumer credit. The founders spotted a large new market opportunity in providing credit cards to narrow demographics or through direct marketing. Being close to the regulators and thus able to gather valuable insights into regulatory trends allowed Capital One to grow a unique business. Moreover, the progeny of Capital One – businesses started by the people who originally built Capital One – include many market leaders in direct marketing using technology. Successful entrepreneurial innovation companies such as Advertising.com and Millennial Media, were grown by entrepreneurs who graduated from Capital One.

In other examples, MCI changed the telecommunications industry – eroding the monopoly on long distance telephony held by AT&T – by being proximate to the regulators that were shaping approaches to new telecommunications technology. AOL and the popularizing influence of the Internet and email were developed here in close proximity to the Internet backbone and web protocols developed by the Department of Defense. AOL has countless

[6] This has created a concern reflected in many of our interviews that M&A patterns have created a "brain drain" in the region and that we lose experienced entrepreneurs to other regions since they relocate as part of a business sale. When businesses are acquired, buyers usually incorporate the purchased business into their existing operations. When an acquisition occurs out of region, post-acquisition integration often shifts the critical mass of the acquired business to the parent's location.

progeny, ranging from venture funds like Revolution, sports powerhouse Monumental Sports, accelerators like 1776 and Launchbox, and the many startups founded or funded by AOL alumni.

Medimmume, a local biotech company is now the center of a growing regional network supporting biotech innovation. It was started by a technology transfer from the National Institutes of Health. Network Solutions was able to turn a federally granted franchise to manage domain names into the largest IPO in Internet history.

When a highly successful exit occurs, the wealth created by the transaction, as well as the human talent that is freed up to look for its "next act,", become regional assets.. Keeping our exits local should be a primary concern.

This region has what it takes to be a place where entrepreneurs can start and grow valuable, rapidly-growing businesses. When compared to other regions including Silicon Valley, it is clear that there is a process unique and indigenous to the region. There is a Greater Washington Region model for innovation.

4. Where Venture Capital Flows

Venture capital is the lifeblood of high-growth businesses whose growth opportunities exceed the amount of cash they can generate internally. A business grows organically by reinvesting retained profits, but certain businesses – particularly those using technology innovation – simply cannot achieve their potential through revenue alone. For them, venture capital is the only viable source of expansion capital.

In certain sectors, success depends on attracting a critical mass of customers. This phenomenon, known as "dense customer adoption," is common to industries characterized by network effects. In these industries, customer acquisition precedes profit and even precedes revenue in many cases. A good example is a social network like Facebook, or a dating app, which only have value if enough people participate. For these types of businesses, venture capital is the only likely source of expansion capital, since revenue cannot provide cash for growth.

The national venture capital market is a large source of funding for rapidly-growing entrepreneurial innovation businesses using technology. Figure 11 shows the distribution of investments by industry for 2015.

Figure 11

National Venture Capital Funding by Area, 2015

Region	Funding	Percent
Silicon Valley	27,347,831,700	46.5%
NY Metro	7,317,247,500	12.4%
New England	6,052,815,300	10.3%
LA/Orange County	5,105,655,100	8.7%
Southeast	2,258,938,300	3.8%
Midwest	2,248,873,600	3.8%
Northwest	1,501,790,900	2.6%
DC/Metroplex	1,414,568,100	2.4%
Texas	1,170,788,400	2.0%
San Diego	1,166,568,700	2.0%
SouthWest	919,046,700	1.6%
Colorado	782,622,600	1.3%
Philadelphia Metro	609,898,400	1.0%
North Central	598,898,500	1.0%
Upstate NY	159,675,900	0.3%
South Central	106,432,800	0.2%
Sacramento/N.Cal	43,215,800	0.1%
Unknown	6,320,000	0.0%
Grand Total	**58,811,188,300**	**100.0%**

Source: PricewaterhouseCoopers

Figure 11 shows that the Greater Washington Region's venture capital market is relatively small compared to other nationally recognized clusters of innovation. It is the 8th largest market by capital invested in 2015. Silicon Valley is the dominant recipient of venture capital, commanding 47% of venture capital invested. Boston and New York both receive significant amounts. Almost $250 million of the funding for the region reflects financing for one company, Tenable Network Security; without that large infusion, the Greater Washington Region would have been ranked 10th on this list.

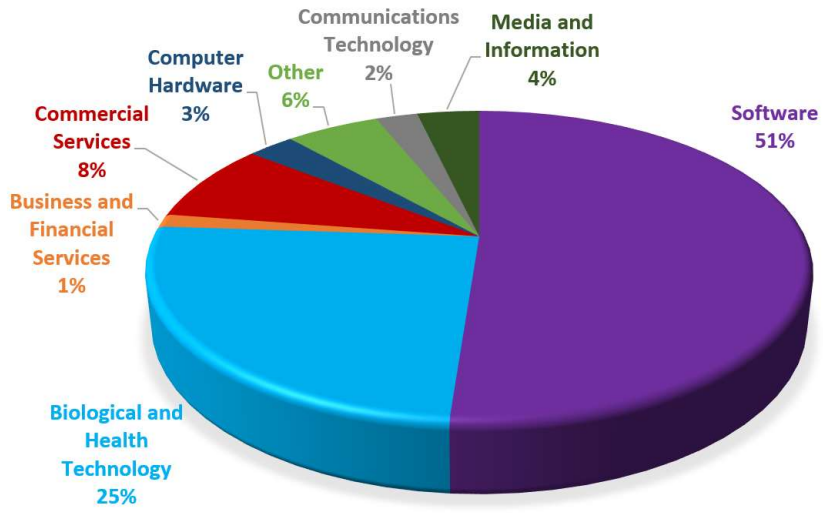
Figure 12
National Venture Capital Funding by Industry, 2015

Industry	Funding	Percent
Software	23,595,257,800	40.1%
Biological and Health Technology	10,971,900,500	18.7%
Communications Technology	4,867,857,200	8.3%
Commercial Services	4,800,123,000	8.2%
Media and Information	4,748,750,900	8.1%
Other	4,260,860,800	7.2%
Business and Financial Services	3,657,997,900	6.2%
Computer Hardware	1,908,440,200	3.2%
Grand Total	**58,811,188,300**	**100.0%**

Source: PricewaterhouseCoopers

Figure 12 shows the industries in which venture capital is invested nationally. It is not spread among all business types reflected in the Inc. 500 list. In fact, there was hardly overlap at all between the companies listed and the recipients of venture capital. This reinforces the argument that business types that can grow through revenue are very different from those that can grow using venture capital. Compare the prevalence of software companies on Figure 3 (none) to the percentage of national venture capital dedicated to software companies (41%) and locally (51%).

Figure 13
Venture Capital Funding by Area
Greater Washington Region, 2015

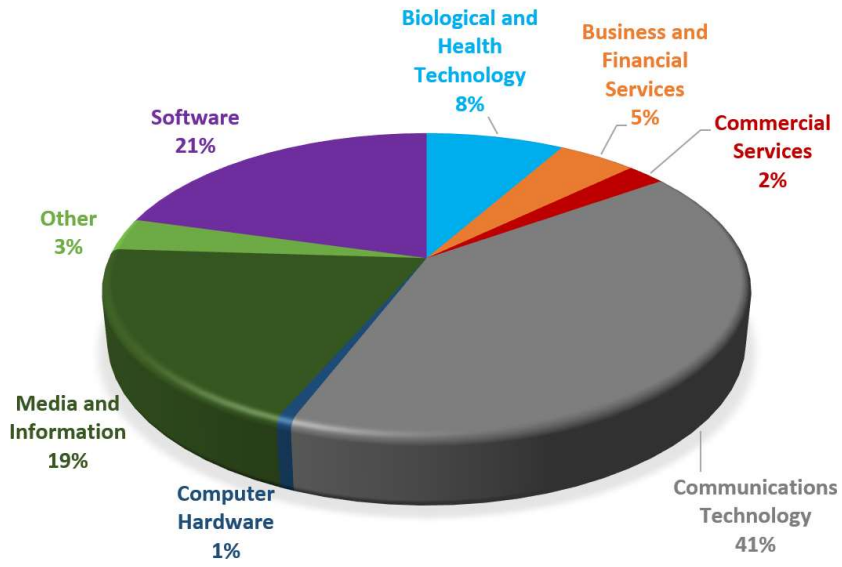


Source: PricewaterhouseCoopers

Figure 13 shows the largest recipient of venture capital in the region was the software industry, receiving 51% of all invested capital. Biological and health technology received 25% of venture capital invested locally, and commercial services received 8%.

Comparing these percentages with national investment levels (as shown in Figure 12) shows that the region receives more investment in software and biotech/ health technology, and comparatively less in communications technology, media/ information, and business/financial services.

Figure 14
Venture Capital Funding by Area
Greater Washington Region, 1999



Source: PricewaterhouseCoopers

Figure 14 shows a very different pattern of venture capital investment in the Greater Washington Region in 1999. Communications technology received 41%, software 21%, media/information 19%, and biological/health technology received 8% of invested venture capital. There was a greater overlap between our revenue-led growth companies (the companies on the Inc. 500 list) and those funded by venture capital in 1999 than in 2015.

This change is likely due to the Greater Washington Region's relationship to the prevailing industrial growth cycle. In the late 1990s, the development of the Internet and the Internet's change from being a hobbyist-driven industry to a consumer-adopted industry was very much centered in the region. The Internet was quite literally invented in the region, with the initial infrastructure – both hardware and software – developed here. Regulatory changes that facilitated this industrial trend emanated from the proximate federal government, creating tremendous local opportunities to establish companies in the vanguard of this new industry. This allowed the regional companies to both command venture capital and grow revenue off a strong group of local customers.

The next generation of web companies that incorporated social networks and mobile technologies was largely driven by Silicon Valley companies that are largely not subject to industry-specific federal regulation. Many of these businesses were not likely cash customers for

vendors as had been many of the leaders of the first Internet wave. The relationship between larger companies and developing ones in this second wave was more likely to result in an acquisition to build scale. This meant that many tech entrepreneurs in the region had to choose between building businesses relevant to companies out of region – and trade revenue for rapid growth – or pursue ones that would provide revenue from local customers.

This dichotomy explains the divergence between the industrial concentrations represented on the Inc. 500 list in Figure 3 and the venture capital concentrations in Figure 14. Two distinct entrepreneurial ecosystems formed: one focused on developing "Web 2.0" innovation technology businesses and one developing innovation businesses (sometimes using technology) focused on local customers, primarily government.

This separation of ecosystems has had a number of effects. Firstly, for many companies built with venture funding, the likely acquirer was on the other side of the country. This put an upward limit on exits, due to the logistical challenges of buyers purchasing businesses out-of-region and having to integrate them. The absence of consistent exits, in turn, made the region less attractive to venture capitalists. Secondly, the perceived drop in exit activity created a chronic perception of insufficient venture capital for entrepreneurs. Thirdly, the prevalence of exits in other markets such as Silicon Valley had the effect of pooling venture capital in those markets. This meant that when a business from the region got to the point of being a candidate for venture capital funding, much of it would come from out of region. That, in turn, made the company more likely to ultimately leave the region, as venture capitalists arrange M&A with buyers they know who are local to them.

5. Business Accelerators

Local governments and private entities have formed start-up accelerators in hopes of compensating for the limited availability of venture capital, and they attempt to accelerate businesses to the point where they can obtain venture capital or exits.

The term "accelerator" describes a broad range of business models that share certain characteristics: helping founders with the formation of new companies through mentorship, partnership connections, access to related expertise (for example, how to set up a limited liability company or hire and organize a sales team) and access to investors. Accelerators provide access to resources to start a business.

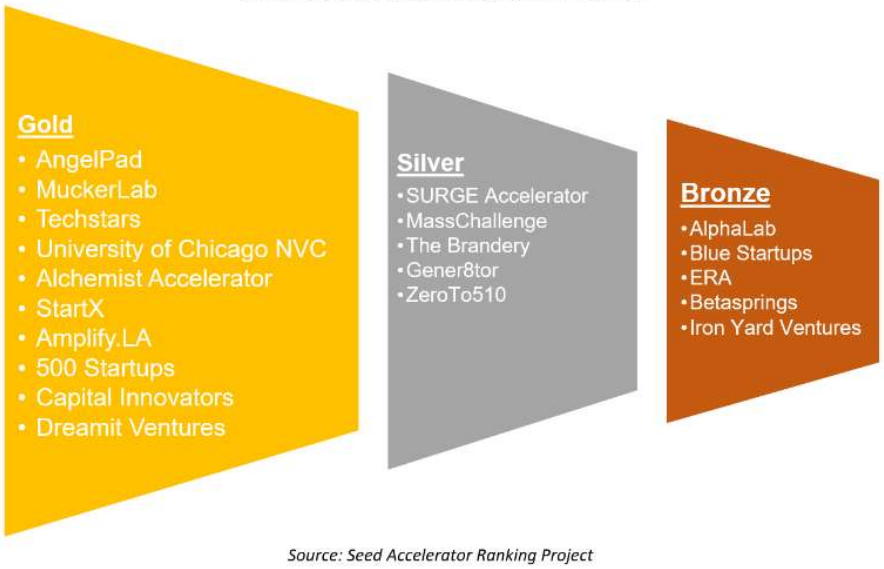
Accelerators may receive equity ownership, licensing revenue, rental fees and membership dues from the fledgling businesses they assist. Not all of the region's accelerators are for-profit businesses; some are located at universities or supported by regional economic development authorities. The term "incubator" is sometimes used to distinguish a support program that does not seek an equity interest in participating companies or is not purporting to get participating companies to a venture financing or exit in a short period. The most prominent

of the regional accelerators, including 1776, Mach37, Healthcare Innovations, and Eastern Foundry, are commercial businesses – owners receive fees or other income and capital gains if they have a corresponding investment activity or receive equity.

The growth in business acceleration has been a national trend, with more than 700 accelerators operating in the United States.[7] The Obama Administration has been a particularly strong supporter of the acceleration model.[8]

Acceleration is supported by many engaged entrepreneurs and businesses. In March 2016, Steve Case, one of the region's most forward-thinking innovators, teamed up with others to invest $7.2 million in the 1776 Acceleration Program. In another example, General Dynamics made a significant financial commitment to the Mach37 Cyber accelerator.

Figure 15
The 20 Best Accelerator Programs in the U.S.



Source: Seed Accelerator Ranking Project

Measured against the success of creating businesses that receive significant expansion venture capital or are exited, the region has not to date had a successful accelerator program. A prominent ranking survey shown in Figure 15 identifies the 20 best accelerator programs in the United States. The Seed Accelerator Rankings Project is a prominent survey undertaken by a multi-university research team, evaluates accelerator success by looking at how much capital is

[7] "Accelerating Growth: Stratup Accelerator Programs in the United States," Ian Hathaway, Brookings, 2016.
[8] "Innovation Accelerators: Defining Characteristics Among Startup Assistance Organizations," Small Business Administration Office of Advocacy, 2014.

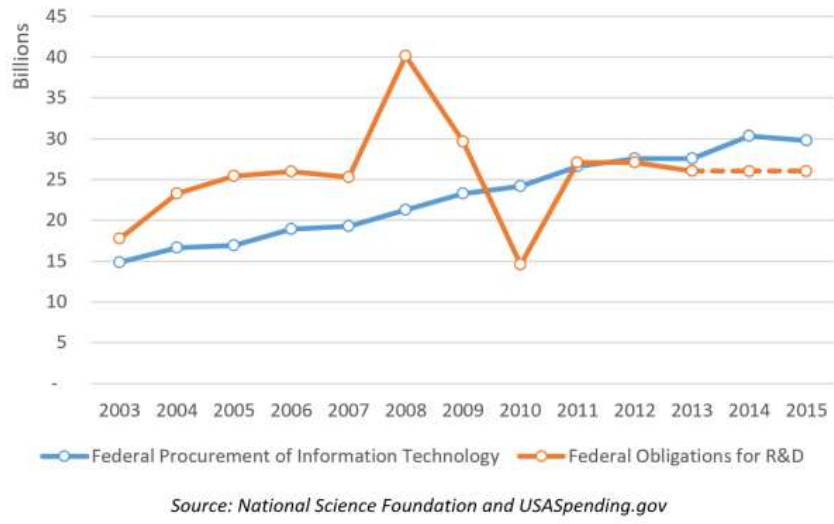
raised and whether a company goes public or is sold after "graduating" from an accelerator program. Based upon these metrics, accelerators in the region suffer in comparison to programs based elsewhere. The question is why.

The answer might be that the region does not provide the required density of financing and exit opportunities for many of the companies participating in our accelerators. If success is measured by obtaining downstream financing or exits, then the region must act to create conditions for our accelerators' success: financing or buyers. Or, looked at from the other end of the telescope, the right start-ups for the existing community of buyers.

6. Following the Money: Federal Spending on Innovation

The flow of federal dollars into the Greater Washington Region to finance innovation development and purchase information technology is larger than venture capital by a large amount.

Figure 16
Federal Spending in the Greater Washington Region, 2003-2015



Source: National Science Foundation and USASpending.gov

Figure 16 shows federal funding flows into the Greater Washington Region for information technology and for research and development. This provides a backdrop for the influence of federal spending on entrepreneurial activity. The amount of federal spending in the Greater Washington Region in 2015 for information technology was $30 billion and for research and development in 2013 (the most recent year for which regional data can be obtained) the amount was $26 billion.

Federal spending for research and development in the region includes money paid to industry, academia, federal labs and federally funded research and development corporations (FFRDCs) to develop new technologies and to apply technology to problems of national interest. The Department of Defense, NASA and the Department of Health and Human Services (the home of the National Institutes of Health (NIH)) are the dominant research and development funders for the region. In 2013, the region received $26 billion in federal research and development dollars.

In the aftermath of sequestration, and in light of the thrust of the Roadmap Project – addressing the challenge of regional economic diversification – it is important to examine the huge difference between what the federal government spends here on innovation – $26 billion – and what venture capitalists invest – $1.4 billion. Conventional wisdom says federal money creates a dependency that should be broken. But that money can be an opportunity to be embraced as our advantage over other regions.

The region should differentiate between federal spending that drives innovation and entrepreneurial activity, on the one hand, and funding that supports a "cost plus" service business on the other. The "cost-plus" business has a major role to play in the regional economy, but it rarely has a business model that leads to explosive job growth. Having the federal government as a customer does not make an entrepreneur less worthy of respect; what matters is whether his or her work results in a high-growth innovation business in an area of regional interest.

In the region, the likely source of blue ocean technology innovations is federally funded research and development. Although private industry spends more nationally on research and development than does the federal government, the balance is reversed in the region. Capturing federally funded research and development dollars is essential for the region to identify new industrial opportunities.

7. National Security Agencies Are Looking Elsewhere for Innovation

A disturbing trend is emerging in how the federal government sources new innovations from the private sector. Over the last year, the Department of Defense, Department of Homeland Security, the State Department and the Army have each opened offices in California to seek new innovations from private businesses, particularly entrepreneurial innovation businesses. The Department of Defense also opened an office in Boston with a similar mission.

In August 2015, the Pentagon created a $171-million Silicon Valley-based consortium of 162 businesses and not-for-profits to create advanced wearable technologies. The participants include Apple, Boeing and Lockheed Martin.[9] In April 2016, a $317-million consortium was

[9] "DoD Ties Closer to Silicon Valley with FlexTech Initiative," Defense News, August 29, 2016.

created in Boston to pursue the creation of advanced materials.[10] In announcing this consortium, Secretary of Defense Ash Carter stated, "I am trying to broaden the base of those who serve the national defense and national security and that includes both people and technology." To date, no similar effort has been announced in the Greater Washington Region.

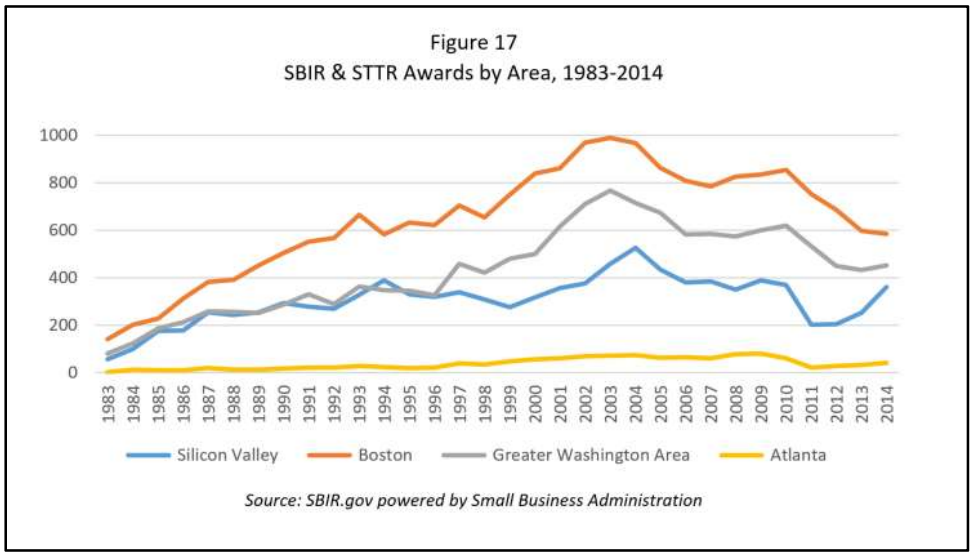


Figure 17 reviews federal awards in the Small Business Innovative Research (SBIR) and Small Business Technology Transfer Research (STTR) grants to Boston, Atlanta, Silicon Valley and the region. These programs allow the federal government to get capital into small, high-growth businesses to build new innovations for the federal government. It shows the overall drop in funding due to budget challenges and sequestration. It also shows the growth of Silicon Valley's funding from these programs. The change in grants to Silicon Valley reflected in this data may indicate a weakening of the region's leadership as a source of federally funded technology innovation.

8. Observations

A review of data and individual impressions gathered during discussions with the region's innovation community leads to the following observations that will help shape further discussion. (See also "Recommendations" below).

The Greater Washington Region is a national leader in revenue-led businesses, based upon its performance in the Inc. 500 survey, with most being entrepreneur-driven innovation businesses. The region is a compelling location for new entrepreneurial activity.

[10] "DoD Announces Award of New Revolutionary Fibers and Textiles Manufacturing Innovation Hub Lead in Cambridge, Massachusetts," U.S. Department of Defense, Release No. NR-115-16, April 1, 2016.

The region lags, however, in the formation of entrepreneurial innovation businesses that depend on venture capital funding. This is reflected in absolute dollars invested, the relatively poor performance of our accelerators, and exits as compared to other regions known for fostering the development of entrepreneurial, innovation-based businesses.

The data show a clear disconnect between the regional businesses and where they themselves look for innovative businesses to acquire. Outside acquirers purchase our software and biotech and healthcare businesses at a higher rate than does our own business base. It appears that the region's entrepreneurs are building technology innovation businesses that are of greater interest to buyers across the country than down the street. That might be good for them but not optimal for the region.

Finally, looking at M&A and IPO data – particularly for the exits above $1 billion in value – there is a recurring model for success that ties entrepreneurial business innovation to proximity to the federal government. In many cases, it doesn't necessarily reflect having the federal government as a customer, but rather having the government as a source of insight, technology and opportunity.

D. Technology Transfer is an Opportunity for The region – If We Look in the Right Places

1. Technology Transfer

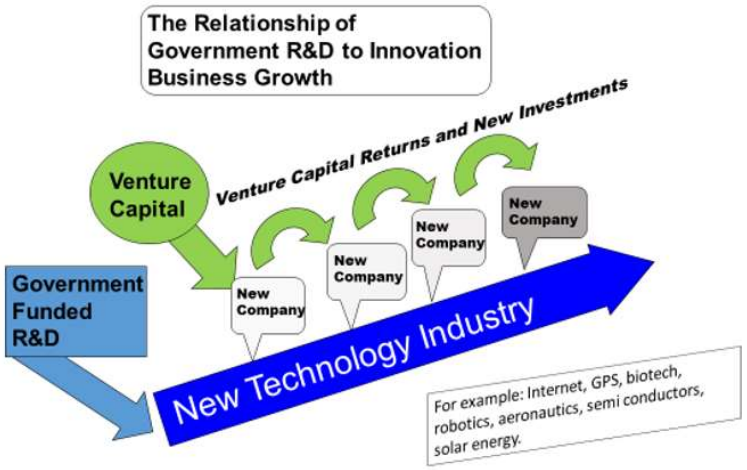
Technology transfer is the process of converting research into a commercial technology. This can occur by licensing the technology into an established company or by transferring the technology into a new business formed for this specific purpose. When technology is federally funded, the government has a strong preference that licenses go to small businesses.

The Roadmap Project identified technology transfer as an opportunity for the Greater Washington Region to create jobs, focusing on R&D from universities and federal laboratories in the region. Because our work focuses on the creation and growth of entrepreneur-led innovation businesses, our analysis now turns to the region's ability to translate the fruit of federal R&D into new businesses.

The positive relationship between federally funded R&D and industrial development does not garner the attention it warrants. Railroads, interstate highways, the Internet, biotechnology, artificial intelligence and robotics are just a few of the industries fostered by federal R&D. The region's prominence in the adoption and boom of the Internet in the late 1990s was directly related to the transfer of the underlying technology from the government into private hands. The National Research Council recently studied the long-term economic effects of federal funding of information technology research. Looking at 30 tech companies that had received initial

government funding, it determined that the portion of revenue traceable to the government-funded research was nearly $500 billion annually.[11]

Figure 18
The Relationship of Federal R&D and Innovation



Source: Jonathan Aberman

Figure 18 shows the relationship between technology transfer and venture capital. Venture capital does not finance tech R&D; it seeks to finance entrepreneurs using technologies to provide a product to customers. This relationship – well acknowledged by the venture industry and academic observers[12] – shows how enabling scientific inquiry to support new industrial opportunities is undertaken by industry, universities, federal labs and federally funded private labs.

Many in the economic development field, such as Brookings Institute's *Global Cities Initiative*, an effort that is prominently mentioned in the region, focus on technology transfer out of universities as the primary pathway for realizing on creating new businesses based upon technology innovation. Based upon the relatively low percentage of research and development funding that flows to the region's universities, as well as certain significant structural impediments that have to date limited their ability to be among national leaders in technology

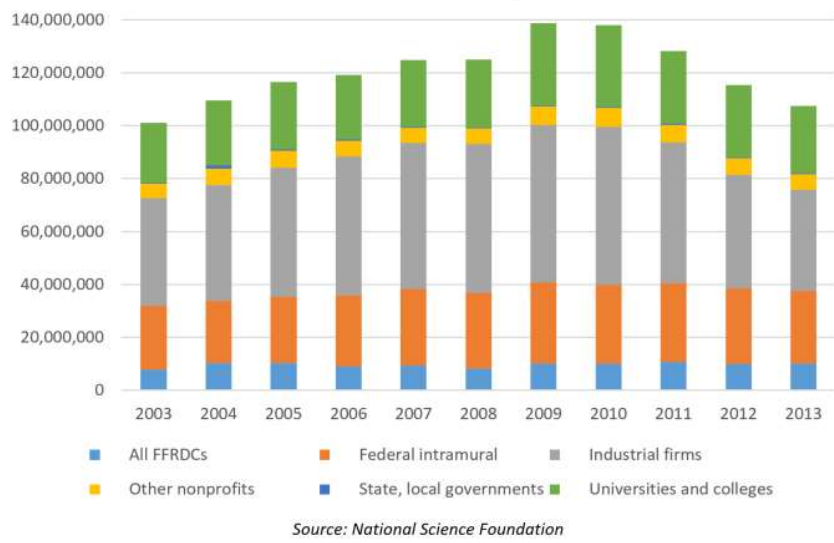
[11] "Continuing Innovation in Information Technology," National Research Council of the National Academies, Committee on Depicting Innovation in Information Technology, 2012.
[12] An example of viewpoints on this relationship can be found in "The State of Innovation: The U.S. Government's Role in Technology Development," edited by Fred Block and Matthew R. Keller, 2011.

commercialization, universities should not be the primary focus of the region's efforts surrounding commercialization of federally funded research and development. Focusing on other sources of technology, particularly industry and FFRDCs, should be considered.

2. Federal Research and Development Funding

Research and development activities are the seeds from which industries grow. The federal government spends billions of dollars each year on research and development.

Figure 19
National Federal R&D Funding, 2003-2013



Source: National Science Foundation

Figure 19 shows that in 2013, of the $107 billion provided in R&D funding by the federal government, industry received 40%, federal labs 25%, universities 21% and federally funded research development corporations (FFRDCs) received 8%. As will be seen below, the region's universities received a significantly lower percentage (and industry a comparatively higher percentage) when compared to national trends.

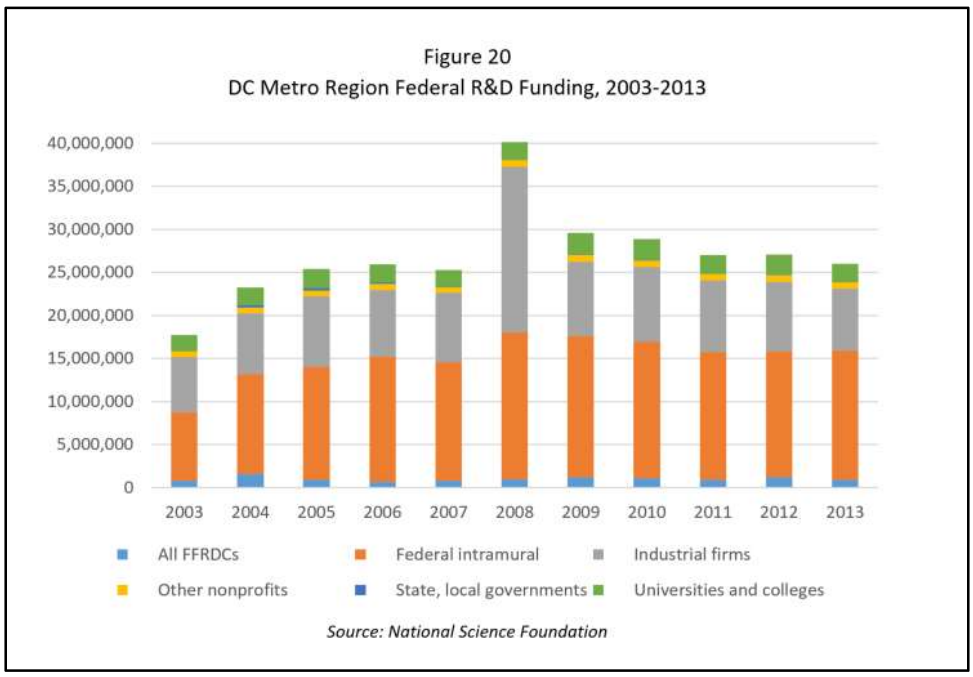


Figure 20 shows that the Greater Washington Region receives a large percentage of total federal R&D spending. It received $26 billion in R&D funding in 2013, and has been a constant recipient of funding for an extended period.

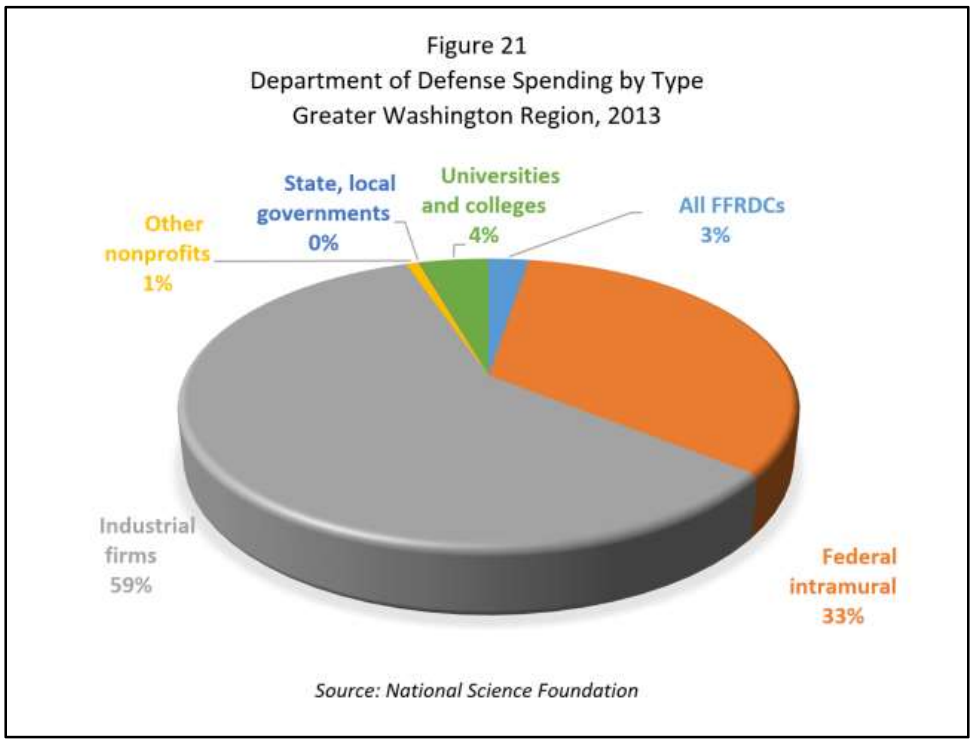


Figure 21 shows the distribution of recipients for federal R&D funding from the Department of Defense in the region in 2013. The majority of funding from the Department of Defense in the region goes to industry (59%), followed by federal labs (33%), FFRDCS and universities.

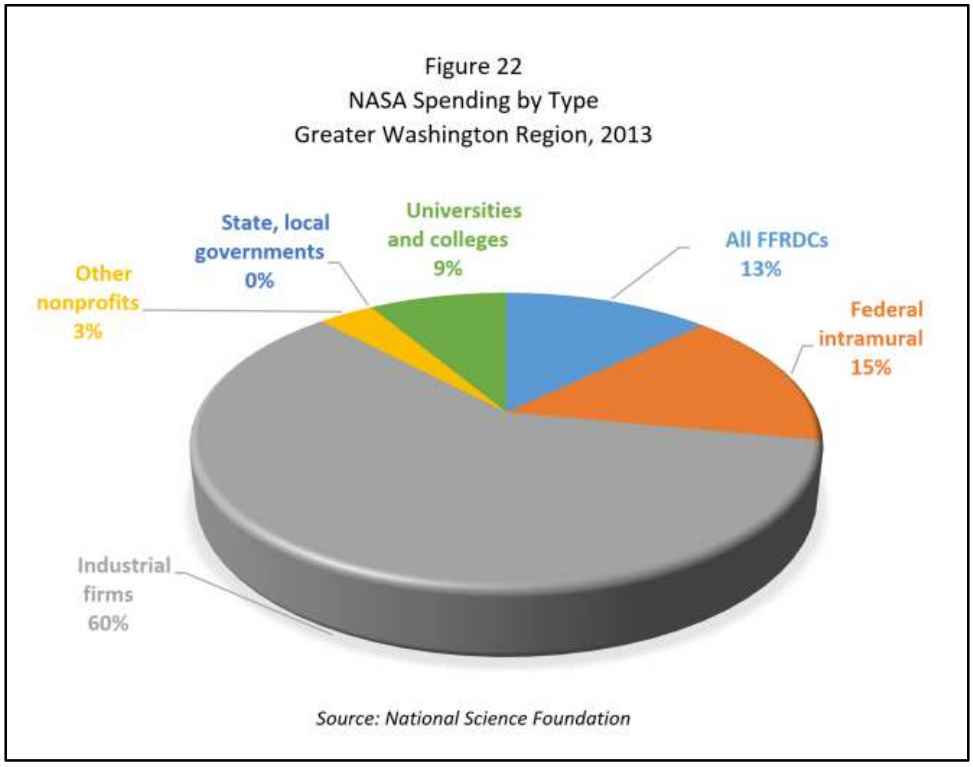


Figure 22 shows the distribution of recipients for federal R&D funding from NASA in the region in 2013. NASA also allocates a substantial portion of its funding in the Greater Washington Region for industry (60%), federal labs (19%), FFRDCs (19%) and universities (9%). Both Figure 21 and Figure 22 show that for the region to focus on technology transfer, the universities may not be the first place to look.

3. Our Universities Matter for Reasons Other Than Technology Transfer

Although they may not be best positioned to lead the region's technology commercialization efforts, universities have an important economic role in the region. Indeed, universities generally engage in five kinds of economic activity contributing to regional economic development.[13]

[13] "The Diversity of University Economic Development Activities and Issue of Impact Measurement," (University ED) at 34, Thomas Gais and David Wright, in Universities and Colleges as Economic Drivers (Drivers), Jason E. Lane and D. Bruce Johnstone, eds. SUNY Press, 2012.

- They are economic units. Universities can provide a wide range of jobs beyond faculty and administrative positions. They hire maintenance and ground crew, information technology specialists, electricians, mechanics, electricians, and more. Universities rarely leave the area in which they were first established, making them long-term economic contributors to their communities.

- Universities can foster community vitality. They provide cultural, recreational, and intellectual resources and opportunities. They are a high-value amenity.

- They are developers of human capital, but their influence in this capacity depends on how many graduates stay in the area. In this regard, there can be a distinction between the role of research universities, on the one hand, and the role of other educational institutions. Technical and community colleges are more suited to providing job-specific training to meet the needs of a particular employee and that are not offered for credit towards a degree. Technical and community colleges are also well-suited to developing degree programs that prepare graduates for the local economy's anticipated needs.[14]

- If they determine to make the necessary investments, universities may be sources of assistance to business. They may provide access to labs, office space, computing resources and incubators. They may also provide advice and training to entrepreneurs.

- Universities that undertake research may be sources of innovation. Basic research, however, does not necessarily lead to market innovations. Universities therefore may engage in other activities, such as technology transfer, assistance to licensees, promotion of interdisciplinary research and research collaborations and partnerships.

Although it is relatively straightforward to see these activities being undertaken in many the region's universities, the economic impacts of these activities are difficult to measure. They are also "contingent on many factors not controlled by the university."[15] Thus, one university's success does not necessarily provide a road map for another.

However, general success in driving economic development is very different from success in technology commercialization.

[14] University ED at 35-38; The Essential Role of Community Colleges in Rebuilding the Nation's Communities and Economies, at 191-205, James Jacobs, in Drivers.
[15] University ED at 48.

4. Our Universities Need Our Help

Historically, the region's universities have not been particularly successful in converting federally funded research and development into profitable and growing new businesses. Part of this is due to the federal rules that universities must operate under to receive federal research and development dollars. For example, "conflict of interest" rules. The Bayh-Dole Act of 1980 was intended to "promote the utilization of inventions arising from federally supported research and development," as well as to support small business participation in federal R&D and to promote collaboration between the commercial sector and non-profit entities.[16] The Act gave universities the option to own inventions made with federal R&D dollars and to license them for commercial development.

Bayh-Dole led universities to contemplate a future of lucrative license arrangements based on faculty inventions. Universities established Technology Transfer Offices, generally responsible for reviewing faculty invention disclosures, determining whether to patent disclosed inventions, and licensing them for commercialization. Universities increasingly patented their inventions to enhance their value. Before Bayh-Dole, universities obtained about 250 patents per year. In 2000 alone, the nation's 89 most research-intensive universities were issued more than ten times that number.[17] Universities often incurred substantial expenses in staffing their TTOs and paying legal expenses.

Yet technology transfer has been a money-loser for most universities in the country, and the region's universities conform to the general pattern. More than 80% of TTOs do not cover their own costs. In 2012, 84% of university TTOs did not earn enough licensing income to pay their staff and patenting costs. And 2012 was a "good year," because "over the last 20 years, on average, 87% did not break even."[18] Other sources report that fewer than 10% make any money.[19]

The list of universities that earned the most from technology transfer from 2003 to 2012 has been remarkably stable. Only 37 different universities have ever cracked the top 20 revenue earners, and eight have been in the top 20 every year. None of the region's universities made the top 20 list during the decade analyzed.[20]

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[16] 35 U.S.C. §§200-212.
[17] The Fountain of Knowledge: The Role of Universities in Economic Development (Fountain) at 47, Shiri M. Breznitz, Stanford University Press (2014).
[18] University Start-Ups: Critical for Improving Technology Transfer (University Start-Ups), at 9, Walter D Valdivia, Center for Technology Innovation (2013).
[19] "Virginia Universities Draw Criticism for Tech Transfer Programs," http://wamu.org/12/04/16/virginia_universities_draw_criticism_for_tech_transfer_programs (April 16, 2012).
[20] University Start-Ups at 8.

The total amount spent by universities on research is directly related to the likelihood of earning substantial licensing revenue. Universities with higher research expenditures are more likely to come up with a blockbuster (revenues in excess of $10 million) innovation.[21]

In 2012, eight universities took 50% of the total licensing income; 16 universities – the top 10% – received nearly 75% of the total licensing income.

Revenues are unevenly distributed by subject matter. Drugs and medical devices account for many of the financial successes. In fact, the official responsible for research throughout the entire University of California system says that for most universities, giving up on everything but drugs and medical devices would not hurt their revenue prospects.[22]

Revenues are also unevenly distributed among licenses. For universities earning significant income from technology transfer activities, most revenues are attributable to one or two licenses. An estimated 99% of income is generated from less than 1% of the inventions disclosed to the TTO.[23]

It must be noted that patents are a poor measure of the value of an invention. Most patents have little or no commercial significance.[24] First, patents don't indicate the commercial value of an invention. U.S. Patent 5,443,036 A, "Method of Exercising a Cat," covered pointing a laser beam at the wall or floor and moving it around so that a cat would chase it. The patent was unenforceable, and thus worthless, without invading millions of cat-owning homes to catch pet-owners in the act. While strong patents can be very difficult to obtain, persistence and clever drafting can almost always obtain a narrow, weak patent that holds little value. At least half of all patented inventions in the US are never commercially exploited; only about 5% of issued patents are licensed for a royalty.[25]

Internal factors affect the likelihood of successful technology transfer, notably the quality and utility of the innovations themselves. Universities with higher research expenditures are more likely to be successful, and a university's entrepreneurial culture (or lack thereof) is also

[21] University Start-Ups at 11-12.
[22] Oral remarks of Steven Beckwith (Beckwith Remarks), then Vice President for Research and Graduate Studies, University of California, at Keynote Session, Pressures Faced by Universities to Bring in More Research Funding, National Association of College and University Attorneys November 014 CLE Workshop: Academic Sponsored Research and Development: Essential Updates, Emerging Issues, and New Challenges (November 2014) (personal communication from attendee).
[23] Tech Transfer Benchmarking, Alan Thomas, then-Director, Office of Technology and Intellectual Property, University of Chicago (2007). Another estimate is that 2% of licensed inventions generate 80% of the revenue. Beckwith Remarks.
[24] Mark A. Lemly and Carl Shapiro, Probabilistic Patents, Journal of Economic Perspectives, Volume 19, Number 2, Spring 2005, Pages 75-98..
[25] Sichelman, T., Commercializing Patents, 62 Stanford L. Rev. 341 (2010)

significant.[26] Entrepreneurial scientists have "special characteristics," including a high desire for independence and a strong need to achieve. They have a positive view of commercialization and are willing to collaborate with industry. Indeed, scientists who collaborate with industry have more citations than those who do not. Universities that approach technology commercialization with a bias towards startup formation often provide entrepreneurial professors with tangible support or encouragement to engage in such behavior – providing for a leave of absence to pursue a startup, or rewarding entrepreneurial behavior as a criterion for tenure.

The region's universities do not have an easy path to successful technology transfer. Most of their research is basic research, which is difficult to commercialize, since so much additional research and development is required before a product or service can be marketed. Applied research takes additional funds from different sources and requires a major commitment from the university's faculty and governing board.

Research at the region's universities covers a broad range of subjects, which in many cases is determined by the availability of grants to fund that research. Dependence on basic research grants can mean no funding for further development of an invention.

Other factors affect a university's ability to get its research to market. One is the wide breadth of research in our universities can indicate a lack of research of immediate interest to the surrounding community unlike, for example, a Midwestern land grant university emphasizing agricultural research that could benefit a dominant local industry. Another is a university's inability to reach "critical mass" in areas that would be good targets for commercially viable inventions.

It should also be noted that a university's attractiveness to new faculty members depends on having faculty members in the field currently.

5. Our Federal Labs Face Costly Challenges

The funding flows suggest that in light of the region's universities challenges in succeeding in technology transfer, more attention should be directed to the federal labs. There are 108 federal labs located in the Greater Washington Region.[27] Additionally, there are prominent FFRDCS such as MITRE, Institute for Defense Analyses (IDA) and Johns Hopkins Applied Physics Lab. The number and density of labs is a significant comparative advantage for the region, when compared to other regions.

The Obama Administration specifically identified the federal lab establishment and FFRDCs as a key asset for the development of new industries and mandated that each federal lab

[26] Fountain at 23-24.
[27] Federal Labs Consortium website www.federallabs.org

facility have a plan for accelerating technology commercialization.[28] However, federal labs suffer from their own regulatory hurdles and institutional challenges.

Federal research labs receive a substantial portion of federal R&D spending. Like universities, many of the labs are engaged in basic research, which is inherently difficult to commercialize. Unlike university scientists, federal lab researchers do not work under a "publish or perish" regime, and they may even be prohibited from publishing in some cases. Internal governance and conflict of interest rules dampen and even extinguish scientists' entrepreneurial inclinations.

Federal labs have had limited and patchy success in technology transfer. For example, in 2012, the Department of Health and Human Services accounted for the most licensing income ($110.6 million), followed by Department of Education ($40.9 million) and Department of Defense ($7.1 million). Together these three agencies accounted for 95% of reported licensing income derived from federal labs.[29]

6. The Region Needs Federal R&D in the Short Term

Focusing on federal labs and universities as sources for technology ready for market brings with it significant operational challenges to be overcome. In the region, however, a majority of federal dollars go to industry, both large and small businesses. Industry does not have as many practical and operational challenges in achieving technology commercialization. Additionally, FFRDCs have fewer governance limitations – such as conflict of interest and tenure rules – that inhibit entrepreneurial behavior on the part of university and federal lab scientists. Although there are many regional programs focused on technology transfer out of universities, including programs financed by the universities or the states they are resident in, relatively fewer resources go into technology developed in the federal labs or FFRDCs. And still fewer resources go towards commercializing technology developed but not used by private industry.

A significant amount of funding goes to small businesses that perform research and development activities, under programs such as the Small Business Innovative Research (SBIR) program as well as research contracts. The companies that receive funding often have the expertise to obtain grants and perform research, but do not have the skills to start a commercial product business.

Much of the federal R&D funding goes to larger government contractors in the region, including Lockheed Martin, Boeing and Booz Allen and their competitors. Much of what they

[29] Federal Laboratory Technology Transfer Fiscal Year 2012, National Institute of Standards and Technology, U.S. Department of Commerce, December 2014.

develop suffers from the same shortcomings as do developments in federal labs – secrecy, lack of commercial insight or technology transfer not being seen as a core mission. However, compared to federal labs or universities, significantly more of the research undertaken by government contractors is applied research or even development. These activities are more likely to be successfully commercialized, usually because the technology requires less investment to create a viable commercial product. Some government contractors, including Booz Allen, have initiated efforts to more directly connect with entrepreneurs and new innovation businesses.

The federal government has attempted to address commercialization of technologies developed in the region through industry. The Defense Advanced Research Projects Agency (DARPA), the Navy and the Department of Homeland Security (DHS), among others, all fund mentorship programs to help small businesses convert their research into commercial products. The National Science Foundation is funding the iCorps program to teach researchers how to commercialize their work.[30]

The clear implication is that regional efforts to leverage the considerable federal spending on commercialization assistance, whether it be mentorship for SBIR recipients, working with government contractor innovation efforts, or supporting the iCorps program should be increased.

III. RECOMMENDATIONS

A. GROW FROM OUR STRENGTHS

For years, people have been writing reports about the Greater Washington Region's need for more venture capital. This has been a recurring theme in the media and among policy makers. It was reflected in many of our interviews with entrepreneurs. The general answer provided by these reports has been that our challenge of how to grow more entrepreneurial innovation businesses can be solved merely by attracting more venture capital to the region. This focus on a single solution implies that the region has all the remaining requisite conditions to growth entrepreneurial innovation companies, absent this missing piece.

The "solution" is not trying to get venture capital funds to locate here through incentives or public relations. The solution is creating the conditions that will reward venture investing. When they have an economic reason for investing here, venture capitalists will come in larger numbers. Venture capital is a funding source raised by institutional investors looking for proven

[30] The iCorps is an advisory/mentor program funded by the National Science Foundation that matches a university or federal lab scientist/inventor with a business entrepreneur to investigate the commercialization potential of a subject technology.

investment opportunities, and predictable, profitable returns over as short a period as possible. It is drawn to a region by the availability of M&A exits and, to a lesser extent, IPOs. Accordingly, venture capital is not a leading indicator of a region's suitability for growing entrepreneurial innovation businesses. It is, in fact, a lagging indicator. It comes into industries and regions which are established producers of companies that grow fast and exit within 3 to 7 years.

The region is not a leading source for the businesses currently most desired by venture capitalists. The "web 2.0" industry trend has been centered in other regions of the United States – primarily California. The region should be concerned that this trend could continue into other areas, including those perceived as rich opportunities for the region, such as cybersecurity, robotics, machine learning and artificial intelligence.

The Greater Washington Region has two isolated entrepreneurial communities. The first grows businesses primarily in software and biotech/ healthcare that are of interest to venture capital and out-of-region purchasers. The second grows businesses without venture capital, in government contracting, services, business/finance, and media and only secondarily in software and biotech and healthcare. Ironically, when it is time for a business exit, our software and biotech and healthcare businesses are purchased by out-of-region purchasers at roughly the same rate as our own companies are purchasing software and biotech and healthcare businesses out of region. It appears as if our two entrepreneurial communities are ships passing in the night.

If the region desires to grow new entrepreneurial innovation businesses, and entice them to remain in the region after an exit (or become sustainable companies after going public), the region must undertake a number of coordinated regional activities for both the short- and long-term. Our data show that we have within the Greater Washington Region has a number of very strong and positive attributes it can use to improve our entrepreneurial innovation business ecosystem.

It has a powerful concentration of business activity: business and financial services, commercial services, government contracting (technology), biotech and life sciences, software (cyber and data sciences) and healthcare. Additionally, it has other areas of concentration – media and hospitality in particular – where technology innovations would be welcomed.

It has a demonstrably strong and beneficial relationship between federal spending and its innovation economy. This relationship has resulted in the establishment of many entrepreneurial innovation businesses over the years.

There is no doubt that the region has a strong entrepreneurial class. It is spread among many communities that see themselves as distinct both by industry – consumer software, biotechnology, government contracting, cybersecurity, and by geography – Northern Virginia, downtown DC, suburban Maryland, Baltimore, Arlington and Tysons Corner. Looked at collectively, entrepreneurial activity is well-established and functioning within the region. It also

is clear that as industrial cycles change, and the source of funding changes (for example, from venture capital in 1999 to revenue or federal spending in 2015), the region's entrepreneurs adapt their activities to "follow the money" to the sources most likely to help them grow new businesses.

Finally, the business success of its exited companies suggests strongly that that there is a "Greater Washington Region model" of entrepreneurial innovation that is distinct from that of other regions in the United States. The model benefits from and leverages its proximity to the federal government. Many of our largest exits and most successful entrepreneurs shared this attribute.

The question is how to take advantage of our attributes and grow what it has, instead of waiting for venture capital to come to the region. Or, using the lack of venture capital as an excuse for inaction.

In order to fully benefit from its strong entrepreneurial culture and the various significant assets that it has as a region, the Greater Washington Region must act in both the short term and in the longer term.

In the short term, it must act to increase intra-market M&A in areas where the region has a distinct competitive advantage and where entrepreneurial innovation companies can be built. It also must act to ensure that the national security establishment continues to view the Greater Washington Region as a primary location for obtaining new innovation and solving the most pressing national security challenges. By accomplishing these two missions, indigenous M&A activity in areas such as software and biotech and healthcare will increase. This would in turn have a positive effect on retaining regional entrepreneur talent and attracting increased amounts of venture capital. Unquestionably, the region should focus on the principle of "buy local" when it comes to establishing and growing entrepreneurial innovation businesses.

In the longer term, the Greater Washington Region must attempt to be at the crest of upcoming industrial waves – the moments when technology moves from the research lab to commercial production and widespread adoption, giving rise to a new industry. The region led the primary industrial waves in the 1990s – the birth of the world wide web and the revolution in telecommunications. The corresponding level of entrepreneurial activity, venture funding and exit activity demonstrates the benefit of being at the crest of a wave. The region must look forward, and take advantage of our proximity to agencies like DARPA, NASA and NIH, as the funding source and seeder of "what comes next." By building its own technology industry road map, the region's leaders and business community can make intelligent investment decisions as to which opportunities can closely align with existing industries.

B. Create Vertical Connections to Foster More Growth and Business Sales

It is essential that the region act to increase the regional M&A exit activity and revenue-driven growth both by using federal dollars intelligently and by more tightly integrating our larger and established businesses with new entrepreneurial innovation businesses. It also must address the current trend of national security agencies looking elsewhere for new innovation.

The business community must take an approach that transcends geographic and political boundaries. Many existing activities promoting business formation and growth are either incorporated into a commercial business model or are supported by a single locality as an adjunct to economic development. These efforts, many of which are effective within their narrow scope, have the unwanted ancillary effect of segmenting the regional innovation community.

There is an immediate need for an objective regional agency or consortium to operate with the clear and specific mission of advocating for, and causing the connection of entrepreneurial, technology innovation businesses with the larger companies in the region, specifically in the technology areas of software and biotech and healthcare. In order to avoid intraregional competition, and to facilitate working closely with the existing private actors working to create and grow such businesses, it is essential that this coordinating organization be agnostic on the success or failure of a particular company or region; its sole mission would be to facilitate connections in the region's key industrial segments.

Regional efforts should focus on specific areas of business activity where there is a congruence of larger established companies seeking innovation and entrepreneurs looking to start new businesses. Activities must tightly integrate communities so that businesses are grown that are essential and important to our larger and established industrial leaders, particularly in areas of high growth innovation. Accordingly, the initial focus should be on three verticals identified through interviews, examination of the data and current technology trends as holding both immediate promise for growth and national relevance. These are:

- Biotechnology and precision medicine.
- National security.
- Cyber security, data analytics and artificial intelligence.

Other areas of potential collaboration include business and finance, media and advocacy and government contracting more broadly. However, in order to establish a regional identity and ecosystem to support more rapid business growth and local exits (thereby having the ancillary

effects of retaining entrepreneurial talent and attracting venture capital), a narrow focus on the foregoing three areas should be undertaken immediately.

There should also be created a financing source to operate in concurrence with the aforementioned entity, and support the businesses growing in the targeted industries. By focusing on businesses within this ecosystem, the possibility of a business being able to repay such funding is enhanced. This funding could be structured as a Small Business Investment Company (SBIC) or state analogue to provide leverage for investors willing to participate, as a royalty-based fund, or as a subordinated debt or grant program.

C. Invest in Intellectual Property and Technology Commercialization

Regional activities around converting federally funded research and development into new entrepreneurial innovation businesses should and must be increased. The point is not to compete with existing federal and state initiatives to grow technology commercialization. However, the region's current focus on technology transfer from universities and federal labs should be broadened to include FFRDCs and industry.

In many instances the challenge for technology commercialization is the lack of entrepreneurs willing to bring the technology to market. A regional organization that can match experienced entrepreneurs to technologies for commercialization is essential.

To succeed in technology commercialization, the regional universities must increase connections with industry so as to obtain more applied research, including participating in sponsored research and subcontracts with the region's government contracting community and small businesses. Consideration should be given to academia increasing its efforts to attract and retain faculty and students in areas of technology identified as core opportunities for the region.

There should also be created a financing source to operate in concurrence with the foregoing entity to provide growth capital past the initial establishment phase of the newly formed businesses. By focusing more on technology derived from our local industry, these activities are more likely to identify applied research or development activities that are riper for immediate commercialization. This will dramatically reduce the development risk inherent in many technology commercialization transactions involving basic research.

D. The Region Must Have a Technology Roadmap

Our research provided many examples showing a clear relationship between blue ocean innovation technology derived from federally funded R&D and the development of new industries. The region must have a mechanism to evaluate the technology research and development of the federal government and make assessments as to the right areas of entrepreneurial activity 5, 10 and 20 years into the future. For example, an organized approach might have seen the coming trend in robotics ten years ago, and it might have helped shape regional activities to support the creation of robotics-related workforce development, to provide state seed funding and to steer university investment in this area of expertise.

Given that the primary concern is the creation of large numbers of high-paying jobs, the region must have a plan for becoming a leader of new industrial waves, as it was in the Internet boom of the 1990s. The effect on the region from the standpoint of job and wealth creation was significant, and its effects are still felt. It will benefit from a regional discussion on which new industries are emerging, and which offer the best opportunities for high paying employment. This policy and research function could be undertaken by the entities recommended above, or by an institute associated with a regional university or consortium of universities.

E. Teach Entrepreneurship and Technology Literacy

The region's entrepreneurial class must be encouraged, enhanced and grown over the next few years. Regional universities must be encouraged to make entrepreneurial skills development part of cross-disciplinary curricula across all academic programs, but especially engineering and business programs. The region should apply its focused approach to industrial integration to provide more applied research opportunities for the region's universities, to connect them to the region's industrial base, and to improve the likelihood of their technology reaching the market.

In order to create the work force necessary to support rapidly-growing technology businesses, our educational institutions should increase skill-based learning in technology fields and provide certifications of related skills in traditional degree programs where meaningful.

The region's business schools could assist and accelerate technology commercialization out of federally funded labs in the region by each entering into a strategic relationship with at least one federal lab for technology commercialization and business creation. Some have done this already, but there are many opportunities for partnering still unrealized.

Our secondary school system should also do its part to create the required workforce by exploring opportunities to add entrepreneurship or leadership classes, as well as computer coding and application writing.

IV. A FINAL THOUGHT

For years, many have talked about the Greater Washington Region's entrepreneurial potential, as if it was something to be attained at some remote future date. Or, they have compared the region to other more prominently celebrated locations of entrepreneurship and found the region lessened by the comparison. These stories of potential or comparison should be amended to one of achievement. This report makes clear that the recipe and ingredients for success in the development of entrepreneurial, innovation based businesses exists in the Greater Washington Region. The region is entrepreneurial and it can be better still. By acting in concert and with focus it can write a story of growth and opportunity. This will be a story worth telling, and it will have the additional benefit of being true.

ABOUT THE AUTHOR

Jonathan Aberman has been part of the Washington, DC technology community since 1998, when he moved to the region from New York City to start the east coast venture capital practice of Pillsbury Winthrop. He has been an active voice for our community's development as an entrepreneurial center, and has been recognized as a leader of change and influence in print and television media, among other things being recognized by Washingtonian Magazine as a "Tech Titan," by Washington Business Journal as a member of the "Power 100" and by the Commonwealth of Virginia as one of the "50 Most Influential Entrepreneurs" in the Commonwealth.

He obtained an education in economics and law (with post graduate qualifications in each) from the London School of Economics (MSc. in Economics with Distinction), Cambridge University (BA and MA in law with Honors), New York University (LLM) and George Washington University (BA with Honors and Phi Beta Kappa).

During his subsequent career as a professional advisor, he worked in the financial services industry in London for Daiwa Securities, Goldman Sachs and Donaldson Lufkin Jenrette, and then as a corporate/venture capital lawyer as a partner in technology law firms Fenwick & West, Pillsbury Winthrop and Fish and Richardson. During this time Jonathan's focus was on opening new business initiatives and offices.

He started Amplifier Ventures in 2004 to help entrepreneurs launch technology businesses, and has since seeded 16 startup technology businesses in Internet, nanotechnology, energy conservation, mobile and cybersecurity sectors. An affiliated business, Amplifier Advisors followed in 2009, to allow Jonathan to apply his expertise to entrepreneurial approaches to innovation creation and commercialization, working for a wide range of government, for profit and not-for-profit ventures. In 2012, he launched FounderCorps — a not-for-profit corporation promoting technology mentorship and regional economic development. In 2013 he formed TandemNSI, a public private partnership that has created a large and growing community of entrepreneurs and national security agencies to address advanced technology challenges of national importance.

He is a Professor of Entrepreneurship at the Robert H. Smith School of Business of the University of Maryland, where he teaches a broad range of classes in business formation, strategy and family entrepreneurship. He has been an active policy maker and has served

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