Advancing Openness

Application of the Open Innovation Model and the Central Role of University-Industry Linkages

A Compilation of Case Studies

Research Report for
Virginia Tech
National Capital Region,
Advanced Research Institute
and
Arlington Economic Development

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Executive Summary

This report employs a case study approach to examine the roles of industry, university and government in open innovation generally; and more specifically, the role of three major industry sectors, Virginia Tech and the Arlington County government, in advancing open innovation in the Washington D.C. metropolitan area.

Each of the case studies contained within this report arrived upon a key set of findings specific to the sector in question – industry, university, or government. From these, several themes, common across the cases, emerged. They are:

Establish linkages based on talent.

- Industry wants and needs talent and views its "connection" to university to be the "talent pipeline". Universities and governments educate and train individuals thereby developing the human capital that keeps industry and government running. The three entities – industry, university and government – are inextricably linked by talent.

Actively promote collaboration.

- All actors – industry, universities and governments – must actively engage in making connections outside of their particular entity. The open innovation model relies on dynamic relationships in the capture of value from knowledge and information flows. Maximum value can only be achieved if all involved make concerted, collaborative efforts toward harnessing available information.

Utilize current resources and models to create open innovation environment.

- "Operationalizing" open innovation does not require "reinventing the wheel". Current resources, in particular, communication and networking technologies capable of linking different entities across geographic locations exist, e.g. Instant Messanger, Web 2.0, Facebook, etc. Additionally, the models highlighted by the cases studies contained in this report provide templates that can be combined and adapted to develop an approach that addresses the circumstances specific to VT-ARI, Arlington County and Washington D.C. metropolitan area industry sectors.

Define roles.

- Virginia Tech and Arlington County will both need to define their roles in and potential contributions to open innovation in the Washington D.C. metro area. Capturing value from the mass amounts of information and ability available in the marketplace requires active engagement based on a timely understanding of current opportunities. While the open innovation model presents a scenario in which multiple actors stand to benefit, it implies a responsibility on the part of those actors to continuously seek out potential partners, to identify the nature of potential partnerships and to keep up-to-date as to their needs and capabilities as well as the needs and capabilities of their partners.

Recommendations to Virginia Tech and to Arlington County were developed based on the overarching themes identified by the case studies contained in this report. They are as follows:

Virginia Tech should:

- Develop intellectual property models that center around flexibility and adaptability.
- Approach industry relationships on to a case-by-case basis.
- Develop networks with industry through graduate placements.
- Use available technologies to develop strong networks.
- Increase its awareness of industry developments and needs; engage in targeted self-promotion.
- Provide the infrastructure necessary to perform collaborative research – increase the "stickiness" of industry presence.
- Serve as the facilitator of project-specific funding.
- Put together a task force to establish guiding principles and models for VT.
- Conduct a research interviews with industries and government to find what goals industry hopes to achieve through the university collaboration and align those findings with the missions of the University.
- Consider multifaceted funding structures to include "gap funding," transfer knowledge from university to industry, and foster entrepreneurial education and faculty development.
- Market VT Research Institute as an entrepreneurial and innovative facility by considering a membership on the iBridge Network.
- Consider a magazine or brochure to market the facility to federal contacts, local government contacts and industry contacts as a way to tell them what research is going on at the research facility.
- Experiment with a new model for commercialization of intellectual property.

Arlington County should:

- Promote cluster meetings with actors and networking opportunities.
- Create an innovation database (I-Bridge).
- Support emerging sectors with innovation grants promoting partnerships between industry and university.
- Create more affordable and workforce housing.
- Plan to provide integrated K-12 college preparatory education with career development programs.
- Promote industry specific career fairs and incumbent workforce education.
- Build an economic development toolkit as community sees fit; include effective measures of success.
- Work with Arlington Employment Center to create a school of management.
- Promote venture forums for target industry start-ups.
- Create a public relations internship program.

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Introduction

At the beginning of the Fall 2008 semester, the Economic Development Studio of the Urban Affairs and Planning program at Virginia Tech was tasked with applying a theoretical construct known as open innovation to the real world case of Virginia Tech's Advanced Research Institute under development in the Ballston area of Arlington County. Additionally, students in the studio were asked to consider the specific role that the Arlington County government could play in applying the model.

This report employs a case study approach to examine the roles of industry, university and government in open innovation generally; and more specifically, the role of three major industry sectors, Virginia Tech and the Arlington County government, in advancing open innovation in the Washington D.C. metropolitan area. The first section details the motivation for, and concept of, open innovation. The next three sections provide case studies of the roles of industry, university and government, in the adoption of a more open environment. The final sections highlight themes stretching across industries and provide recommendations for Virginia Tech's Advanced Research Institute and the Arlington County government.

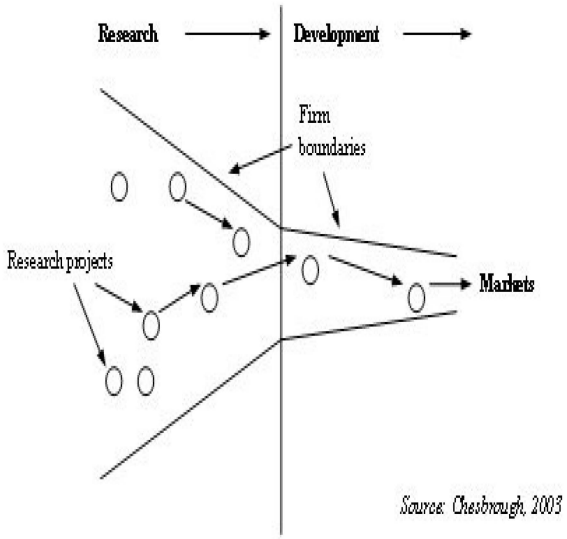
Economic Development Studio members thank Jim Bohland and Terry Holzheimer for providing the opportunity to conduct this semester's project and for constructive comments that aided the development of this report.

The Open Innovation Model

Innovation is essential. It is a driver of the growth that spurs and maintains healthy economies (Fredberg et al., 2008). In the past few decades, the remarkable performance of several highly successful industrial clusters including Silicon Valley (Saxenian, 1994), the Emiglia-Romagna region of Italy (Scott, 1993), the Baden Wurttemburg region of Germany (Strambach et al., 2001) and others have sparked a great deal of interest in innovation and the dynamics of regional development (Gordon and McCann, 2005). The prosperity of these regions has lead to concern over how innovation can be further promoted and managed (Fredberg et al., 2008). Increasingly, industry actors are turning to alternative approaches to fostering innovation.

Despite the success of many firms that had invested and reinvested heavily according to the in-house R&D model, by the end of the 20th century, the business environment had begun to change (Chesbrough, 2003). Greater numbers of highly mobile knowledge workers and an increased availability of venture capital had caused the closed innovation process to break down (Chesbrough, 2003). As a result, the management of innovation came into question and began to change.

The Closed Innovation Model

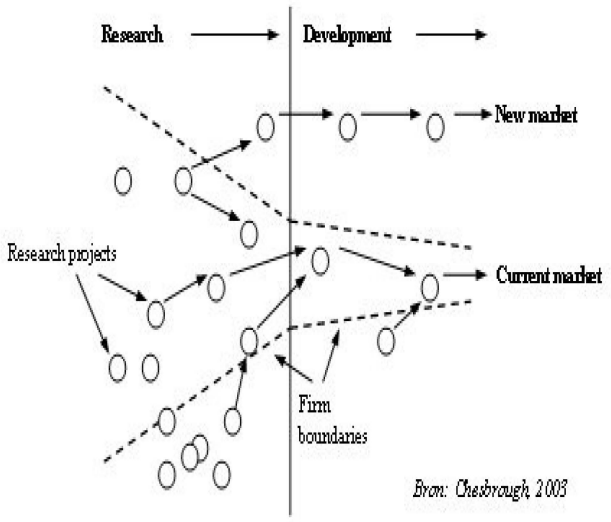


Several factors that indicate a shift in how innovation is managed have been identified. The most notable of these factors include: the mass diffusion of valuable knowledge; firms that are unable to exploit the wealth of information they have created; ideas that are not readily used are often lost; the significance of ideas and technology depend on the business model employed; the presence of venture capital results in changed incentive structures; and companies must be active suppliers and consumers of intellectual property (IP) (Chesbrough, 2003 as cited in Fredberg, 2008). Moore (2008) echoes these findings noting that today's economy is all about networking - networking between businesses, educational institutions, and nonprofit organizations. Collaboration is necessary for success because no one firm or organization has all the resources needed to do it alone. The changing business climate has lead many industries to reconsider their approach to spurring innovation. Firms that continue to follow the internal or closed model will likely find themselves lagging behind younger and more adaptive new entrants.

One method developed in light of the new industry dynamics is open innovation. This relatively new paradigm assumes that firms can, and should use external ideas, as well as internal ideas, while at the same time considering both internal and external paths to market (Chesbrough, 2003). In today's new global, knowledge-based economy the need to reinvent innovation processes is clear. Underlying this need are two new realities

which make necessary the adoption of an open innovation model within industry. The first of these new realities is the increased use of networking which allows customers to actively engage in the R&D process (Chesbrough, 2006).

The Open Innovation Model



As such, they bring with them explicit and tacit knowledge which affords the prototyping stages a real chance to flesh out major shortcomings prior to a product's market introduction (Chesbrough, 2006). The second reality is that the world's most intelligent and talented people are not all members of the same team or organization; rather they are distributed across institutions spanning the globe (Chesbrough, 2006). To ensure growth and viability, industry can no longer afford to rely on closed systems of innovation.

Flexibility and open communication are fundamental to advancing business models capable of addressing changing economic realities. However, firms exhibit different characteristics depending on the industry they belong to. Some industries are less nimble and responsive to general business and economic trends. Others are at the forefront of adaptation. Technological capacity, firm progressivity, organizational structure, networks and linkages, labor force availability and skill level, the push or pull nature of products and the business cycle are all factors affecting the speed with which industries move from one innovation paradigm to another.

In the move toward adoption of a more openly innovative model, industry sectors have begun to seek out relationships with universities. As significant generators of new ideas and knowledge, universities are a key external source of information. The extent to which industry sectors establish university linkages is dependent on the needs and structure of a given industry.

Chapter 1: The Role of Industry in Open Innovation

Mary C. Fisher, David Arnold and Katya Shkolnikova

Executive Summary

The application of the open innovation model to the case of Virginia Tech's Advanced Research Institute and Arlington County reveals the potential benefits and challenges associated with movement toward more open systems. Virginia Tech can move toward a more open business model by concentrating its efforts on the establishment of strong linkages with industry sectors prominent in the Washington D.C. metropolitan area. To do this Virginia Tech should consider the following findings and recommendations:

1. Global competition pressures have intensified enabled by ready access to information.[1]

- Technology has made the "complete" security of information nearly impossible. The same category of technologies that have made total information security a thing of the past, have also opened up the potential for reducing the perceived distances between the innovation actors while simultaneously allowing for the inclusion of customers and suppliers into the design and development process.[2]

- Capture of external human capital is a priority. The further development of the knowledge economy and clusters of highly specialized knowledge dispersed across the globe, make necessary new methods of attracting talent.[3]

- Innovation is essential to remaining competitive. As such, industry is looking to external knowledge sources for value-added. Firms are looking to move from a "closed" system incapable of completely protecting their ideas and receiving outside ideas, to a more "open" system wherein the transmission of information is beneficial to all involved.

- "Radically new product innovation" results from breakdown of long-standing barriers. In acknowledgement of the outdated nature of traditional in-house technology and R&D management model, most companies now prize agility, flexibility, and concentration on core competences.[4]

2. The Washington D.C. metropolitan area is characterized by the significant presence of three major knowledge-based industry sectors.

- The region is home to strong clusters in defense, aerospace and national security industries.[5] A variety of defense firms and the more than 800 aerospace

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[1] Porter, M.E., & Stern, S. (2001). Innovation: Location matters. *Sloan Management Review 42*(4), 28-36.
[2] Gassmann, O. (2006). Opening up the innovation process: Toward an agenda. *R&D Management 36*(3), 223-228.
[3] Ibid.
[4] Ibid.
[5] SRI International. (2008). Virginia's technology industry potential: Catalyzing innovation in the Commonwealth. Report prepared for the Virginia Economic Development Partnership.

companies enjoy close proximity to the Pentagon, 11 military installations, and 10 federal agencies with strong ties to the industry. In 2006, Department of Defense procurement in the region was more than $31 billion.[6]

- The information technology sector accounts for 333,000 of the D.C. area's workers double the national average. The region is also characterized by a higher concentration of network and computer system administrators, database administrators, and programmers than any other leading tech area in the country.[7]

- The D.C. metro area is the nation's third largest center of bioscience companies with 17,000 public sector and 13,500 private sector employees. The region boasts 20 colleges and universities with medical or bioscience programs, 16 federal laboratories, 16 large bioscience firms, and 11 nonprofit research facilities.[8]

3. A continuum of openness exists across industries and each industry embraces its own specific innovation model.

- Some sectors, like the biotechnology industry, are currently more open than others – information technology and defense.

- The defense sector is driven by a technology push than market demand pressures.

- The information technology sector is more open at the beginning of the innovation process than toward the end.

- The biotechnology sector is prompted by the need to improve public welfare and is subject to a lengthy product development process.

4. Strong industry-university linkages allow a greater degree of "openness" to be achieved. Across industries, several key issues related to the establishment of these relationships exist.

- Intellectual property: Industry struggles with fairly awarding credit to partners while still protecting and capitalizing on individual contributions.

- Project specificity: Industry is looking to tailor partnership agreements as dictated by the needs of each individual project. Standardization of relationships across all is not likely to attract industry interest in collaboration. Industry is also looking to partner with entities capable of fully understanding its specific needs and desires.

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[6] Greater Washington Initiative (2007). Greater Washington Aerospace and Defense Industry Overview: Assets and Resources in Washington, D.C., Northern Virginia and Suburban Maryland.
[7] Greater Washington Initiative (2005). Information Technology, Communications & New Media in Greater Washington: An Analysis by the Greater Washington Initiative.
[8] Greater Washington Initiative. (2007). Greater Washington: Leading Bioscience Center.

- Human capital: The development of talent with industry-specific knowledge is a major attraction to potential industry partners.

- Funding: Some industry sectors, e.g. biotechnology, are marked by a greater presence of start-up firms lacking the ability to effectively attract and assemble necessary funding.

- Infrastructure: Much of the innovation in an industry sector often comes from newcomers. In the case of the biotechnology industry, these emerging players require access to highly specialized research environments.

5. The following recommendations will aid Virginia Tech in establishing strong linkages between industry and the Advanced Research Institute in Arlington, VA:

- Approach industry relationships on to a case-by-case basis and develop intellectual property models that center around flexibility and adaptability.

- Develop networks with industry through graduate placements.

- Use available technologies, e.g. Web 2.0, to develop strong networks.

- Increase its awareness of industry developments and needs and use the resulting information to engage in targeted self-promotion.

- Provide the infrastructure necessary to perform collaborative research – increase the "stickiness" of industry presence.

- Serve as the facilitator of project-specific funding assembly.

Table of Contents: The Role of Industry in Open Innovation

1.1 Introduction

This chapter presents the findings of a research effort that applied a theoretical construct known as open innovation to a the real world case of Virginia Tech's Advanced Research Institute (VT-ARI) under development in the Ballston area of Arlington County. In particular, the research presented in this report examined the level of consideration given to increasing openness in research and development (R&D) processes; the extent to which the open innovation model is utilized in prominent Washington D.C. metro area industry sectors; and the potential benefits and challenges associated with movement toward more open systems.

1.1.1 Purpose of study

This chapter aims to address the following: the trend toward a more "open" R&D development model across industries; the extent to which the defense, information technology and biotechnology industry sectors have employed the open innovation model; the potential benefits and challenges associated with movement toward more open systems; and recommendations designed to aid development of industry-university relationships as a key component of the open innovation model. The recommendations are framed in the context of establishing linkages between VT-ARI located in Arlington, Virginia, and the major industry sectors represented in the Washington, D.C. metropolitan region.

1.1.2 Organization

This chapter is divided into nine major sections. The first section introduces the study and the purpose of the research conducted. The next section provides information about the methodology used to analyze open innovation and its potential application in the D.C. metro area. The third section provides background information on the theory of the open innovation. Here we outline the developments that led to the conception of the model. The fourth section presents the role of industry in open innovation. The fifth, sixth and seventh sections analyze, in great detail, the strengths, weaknesses, opportunities and threats associated with the defense, information technology, and biotechnology industries' adoption of the open innovation model. The final two sections of the chapter highlight the overarching themes across the three industries examined and specific recommendations for establishing strong industry-university linkages.

1.2 Methodology

The open innovation paradigm is a relatively new topic in the research literature. The majority of open innovation studies attempt to further the theoretical model's development, abstracting from broad observations of industry dynamics. Other studies focus on specific cases within industry particularly the open source phenomenon.

The research detailed in this chapter focuses specifically on the application of the open innovation model to the case of VT-ARI and the Washington D.C. metropolitan area. As such, data relevant to this study necessarily had to be primary in nature.

1.2.1 Data collection

This analysis relied on several methods of data and information collection. Primary data was collected through expert interviews with key industry actors. Secondary sources informed the development of survey questionnaires. In total, 13 representatives of the defense, information technology and biotechnology sectors were interviewed. The questionnaires used were designed to collect basic information related to industry adoption of the open innovation model and details pertaining to the potential benefits and challenges associated with adoption of the model. Information current industry structure was also gathered. Additionally, interviewees were asked a series of industry-specific questions related to their industry's unique characteristics.

Case studies published in the peer-reviewed research literature and consultant reports provided a great deal of information used to both frame the study and provide necessary details lacking from the primary data collected. Key words used in the searches for all three industries followed the work of Chesbrough and Crowther (2006).

1.2.2 Analysis

This SWOT method of analysis was employed in this study. The primary and secondary data collected was used to assess the strengths, weaknesses, opportunities and threats related to adoption of the open innovation model in each of the three industries. As such, the analysis relied upon the categorization method employed to identify the potential for and challenges associated with, industry-university linkages under the open innovation paradigm.

1.2.3 Limitations

Heavy reliance on a small number of expert interviews leads the conclusions of this study to be pertinent solely to the cases presented in this study. Generalization of this study's findings and conclusions would be in err, due to the limited number of experts interviewed during the data collection phase.

Additionally, this study was conducted on a relatively short timeline. As such, it should be considered preliminary in nature. Further, more in-depth analysis of the findings and recommendations presented within should be considered necessary prior to adoption of any of the action items highlighted.

1.3 The Role of Industry in Open Innovation

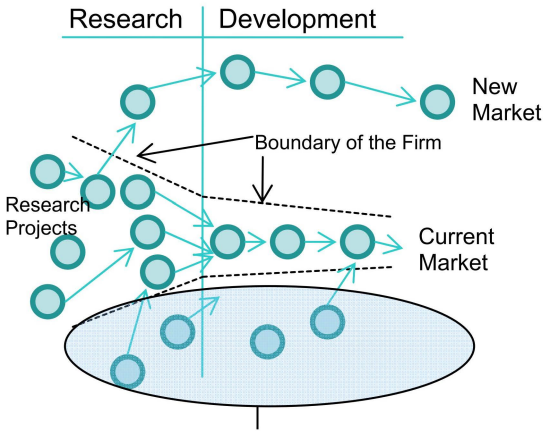
In global marketplace with readily available access to information through technologies like the Internet, it is hard to imagine that information can ever really be completely secured. Since the near impossibility of absolute information security has emerged a reality, businesses are looking to move from a "closed" system incapable of completely protecting their ideas, to a more "open" system wherein ideas are beneficial to all.

The same category of technologies that have made total information security a thing of the past, have also opened up the potential for reducing the perceived distances between the innovation actors while simultaneously allowing for the inclusion of customers and suppliers into the design and development process (Gassmann, 2006).

As global competition pressures have intensified, the recognition of external sources of knowledge and innovation has become increasingly important (Porter and Stern, 2001). A flourishing knowledge economy and globally dispersed clusters of highly specialized knowledge have made the development of strategies to capture external human capital resources a known priority (Gassmann, 2006). Firms are increasingly aware of the "radically new product innovation" that comes with the breakdown of long-standing barriers. The outdated nature of traditional in-house R&D management model has lead most companies to now prize agility, flexibility, and concentration on core competences (Gassmann, 2006). Achieving a greater degree of "openness" is a concern for all industries as the global business environment broadens.

However, each industry embraces its own specific innovation model and as such, a continuum of openness exists. The defense industry, for example, has engaged in multi-actor partnerships amongst a relatively small number of firms and yet, remains less open than other sectors because of the national security issues. The information technology industry is well-known for its inroads toward more openly innovative processes as is evidenced by the advent of open source software. The Salk polio vaccine, a major biotechnology industry development, would not have been produced on a scale necessary to save millions had it not been for an industry-university partnership (Hope, 2008).

Common to several industries including defense, information technology and biotechnology, is the key role of relationships with universities. Both parties view relationships with one another to be beneficial. Industry seeks to establish linkages with universities for: access to students and faculty; access to technology and cutting edge information; prestige; efficient, cost-effective use of resources; support of technical excellence and proximity (Link & Tassey, 1989).



Source: Mayer, 2008

Universities consider: access to scientific and technical expertise unique to industry; opportunity to immerse students in solving real-world problems; use of "ear-marked government funds"; and potential post-graduate employment opportunities, to be the benefits of collaborating with industry (Link & Tassey, 1989). Industry-university interaction is flexible, ranging from one-time transmissions of information to long-standing, more durable relationships including cooperative research centers and parks (Link & Tassey, 1989).

Industry-university collaboration has yielded improvements in product development and manufacturing, enrichment of specialized skills and the development of innovative products and technologies (Konishi, 2000). Based on a study of university faculty members and industry technology managers, Lee (2000) concluded that university-industry collaboration in the United States is sustainable because each individual faculty member and individual firm is able to allow the other to realize their own objective while contributing simultaneously to a mutual goal. Universities have been and continue to be a desired partner for firms as they contribute to the development, dissemination and use of knowledge and innovation (Bercovitz & Feldmann, 2006). According to Bercovitz and Feldmann (2006),

> "*...university–industry collaboration has intensified in recent years due to four interrelated factors: the development of new, high-opportunity technology platforms such as computer science, molecular biology and material science; the more general growing scientific and technical content of all types of industrial production; the need for new sources of academic research funding created by budgetary stringency; and the prominence of government policies aimed at raising the economic returns of publicly funded research by stimulating university technology-transfer (Geuna, 1998, pp. 5–6)".*

Given the potential benefits industry-university collaboration present to both parties, it is important to further explore the relationships between universities and specific industry sectors. Furthermore, it is necessary to examine how these relationships play into the emerging open innovation paradigm.

1.4 The Defense Industry Perspective

The defense industry is unique. It is subject to technology push rather than competitive market demand pressures. Consumers of defense industry products purchase the newest technologies available without consideration for the bottom line (Malecki, 1997). For this reason, the defense industry finds itself within "the establishment of a class of firms that are unlikely to produce commercially successful innovations" (Horwitz, 1979; Kaldor (1980, 1981) as cited in Malecki, 1997). As such, the defense industry would likely benefit from relationships that allow for integration of external information (i.e. commercial demand) and the expansion of internal ideas externally (i.e. adaptation of defense innovation for commercial use – example: the Internet).

The defense industry in the United States has long been known as a military industrial complex (MIC) or "iron triangle", in which defense contractors with long-standing DoD relationships, federally-funded R&D centers, government laboratories and DoD collaborate readily but rarely welcome others in (Reppy, 2000). Given the tightly woven nature of the U.S. defense industry, it is reasonable to question whether or not the requirements of the open innovation model could be met. The defense industry is likely to be particularly "closed" in its innovation process due, in large part to, the distinctive nature of its products and the necessary secrecy surrounding their development. As such, the typical challenges that other industries might face when transitioning to the open innovation model are particularly heightened for the defense industry.

1.4.1 Presence in the Washington D.C. metropolitan area

The D.C. metropolitan region is home to a significant defense, aerospace and national security cluster (SRI, 2008). The D.C. metro region is home to 43 of Defense News' Top 100 international defense companies (GWI, 2007). A variety of defense firms and the more than 800 aerospace companies in the metro enjoy close proximity to the Pentagon, 11 military installations, and 10 federal agencies with strong ties to the aerospace and defense industry (GWI, 2007). In 2006, Department of Defense procurement in the D.C. metro region was more than $31 billion, greater than total defense procurement in Texas with $27 billion and Florida with $10.7 billion (GWI, 2007). Lockheed Martin, Northrop Grumman, SAIC and Booz Allen Hamilton are ranked in the top ten for largest D.C. area employers by number of employees (Washington Post, 2008). Lockheed Martin and General Dynamics topped the list for most valuable, with market capitalizations of $40.21 billion and $33.19 billion, respectively (Washington Post, 2008).

1.4.2 Focus on Talent

Recent decades have shown that defense industry players are interested in seeking more opportunities to collaborate (Interview 1D). The industry looks to universities as potential partners for the breadth of relationships which can be established. In a presentation prepared for the Cambridge-MIT Partnership Programme, J.A. Murphy, Head of University Partnership Programmes for BAE systems, a major defense industry firm, highlighted a number of these types of relationships including secondments - the transfer of a person from their regular organization for temporary assignment elsewhere- and the recruitment of students into the workforce.

A defense trade association officer echoed Mr. Murphy's sentiments, noting that firms are particularly interested in forming relationships with the new, young technical minds at universities and that it is not uncommon for DoD to assign a three- or four-star General to work in the field with entities developing defense products and technologies to ensure that the requests for proposal that issues yield the exact deliverable it desires. The formation of well-established working relationships with students is desired by industry for many reasons including: the creation of a forum for the exchange of ideas; the development of a talent pipeline that is already familiar with the projects firms are engaged in; and replenishment of the human capital pool (Interviews 1D, 2D and 3D).

1.4.3 Mutually beneficial collaboration

Increasingly, industry looks to universities not only as a source of high quality basic knowledge generation or as a source of graduates but also as a partner capable of providing complementary expertise, knowledge and resources that are not always easily identified within the industrial community (Santoro and Betts, 2002). A defense industry consultant echoed Santoro and Betts' findings, noting that his company's university relationships allow for the ability to stay current the latest "thinking" while students and faculty receive the benefit of having an opportunity to apply their "book knowledge" in a real-world setting.

In a study of the relationships between industrial firms and university research centers, Santoro and Betts (2002) found that partnerships between the two can be beneficial in assisting firms in the generation of knowledge and new technologies while universities may benefit from receiving patents and the rights to technologies that their industry partners choose not to pursue. These alliances assist in developing standards, aid in situations where resources are scarce or vulnerable, offer more rapid access to necessary resources than may be the case with internal development and foster organizational learning (King, 2006-2007).

Industry is always looking to put together the best team possible and universities often play a part in meeting that goal because of the new, innovative ideas that originate within the university environment (Interviews 1D and 4D). In the end, these linkages [between industry and universities] could serve as a "force multiplier" in the development of products and services. The impact of disseminating information and sharing ideas is tremendous [in making the commercialization of defense products and technologies a reality]. Often there is more added to the equation by the university than what a Department of Defense (DoD) contract can do alone. Linking up with academia adds a tremendous technological edge to the brainpower side of universities (Interview 1D).

1.4.4 Inroads toward linkages

Industry has already demonstrated its knowledge and acceptance of the positives associated with open innovation. According to a retired Navy Captain, who is now a defense industry consultant, there are already examples of a more open industry as is evident with the number of defense industry consortiums and much of the facilitation of teamwork across the industry can be credited to the presence of industry trade associations. The interviewee's own firm frequently teams with others but does so with non-disclosure agreements in place up-front. In the past twenty-five years or so,

producers have engaged in a great deal of teaming where team dynamics and the players involved tend to change with each project (Interview 3D).

An academic expert noted that the defense industry has been moving closer to the open innovation paradigm for quite a long time. In the development of defense products and technologies, the buyer, DoD, tells a company what they want and the company then works to meet that need. So, in a sense, this is openly innovative because the developer of the product/technology (the defense industry firm) is creating/developing a product/technology based on someone else's idea (DoD's specification of what they want/need). Additionally, there is a great deal of information flow between defense firms and DoD as products/technologies are being developed. There is currently much more open discussion in the defense industry than in the commercial market.

1.4.5 Information transmission roadblocks

When major research developments are achieved, additional roadblocks in the form of outdated university policies for IP rights, patent ownership and licensing, exist (Santoro and Betts, 2002). Universities often conflict with companies over terms of use related to proprietary data and/or they conduct research much too slowly relative to the needs of their industry partners (Kotnour and Buckingham, 2001).

The weaknesses that present obstacles to the formation of thriving industry-university relationships are not unique to the university-side of the equation. Current industry culture is also responsible for a number of challenges. According to a defense firm representative, firms are very reluctant to openly share information particularly due to the fact that it is tough to protect IP when they venture externally.

Additionally, standards in the way that information is shared exist and each vendor or design team has its own philosophy governing their way of viewing, doing and using information (Interviews 1D and 3D). Ultimately, this manner of conducting business allows each vendor or team to maintain a certain level of propriety but it greatly interferes with communication between potential partners (Interviews 1D and 3D). A "mine vs. yours" mentality still predominates (Interview 1D). Industry also finds it challenging to award IP in a collaborative setting particularly as it concerns rewarding university students who are responsible for "the next big idea" (Interviews 1D and 4D).

With respect to the defense industry, which is essentially accountable to a single client – DoD – efficient information flow is highly desirable. DoD has tools to actively open doors that reach back to industry to most quickly get done what needs to be done but industry struggles to mirror this (Interview 1D).

In their study of aerospace firms and the university system in Florida, Kotnour and Buckingham (2001) found that educational systems often either don't understand or are unresponsive to the needs of the companies they work with. Professors and students take the time to learn only as much of the jargon as is absolutely necessary to receive funding but often go no further to gain a true understanding of what is really being asked for (Interview 3D). Companies may also avoid actively seeking university partnerships

because they are either unaware of what the educational system has to offer or they are bound by provisions of the contracts that employ them (Kotnour and Buckingham, 2001).

1.4.6 National security and classification scheme challenges

Once IP is created and a solution to the issue at hand is developed there exists a real fear of the talent "running across the street" after they finish working on the specific project or internship. This potential problem is even more challenging for the defense industry because security is the number one priority with everything that is done. DoD has major concerns with openness as they don't want the next "system" to end up in China, Russia or any countries that present a potential threat. The United States enjoys a technological edge and command of that edge is where its power lies. Moving toward an "open" system in a totally collaborative sense is not currently feasible due to the relatively risk-averse nature that currently prevails (Interview 1D).

Threats to the adoption of the open innovation model specific to the defense industry relate primarily to issues of national security with some areas more prohibitive to open access than others due to their classification. Partnering with an agency like the Defense Advanced Research Projects Agency (DARPA) would require at least a secret clearance (Interview 2D). Generally, universities do, and will continue to have problems gaining the necessary clearance to work on classified projects. Classification also has the potential to prevent information from one project from being accessible to those working on another project (Interview 3D). An additional challenge presented by the prevailing classification scheme, is the long lead time required to obtain the appropriate security clearances for participating visiting scientists from universities (Interview 5D).

1.4.7 Motivation mismatch

Universities may exploit DoD dollars to get to do what they want (basic physics, engineering research) despite the fact that what they do may not necessarily yield practical applications for the industry. This mismatch between the University's desire for basic science and the industry's desire for useful products hurts the relationship between the two as it is established based on different end goals (Interview 3D).

The defense industry budget, which is primarily tax dollar driven, has its limits and all of the services (Army, Navy, Air Force and Marines) spend a lot of time vying for their share (Survey 2D). The limited nature of the budget would most often preclude partnerships with any goal (ease of product/process commercialization) other than the goal of developing/creating exactly what they [DoD] needs. Of particular concern is the tendency for items related to university partnerships/funding to be cut earlier than other items when budget cuts become necessary (Interview 2D).

King (2006-2007) reveals that the organizational learning that occurs as a result of alliances can lead to partners to reach a point at which they no longer need to participate in the alliance. As such, alliances can be inherently instable and experience a relatively high failure rate (Inkpen & Beamish, 1997 as cited in King, 2006-2007). This is particularly true in the defense industry because DoD is only interested in rapid development of a final product and not the long-sustaining partnerships that lead to the development of that product.

1.5 The Information Technology Perspective

In a 2008 SRI report it was shown that Virginia ranks low on entrepreneurial activity when compared to competitor states, ranking second to last in the number of per capita entrepreneurs and creation of firms when compared to nine other benchmark states. Thirty four percent of Virginia's total share of research and development enterprise is performed by the federal government, the problem is that markets tend not to be driven by federal funding, which means the motivation to create new products and services is diminished (SRI, 2008). Most of the information technology companies in the region are concentrated in computer and information services, and less in telecommunications and electronics, but the industry exists heavily within the defense and biotech sectors, along with a diverse group of sub-industries (Stough et al, 2003). The climate of federal money, coupled with the clandestine nature of the defense industry, has made firms apathetic, or unable to develop new innovations, and propel them to market.

1.5.1 Presence in the Washington D.C. metropolitan region

One of the strongest attributes to the D.C.'s IT sector is the quality and quantity of firms and human capital. In a 2005 study by the Greater Washington Initiative several positive statistics about the IT industry in the D.C. metro region were reported. The most promising findings were that commercial firms, combined with the federal core, have created a regional technology IT workforce nearing 333,000, which is more than double the national average. The concentration of highly skilled workers and firms clustered around the nation's capital owes its existence to federal money, which, unfortunately, may have inhibited the growth of innovation. Consequently, more than 12,000 IT companies feed off of the federal core, from defense giants, to specialized subcontractors (GWI, 2005).

1.5.2 The open and closed business model

It is important for Virginia Tech to understand that firms want open collaboration on individual projects, as opposed to a full engagement of sharing, and this is the angle the university must pursue companies with. As one interviewee stated, their company is always looking for ways to differentiate themselves from competitors, this means they absorb other companies, or invest millions into specific projects, such as instrumentation for simulation and training (Interview 1IT). The need for project specialization is precisely what placed Linux not only into IBM operating systems, but allowed them to lead the world in operating systems for supercomputers. Users want the freedom to tailor programming to suit their needs, without having to pay a licensing fee (Lyons, 2005).

In the fast paced IT market the freedom to alter code allows companies to advance on projects much more quickly and efficiently, and this desire is what propels open source into motion. A university should not worry about licensing rights, because a truly remarkable innovation will become the standard design, after it has been proven in the market. As one interviewee stated; their company usually does not see a new technology until it has been proven for a couple years (Interview 2IT). The nature of the IT business is that firms acquire 3rd party R&D, or licensing rights, which was substantiated by every person interviewed for this report. In such a crowded market place the secret is to maintain a balance between a state of commercialism and openness.

1.5.3 IBM: A case of the open and closed model

IBM has a close relationship with Linux, which has always had the popular distinction as an open source company. Open sourcing is essentially the collaboration between firms, suppliers, and customers, or those who produce software, to pool resources together, which results in a shared technology (Gallagher & West, 2005). In the case of IBM $100 million was invested into Linux, but such a decision must be based upon where and when it will give a company advantage (Interview 5IT). Firms are acutely aware of shareholder investments and expectations, therefore place a boundary on what projects should be open, but this boundary is continually changing, because in the case of IBM, everyday people are observing where to keep standards, and when to move them. They may decide something is proprietary at the moment, but next year it may become open (Interview 5IT). This attitude was also reiterated by another respondent, who stated that when choosing partners it must be done wisely, and by a project specific basis (Interview 2IT). This is also a reason IBM utilizes the company Red Hat, which is essentially a vendor of the Linux operating system. By employing Red Hat IBM has a good way to leverage open source, because they are a Linux solution provider, which means IBM can choose to use a more rigorously tested and proven version of Linux at the proprietary level, and the free version in a collaborative environment (Interview 6IT).

The IT industry, in general, has gone from a proprietary closed innovation model, towards one where customers demand more open information, which happens when an industry matures, so IBM views what they are doing as a mix of a closed and open model; companies must adapt and understand when something has been overtaken by standardization (Interview 5IT).

Another prominent example of this is Mitchell Baker, founder of Mozilla, capturing 10 percent of the web browser market in the U.S utilizing open source information (Pethokoukis, 2006). On the flip side of Mozilla is Microsoft. In a 2007 Business Week article Henry Chesbrough noted how Microsoft pushed to have several places in India and China raided for pirating Vista, when the large company should have been more concerned with open sourcing information in the early stages of a new product. Chesbrough contends it is a mistake to handle intellectual property the same way throughout the life cycle of a particular technology. This is true for a new technology, or an established brand entering into uncharted markets. The goal is to enable a product to be the standard design, which can often times only be achieved by disseminating free information (Chesbrough, 2007).

1.5.4 Where to focus

Opportunity must be cultivated by seeking diversity in projects, and not placing limitations on the scope of interactions. As one interviewee stated, "no good company expects all ideas to come within," meaning that utilizing outside information is a necessity to IT firms, and, as mentioned by two other interviewees, the size of participants should be diverse, along with the types of projects being pursued (Interviews 3IT and 4IT). There are two things currently allowing for growth in specific technological areas: the first being that IT is implemented into almost every business sector, therefore to get your product used it must become operable with other standardized technologies, and secondly, customers demand openness to easily integrate a new technology into their own systems (Interview 5IT). This means that firms must learn to adapt and anticipate when a technology will become the proven standard if they want to seize upon an opportunity (Interview 5IT).

Some current trends to focus on:

-*Cyber Security*: The rapid spread of wireless technology makes protecting user ID's and IP addresses an ongoing challenge. Firms must grapple with how to create boundaries of free access, while simultaneously limiting access for unauthorized users (Interviews 3IT and 6IT).

-*Online Medical Records*: There is a major push to merge health care into the IT realm by the federal government; many companies located in and around D.C. are interested in pursuing these federal contracts (Interviews 1IT and 2IT).

1.5.5 Intellectual property: The largest hurdle

The nature of the defense and federal contracting business has created an atmosphere where innovation is slow to burgeon, and the most important problem for Virginia Tech to overcome is the creation of effective intellectual property agreements (IP); one that is mutually beneficial, and flexible. Nearly every person interviewed noted IP as a crucial aspect when deciding whether or not to partner with a university. R&D must be exchanged freely without the threat of exploitation by either side. In the eyes of the IT industry, partnerships with universities can be accomplished, but licensing agreements must be clearly defined, and non-rigid (Interviews 2IT- 5IT).

The problem universities have with this process is fear of exploitation, which results in unrealistic licensing agreements (Interview 4IT). A good example is the case of Cornell suing Hewlett Packard (HP). The university successfully won $184 million after claiming HP infringed on the patent rights of a student, who developed a device that greatly enhanced processor speeds, which HP then used in all its workstations (McDermott 2008). All those interviewed, on some level, stated that universities tend to be fearful or suspicious of business activities, therefore strict limitations are placed on their licensing agreements, which makes the industry shy away from any sort of partnership, especially if the prospect of being sued exists. The other problem is that both sides view R&D as a money making endeavor, instead of a means to produce truly innovative products (Interviews 1IT-6IT). Universities, just like industry, have been caught up in the need to generate dollars to appear competitive, but if there is

overwhelming consensus on the industry side to promote R&D as a tool for discovery, and not dollars, then why are both sides hesitant to openly collaborate? The answer lies within the mechanism of licensing agreements, and IP rights.

It may sound oxymoronic to call for a completely open exchange of research information, flowing from company to university and vice versa, and then cite the need for a comprehensive written contract, but it is a necessary part of the process, especially when considering many companies, like IBM, are utilizing a closed and open model of business. In response to this, one respondent mentioned the use of a Cooperative Research and Development Agreement (CRADA) as a means for people to collaborate, knowing that IP is an issue (Interview 5IT). A jointly owned patent is simple and mutually beneficial, and a CRADA can enable such an agreement (Interview 5IT). This type of agreement is ideal for Virginia Tech to employ, because many of the firms in the D.C. region are more than likely familiar with its implementation, and it can be modified to suit the needs of the university and their industry partnerships, with ease and flexibility.

CRADA's were the federal government's response to technological collaboration, so in 1986 the Federal Technology Transfer Act was enabled, to foster open collaboration between governmental entities and the private sector, thus establishing this type of agreement.

The primary purpose of the CRADA legislation is to allow government-owned, government-operated (GOGO) laboratories to enter into cooperative agreements for technology transfer with all types of organizations. This includes other federal agencies; public and private foundations; nonprofit organizations, including universities; and others, including individuals who are licensees of government-owned inventions. CRADAs support the broader purpose of providing the means for a laboratory to leverage its R&D efforts, consistent with the laboratory's mission. (http://www.federallabs.org/)

1.5.6 Linking people together

At the individual level open innovation requires collaboration through lines of uncut communication. Web 2.0 is a vital link in the flow of information from person to person, because it is the next generation of IT related to the Internet, such as, the use of blogs, video sharing, and social networking sites, like Facebook (Interview 3IT). According to the Bay Area Science and Innovation Consortium, it enables companies to innovate at the global scale, and has become a major determinant of commercial success (BASIC 2007). If a company or university wants to promote open innovation there must be a method of exchange everyone is comfortable with. An interviewee stated their company tried to have a free exchange of ideas with workers outside the firm, but they used a company centric template, which nobody outside the company was familiar with. In the end it took weeks for them to gather and compile information, when they could have simply allowed people to use standardized communication programs, like instant messenger, or other familiar software (Interview 3IT).

-Web 2.0 speaks to a need of linking people together in the easiest and most efficient manner. The IT industry is fueled by human capital, where outside input is vital.

-IBM's solution to such a problem was an event, which it holds every year, called "Innovation Jam" (Interview 3IT). The event uses web 2.0 collaborative mediums to, as IBM says," work across industries, disciplines, and national borders."

The history of Jams
Since 2001, IBM has used jams to involve its more than 300,000 employees around the world in far-reaching exploration and problem-solving. ValuesJam in 2003 gave IBM's workforce the opportunity to redefine the core IBM values for the first time in nearly 100 years. During IBM's 2006 Innovation Jam™ - the largest IBM online brainstorming session ever held - IBM brought together more than 150,000 people from 104 countries and 67 companies. As a result, 10 new IBM businesses were launched with seed investment totaling $100 million.
(https://www.collaborationjam.com/)

1.5.7 Active industry-university connections

It would be wise of Virginia Tech to think about how it can optimize its greatest asset; the students and professors. All those interviewed said the greatest benefit a university/industry partnership produces is the connection to bright young talent on the cutting edge of research (Interviews 3IT- 6IT).

Technology can help connect industry to students, but more should be done on the administrative end to promote Virginia Tech's new research center in the D.C. metro region. Some form of business outreach should be set into motion, because schools like George Mason University and NOVA are active pursuers of industry, where Virginia Tech has a limited presence (Interview 6IT).

1.6 The Biotechnology Industry Perspective

The biotechnology industry (biotech industry) generates some of the most cutting edge innovations. It is driven by the need to improve public welfare. As such, a major focus of the industry is to develop products that will potentially improve consumer's quality of life. Healthy foods and effective drugs are essential and the biotech industry tries to provide them.

The idea of open innovation in the biotechnology industry emerged when patents on certain biological tools started to block use of, and access to information critical to the development of wholesome foods and necessary pharmaceuticals. This scenario is of particular concern in developing countries where any component that influences the health of the population is especially critical. In recent years, the need for action gained even more attention as biotech research has increasingly shifted from a public-sector activity involving governments and universities, to a private-sector activity led primarily by companies (New York Times, 2005). BiOS Initiative, or Biological Innovation for Open Society, was formed in response to this phenomenon and serves as an administrator controlling public access of protected information. It also permits innovators worldwide to use, and improve, existing technology when they accept to comply with conditions targeted towards preventing patent thickets (http://www.bios.net).

The unique characteristics of the biotech industry influence how the open innovation model is applied. The nature of biotech products requires years of development and hundreds of millions of dollars in research funding. Product development also requires the marriage of multiple components drawn from other fields including chemistry, biology, physics, engineering and IT (http://www.bios.net).

Additionally, biotech product innovation usually relies on, and makes use of, existing information, which means that it would be faster and more cost-effective if current researchers have access to a wide array of R&D information rather than having to start anew. The open innovation model makes use of existing tools and data. This approach provides a great deal of benefit wherein different research groups can leverage each other's work resulting in successful developments. Even though open innovation helps different research groups share information amongst each other, it can have a negative effect on the newer research. As a result larger companies, seeking profit over public benefit, refrain from investing in such projects. So, on one hand, open innovation is beneficial, but on the other, it reduces the interest of certain research groups because now they can't have control over their researched products.

1.6.1 Presence in the Washington D.C. metropolitan area

The Washington, D.C. region is the nation's third largest center of bioscience companies, encompassing 17,000 public sector and 13,500 private sector employees (GWI, 2007). The area is home to 20 colleges and universities with medical or bioscience programs, 16 federal laboratories, 16 large bioscience companies and 11 nonprofit research facilities (GWI, 2007). Major healthcare and research facilities including the National Institutes of Health, the National Science Foundation, and the U.S. Food and Drug Administration are headquartered in the area. (http://www.vabio.org/).

1.6.2 New business model

Investment in the biotech industry has increased in the last decade. Contemporary investors are more knowledgeable about the industry and it's potential. As such, they've become more critical and demanding. They have come to expect the provision of highly developed data and information on a given technology before they make their investment decision (Interview 2B). The number of biotech companies and the number of R&D programs expanding. The relatively high revenues generated by R&D activities fuel further research which results in the delivery of better products to market (Interview 1B).

Biotech companies have the ability to run as 'virtual entities' (Interview 1B). This allows companies to run R&D activities without the need to risk large investments including substantial amounts of physical infrastructure (Interview 1B). VDDI Pharmaceuticals is one such example. VDDI (Virtual Drug Development) Pharmaceuticals is an Internet-based pharmaceutical company that has created and currently utilizes a virtual business model for drug development. At the core of this model is the communications technology-based connection of researchers and consultants who comprise a team responsible for the production of a particular product. The company leverages available technology and resources instead of investing all its capital on infrastructure and workforce. By licensing early-stage products at Phases I and II of clinical studies, and then licensing to large pharmaceutical firms for Phase III clinical studies, product development costs and development time are reduced by up to 25 percent and up to 50 percent, respectively (http://www.virtualdrugdevelopment.com/).

VDDI Pharmaceuticals and other 'virtual companies' follow the principle that tasks can be performed through external contracting, while management activities must stay in-house (Hutchinson, 2001). Although executive activities become more clear and more effective bypassing middle management, companies seeking successful operation as a 'virtual entity' must utilize the best "in-house" workforce with the highest possible levels of experience covering diverse disciplines (Hutchinson, 2001).

1.6.3 "The Tragedy of the Anticommons"

"The Tragedy of the Anticommons" theory claims that over-patenting of research in the biotechnology industry prevents research and development of new treatments, and limits the number of new technological breakthroughs (Buckley, 2007). One of the biotechnology industry's unique characteristics is a lengthy and costly process of product development. Each biopharmaceutical that is brought to market requires, on average, $1.2 billion in research and development. High costs are primarily associated with the industry's high number of failures – about 10,000 failed attempts for every biopharmaceutical. Additionally the period between clinical development and regulatory approval to market averages eight years (Buckley, 2007). Thus, from the moment the innovative idea is conceived to the point a product reaches the market there is a great chance that either the research will need to be suspended or the product will not be commercialized. The longer the research and development phase is, the higher the risk of losing time, money and valuable knowledge generated during the process. If for some reason the research process must be terminated, all newly collected information and data on the product will be lost and rarely gets published (Interview 1B). For this reason, neither companies nor research groups will ever be able to benefit from the information learned over the course of the process. This lack of information leads to duplication of efforts targeted toward the same purpose.

Patents provide yet another risk, especially for smaller companies. Patents play a very important role in the biotechnology industry. While they are essential in securing innovation and providing incentives to investors, they may also thwart the development of a final product due to the potential for the creation of a "patent thicket", which smaller and less profitable firms are most vulnerable to (Cukier, 2006). With the commercialization of products in today's biotech industry, the dynamics of new research are greatly influenced by how existing products and inventions are governed by intellectual property protection laws (Hope, 2005). Patents help in regulating the new research, but also have some negative effects on the research process conducted by smaller companies. Because larger companies make their decisions based on the market forces and conduct their research based on the calculation as to which product will provide the highest return on the investment (Hope, 2005), they secure the product at the very early stages of research through patents. Patenting allows larger companies to block smaller firms from the opportunity to conduct research (William-Jones, 2003). This prevents smaller players and the most innovative start-ups from participating in research due to the fear of patent infringement, which eventually allows large companies complete control over the final product and its market price.

1.6.4 Opportunities

The idea of an innovative biotech product happens when technological capabilities are matched with public needs. Smaller biotech companies often exhibit great potential for innovation. They have the ideas, but lack the knowledge and tools necessary to implement them. Thus, pursuit of their research goals rests on a heavily on academia. Data that is available in the public domain is very limited and in many cases is outdated (Interview 1B). Universities not only have the most current data but they are also willing to conduct research with smaller companies on a basis other than shear profit. University researches have decades of experience in the field of interest; which is rare in the commercial sector, and would be impossible to recreate in a company setting (Interview 1B). Partnering with academia allows many smaller companies to use university facilities and talent for their research purposes. The open innovation model creates opportunities for both university researchers and companies. For universities, it is an opportunity to market the ideas, and for companies, it is an opportunity to embark on project with significant potential for success.

1.6.5 Providing industry-friendly environment

In early 2007, two George Mason University researchers started a company. Theranostics Health LLC, was based on technology that they had developed at the university (Burke, 2007). The firm ultimately located in Rockville, MD due to Virginia's unwillingness to provide them with that kind of environment they were looking for (Burke, 2007). This example raises a question as to what Virginia can do to attract more biotech companies from other states and prevent home-grown ones from relocating?

The possible answer to this question lies in infrastructure and funding. The Virginia Biotechnology Association identifies two factors that the state of Virginia lacks which result in home-grown companies moving out of area. First factor is the limited number of available wet lab spaces. These highly specialized spaces differ from and cost much more than standard office spaces ($250-$350 per square foot vs. $50-$75 per square foot). Such spaces are unlikely to be

financed by the private sector due to uncertainty of the lifespan of research. The Virginia Biotechnology Association estimated that if the state invested $100 million in financing toward the construction of such laboratory space and infrastructure, it would be a positive step aimed at expanding and improving Virginia's biotech industry. As a second factor, Virginia must improve access to capital and financing for early stage biotech companies (http://www.vabio.org). Neighboring states including North Carolina, Maryland and West Virginia, have each invested $10-$20 million or more, into assisting private venture capitalists interested in and capable of growing new biotech companies in their states (http://www.vabio.org). Authorizing direct investment by the state into a number of private venture capital funds and investing $10-$20 million could create more than $30 million in available funds for Virginia companies which would, in turn, attract existing venture capital funds to the state.

1.6.6 Competition boom

Competition is one of the challenges faced by companies in the biotechnology industry. About 80 percent of large companies across industries currently rely on external innovation for market growth (Fetterhoff, 2005), and the biotech industry is no exception. Venture capital firms do not always have the necessary tools or funds to realize the development of ideas into a product. Identifying essential partners, including technology incubators, universities, or other start-up companies, is a challenge in- and of-itself. Companies need to evaluate capabilities and potential risks when establishing criteria used to seek partners. Once criteria are established, finding partners who will be part of the process from the research stage to the marketing of the product becomes easier.

The strategy to win over a potential partner lies in either increasing the capital or adding alternative forms of currency including manufacturing capacity, broader distribution channels, stronger marketing potential and company reputation, attractive to the technology provider (Fetterhoff, 2005). Once a biotech company finds its partner that will satisfy its criteria, competition within other similar biotech companies that seek the same technology tool provider ensues. Pressure to demonstrate capabilities and the opportunities beneficial to both the biotech company and the technology partner intensifies.

Patents further stimulate competition and development of new similar products by other companies once they expire – 20 years for all drugs (Tansey, 2007). After the patent on a certain drug runs out, it becomes a race between generic pharmaceutical firms to copy the drug on a massive marketing production scale in an attempt to collect all revenues which leaves the original inventor of the drug feeling pressured to commercialize the product before the patent expires (Tansey, 2007).

1.6.7 Finding the balance

Open innovation has its advantages and disadvantages. Eventually there is a balance between benefiting from shared information vs. the incentive to put in hard work and come up with a cutting edge research solution that is strictly protected by law. Here, Virginia Tech has an advantage, as its inventors receive 50 percent of the revenue, which is probably the highest proportion of any university in the U.S. (Interview 2B). But in the end, it is the patents that can provide the balance wherein the research companies are rewarded for their efforts, while at the

same time, the patents itself are acting as an obstacle for other smaller players to participate in the new research and leverage off of the already available information and tools.

The open innovation model allows different research companies to benefit from and leverage each other's "finds. As such, the final cost of the research stays lower than would otherwise be possible. Another factor that adds to the difficulty of projects is the unpredictable nature of research costs during early stages of the R&D process. Sharing the risk reduces the extent to which any one actor takes on a significant financial gamble, making it impossible for some of the companies that would otherwise refrain from investment to partake. Lowering the total cost and distributing risk makes it easier for smaller companies to participate. This is one of the major benefits of open innovation. Ultimately, application of the open innovation model in the biotechnology industry can lead to lower relative research costs while possibly preventing larger companies from gaining monopolistic power. Therefore everyone, even the public at-large reaps the benefits of a greater degree of "openness".

1.7 Overarching Themes across Industries

Across industries, a continuum of openness exists. Some sectors, like the biotechnology industry, are currently more open than others – information technology and defense. This is likely due to the fact that each industry follows a different innovation model.

The defense industry is driven by a technology push rather than by competitive demand pressures, while the biotech industry is more driven the need to improve public welfare and is subject to a lengthy product development process. The IT sector is more open a the beginning of the innovation process than toward the end while the defense industry is more "closed" throughout the entire innovation process than either of the other two industries.

While industry-university linkages are not the sole drivers of industry's adoption of more openly innovate processes, they do comprise an essential step in the movement toward openness. The development of strong industry-university linkages will lead all three industries to become more open. Given that universities are major repositories and generators of information and knowledge, they play a major role in capturing value from information and knowledge movements. Additionally, the stronger the linkages between industry and university, the greater the potential for information flow outside of traditional channels. Industry will become more globally competitive as it becomes better able to respond to the new more open business climate. However, not all industries can be expected to benefit from these linkages equivalently. For example, defense may become more open but will, at the same time; remain more closed than other industries because of its central focus on national security.

Several issues are present across all the industries examined in this study:

1. Intellectual Property: Industry struggles with fairly awarding credit to partners while still protecting and capitalizing on individual contributions.

2. Project specificity: Industry is looking to tailor partnership agreements as dictated by the needs of each individual project. Standardization of relationships across all is not likely to attract industry interest in collaboration. Industry is also looking to partner with entities capable of fully understanding its specific needs and desires.

3. Human capital: The development of talent with industry-specific knowledge is a major attraction to potential industry partners.

4. Funding: Some industry sectors, e.g. biotechnology, are marked by a greater presence of start-up firms lacking the ability to effectively attract and assemble necessary funding.

5. Infrastructure: Much of the innovation in an industry sector often comes from newcomers. In the case of the biotechnology industry, these emerging players require access to highly specialized research environments.

1.8 Establishing Strong Industry-University Linkages

The question remains: how does Virginia Tech utilize the information presented in this analysis to pursue an openly innovative policy for the new research center in Ballston? From an industry perspective, partnerships with universities appear to hinge on companies strategically collaborating to achieve project specialization, while trying to maintain a level of protection with licensing rights. As a major potential part of this process, universities possess an invaluable supply of human capital that must be utilized to suit the needs of the outside business community. For Virginia Tech, it is important to understand that firms may only want to openly collaborate on individual projects, and this is the angle the university must pursue companies with, because businesses require a certain freedom of movement. Universities, just like industry, have been caught up in the need to generate dollars to appear competitive however there is overwhelming consensus on the industry side that R&D should be promoted as a tool for discovery, and not dollars.

Two things are clear: industry requires the freedom to pursue closed and open models of innovation based on the type of project they are pursuing; and successfully partnering with a university means drafting clear and concise agreements. The research center in Ballston will successfully implement the open innovation model if it can attract the right firms to its doors. Doing so means investing money and time towards the direction that the industries highlighted in this analysis are taking. One of the key factors that preventing this from occurring, is the lack of effective communication between the parties involved. Universities have their own culture and industry has an equally unique culture ripe with its own "jargon". Making university research more relevant will require bridging of this gap.

Specifically, VT-ARI should:

- **Develop intellectual property models that center around flexibility and adaptability.**

- **Approach industry relationships on to a case-by-case basis.**

- **Develop networks with industry through graduate placements.**
    - The development of a system to better track and maintain an open dialogue with graduates who become employed in the field; and the establishment of an entity tasked with tracking industry developments and identifying those projects within the university that are related.

- **Use available technologies to develop strong networks.**
    - Web 2.0 technologies including Facebook, Instant Messenger, LinkedIn and others, are readily available, understood by many and were developed specifically for networking.

- **Increase its awareness of industry developments and needs; engage in targeted self-promotion.**
    - There are several ways in which universities can approach this task. Secondments, wherein, university researchers work side-by-side with industry representatives; industry information liaisons; systems designed to track the

industry-university relationships already in existence; and other proactive marketing channels exist.

- **Provide the infrastructure necessary to perform collaborative research – increase the "stickiness" of industry presence.**
    - Supplying industry with the capital intensive, narrowly defined infrastructure necessary for product research and development will aid in bringing firms back to the university when embarking on new projects.

- **Serve as the facilitator of project-specific funding.**
    - Resource development is already a major strength of the university. All of the colleges within the university have resource development officers who have access to extensive donor networks. As such, the university has established an ample number of connections to aid smaller firms and emerging sectors in the assembly of research and development funds.

The critical point to take away from this analysis is that, if universities are serious about advancing the development of tomorrow's great innovations, then they will have to reevaluate how it is they go about it. The ivory towers that once existed are no longer relevant, and universities must now be active players in a more open, collaborative environment. The key is that one of the major linkages to be made – the industry-university linkage – will not simply materialize without concerted efforts on the part of universities. In a general sense, industry is already aware of the great potential that exists across this country's campuses. What it wants is to be actively engaged and shown that universities can, and will, respond to its needs.

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Interview 5D. Defense industry consultant and United States Navy Officer (Ret.). Conducted 11/9/2008.
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Interview 2IT. Vice President of IT firm in D.C. region. Conducted 10/27/2008.
Interview 3IT. Head of Army Division in IT firm in D.C. region. Conducted 10/27/2008.
Interview 4IT. Venture Capitalist and former VP of R&D at a leading corporation. Conducted 10/28/2008.
Interview 5IT. Chief Technology Officer at leading corporation in D.C. region. Conducted 10/31/2008.
Interview 6IT. Information Technology academic expert. Conducted 11/11/2008.
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Appendices

Appendix 1: Open Innovation Expert Interview Questionnaires

Defense Industry Expert Questions
1. With regard to research and development activities, in what ways has your industry changed in the past few decades?
2. ***Open Innovation is defined as a paradigm that assumes that firms can and should use external ideas as well as internal ideas, as well as internal and external paths to market.*** Given this definition, what do you feel is the best way to foster open innovation, while still protecting intellectual property rights?
3. Does your industry actively partner with universities? Why or why not?
4. What are the major potential benefits of industry-university partnerships? Major challenges? Please provide examples of both.
5. Is it feasible to share intellectual property rights with universities? Why or why not?
6. How do the national security priorities of your industry affect the adoption of a more openly innovative system?
7. Would industry-university partnerships improve the commercialization potential of defense industry products and technologies? Why or why not?

Information Technology Industry Expert Questions
1. With regard to research and development activities, in what ways has the information technology industry changed in the past few decades?
2. Open Innovation is defined as a paradigm that assumes that firms can and should use external ideas as well as internal ideas, as well as internal and external paths to market. Given this definition, what do you feel is the best way to foster open innovation, while still protecting intellectual property rights?
3. Given the definition of open innovation in question 2, how would/do you promote a free exchange of information, related to IT development, amongst researchers or workers inside, and outside the confines of their university, or company? Please elaborate.
4. If an IT firm was partnered with the new Virginia Tech research center in Arlington VA, what specific technological areas in the IT field would be most beneficial to openly exchange information on with the university? Please explain why.
5. What are the potential benefits of industry-university partnerships? Major challenges? Please provide examples of both.
6. What type of long term open innovation strategy would you like to see between Virginia Tech and the IT sector of Northern Virginia?

Biotechnology Industry Expert Questions
1. With regard to research and development activities, in what ways has biotechnology industry changed in the past few decades?
2. ***Open Innovation is defined as a paradigm that assumes that firms can and should use external ideas as well as internal ideas, as well as internal and external paths to market.*** Given this definition, what do you feel is the best way to foster open innovation, while still protecting intellectual property rights?
3. Does biotech industry actively partner with universities? Why or why not?
4. Do you encourage companies and other research centers to work collaboratively? If so, in what way?
5. Would you be willing to share information across different research groups if they are working on a similar product development but for different companies?
6. In case of a need to suspend a research halfway through the process due to unexpected impediments, how would your research facility handle it?
7. What happens to a partially-developed product and information it holds in case the product doesn't make it to the market?
8. Upon the successful development of the product who will have the rights to the patent and at what share?

Chapter 2: The Role of the University in Open Innovation

Kathy Mason and Jessica Chopko

Executive Summary

The open innovation model asserts that identification of, and cooperation based upon the synergies that exist amongst industry, government and university, lead to the production of new ideas and innovations outside of traditional research and development channels. The university is no longer a reactive member that provides basic research to industry and government in order to generate innovations. Universities are increasingly proactive in seeking out and establishing mutually beneficial relationships with industry and government sectors. As a result, the university has become a key player in innovation.

Examination of successful cases and information collected from interviews of key Virginia Tech representatives provide insight into the university's perception and potential adoption of the open innovation. A number of challenges and recommendations associated with the implementation of the model were revealed. Previous research, Perkmann and Walsh, 2007, guided the analysis.

Key Virginia Tech Findings:

- **Research Partnerships**: The centers moving into Virginia Tech's Advanced Research Institute (VT-ARI), will bring existing research partnerships with them. Leveraging these partnerships and building new partnerships will help VT-ARI link to local industry. Researchers are proactive in looking for collaborations but some may consider formalization processes for partnerships is difficult.

- **Research Services and Human Resource Transfer**: VT-ARI will build a reputation in the Washington, D.C. region through consulting services and labor force transfer. VT-ARI should encourage researchers to consult with industry.

- **Academic entrepreneurship**: Academic entrepreneurship allows VT-ARI to link to industry and actively participate in new business opportunities. VT-ARI can encourage researchers to partner with start-ups and business ventures.

- **Informal interaction**: The University can function as an important public space in the community. One of the more formal public spaces at VT-ARI will be Cafe Scientifique. It can foster informal interactions within the science community.

- **Commercialization of property rights**: Virginia Tech Intellectual Property can play an important role in the marketing and exposure of VT-ARI intellectual property. However, we suggest Virginia Tech experiments with intellectual property marketing models, like those proposed by the Kauffman Foundation.

- **Global engagement**: The state of the world's economy, health, and environment depend on universities, governments, and industries to work in an alliance to find solutions to the ever changing world. Through a conglomeration of these resources, research and development can create answers.

Key Case Study Findings:

- **University of Akron Research Foundation**

  The foundation helps to regulate technology transfer between universities and outside entities including industry, government, and other institutions

- **Arizona State SkySong Center**

  ASU created the "New American University" using guiding principles identified by a task force. This new approach allows ASU to: build upon entrepreneurial colleges and schools; allot intellectual and entrepreneurial responsibility to colleges and schools; create a design that allows colleges and schools to prosper; and develop a federation of unique university components that serve as the foundation of a premier research institution

- **Michigan Initiative for Innovation and Entrepreneurship and the University Research Corridor of Michigan**

  The state of Michigan created programs to build sustainable companies and developments to rebuild its economy. Various funds and programs including Gap Funding, Industry and Economic Engagement, and Talent Retention and Entrepreneurship Education are aimed at economic prosperity and the diversification of knowledge-based industries.

- **MIT iCampus and *Best Practices for University-Industry Collaborations***

  MIT and Microsoft formed a university-industry collaboration that has lasted for seven years and built upon approaches identified in *Best Practice for University-Industry Collaborations.* iCampus is a partnership used to create new technology that improves information technology-enabled teaching models and educational tools.

Recommendations to Virginia Tech Advanced Research Institute

- **Establish a task force to develop guiding principles and models for Virginia Tech's adoption of an openly innovative model.**

- **Conduct interviews of industry and government representatives to identify possibilities for and goals of university collaboration.**

- **Implement multifaceted funding structures, new industry-university knowledge transfer models, and entrepreneurship education for faculty.**

- **Market the Advanced Research Institute as an entrepreneurial and innovative facility through membership in the iBridge Network.**

- **Advertise to all levels of government and industry contacts. More specifically, communicate stories about the types of research conducted by faculty at the Advanced Research Institute.**

- **Experiment with a new model for intellectual property commercialization.**

Table of Contents: The Role of University in Open Innovation

2.1 Background and Purpose of Study: University Perspective

In mid-2008, Virginia Tech's President, Charles Steger, announced the University's plans to open a new research facility in Arlington, Virginia. As such, Virginia Tech is interested in identifying strategies for the launch, branding and success of the new Advanced Research Institute (VT-ARI). Adoption of the open innovation model may assist the University in meeting these goals.

Open innovation allows synergies among industry, government and university to serve as a base for cooperation yielding new ideas and innovations outside of traditional research and development (R&D) channels. The university is no longer a reactive member that provides basic research to industry and government. Rather it is has become increasingly proactive in seeking out mutually beneficial relationships wherein it is a central player in fostering innovation.

Innovation is essential to gaining an edge in both global competition and competition among research facilities. Universities can facilitate open innovation through research partnerships, research services, academic entrepreneurship, human resource transfer, informal interaction, commercialization of property rights and global engagement (modified from Perkmann and Walsh, 2007).

This chapter examines the role of the university in the open innovation model. It evaluates the resources currently available to Virginia Tech that may facilitate open innovation and also proposes recommendations for fully implementing a more openly innovative approach at VT-ARI.

2.2 Literature Review

Chesbrough (2003) highlights industry's search for external knowledge through academic research and partnerships as a major facet of the open innovation model. Much of the literature reveals industry's desire to capture external ideas; in particular industry seeks to incorporate knowledge generated through university research (Perkmann and Walsh, 2008). Virginia Tech will be able to engage industry and government through relationships at VT-ARI. In doing so, Virginia Tech will contribute to the innovation process while gaining national recognition beyond the mere "generic economic and social benefits of universities" (Perkmann and Walsh, 2008). Indeed, the University will be able to establish long-term partnerships capable of fostering meaningful opportunities for innovation. As Perkmann and Walsh (2007) note: "Research partnerships are formal collaborative arrangements among organizations with the objective to co-operate on research and development activities."

The technological infrastructure of a geographic region is integral to the level of innovation and brings together crucial resources to spur innovation (Feldman and Florida, 1994). Feldman and Florida (1994) identify four indicators of technological including:

1) firms in related industries;
2) university research and development;
3) industrial research and development; and
4) business-service firms.

Feldman and Florida (217) cite Mansfield (1991) stating "…university R&D has a positive effect on commercial innovation and generates a significant social rate of return – in excess of 25 percent according to one recent study." It was also found that research conducted in areas exhibiting close physical proximity between university and industrial R&D lead to an increased number of patents and additional innovation (217). The four components of technological infrastructure [as defined by Feldman and Florida] must not only be present, but the appropriate synergies between innovation actors must also exist.

The Virginia's Technology Industry Potential: Catalyzing Innovation in the Commonwealth report, published in February 2008, and prepared for the Virginia Economic Development Partnership by SRI International, examined knowledge-based economic development. The report highlighted that through a transfer of ideas the federal government, educational institutions and private industry, are working together to advance some of the larger industries present in the state. These entities are collaborating, in part, because of the increasing scarcity of well-educated human capital, and the increased expense associated with attracting an adequate labor force. Additionally, the need for university collaboration stems from four factors:

1) the development of new technology platforms;
2) the growing technological need in industry;
3) the presence of budgetary constraints; and
4) the increase in funding of government policy.

Universities play a major role in generating new technologies. The social networking that occurs in the university setting can create knowledge spillovers across disciplines. Bercovitz and Feldman (2006) examine a conceptual model of the role of universities in innovation systems and show that a variety of networks can be created through the interaction of disciplines which ultimately results in increased interest and knowledge for the individuals in the network. The model further illuminates the existence of the following university-industry transactions: transfer of knowledge; sharing of concepts; and establishment of funding pathways.

According to the Virginia Economic Development Partnership, the Commonwealth has six main service industries, including:

1) Education and Government;
2) Retail Trade;
3) Construction and Real Estate;
4) Tourism;
5) Life Sciences and Medicine; and
6) Business Services.

However, not all regions of Virginia consist of the same industrial mix. It is important to identify the particular industrial characteristics of each region so as to develop relevant industrial targets and focus for each of the Commonwealth's public research institutions.

SRI International, a nonprofit research and development group, has identified potential technology areas in Virginia as:

1) Health Care and Biomedical Sciences;
2) IT Services;

3) Materials and Chemicals;
4) Clean Energy and Environment; and
5) Transportation and Logistics.

Virginia currently has research centers in locations capable of servicing these areas. Several steps, necessary to the enhancement of these centers such that they can adequately address the potential areas, must be taken. The first step will be to facilitate research excellence by hiring recruiting the best talent, particularly notable faculty members. Additionally, fostering collaboration across disciplines will be necessary. Finally, the support of entrepreneurialism, and the provision of capital to individuals interested in R&D likely to yield innovations that area useful to both industry and society as a whole, are essential.

This approach can be measured through a long-term review of identified milestones. Collaboration will be a key part of all R&D performed by universities. Industry should be proactive in the process as its capital and reputation are at stake. The university, on the other hand, should not expect any one private organization to be solely responsible for funding. Instead it should actively leverage funds it receives. Ultimately, team players should have a sense of what they are accountable for before a project starts, and should accurately account for how time is spent (VEDP, 2008).

Lester (2005) examined the relationship between universities and industry; and university contributions to the local industrial innovation process and local economic development. The technology transfer model, whereby discoveries are made at universities and transferred via patenting and licensing, are a key focus of Lester's 2005 study. A major drawback to universities' patenting and licensing approach is that they "are often weak on capitalizing on the research and discoveries that they make." Despite this problem, the importance of licensing, regardless of monetary gain, is that faculty members take advantage of opportunities to publish while industry still benefits from the use of researchers as consultants who offer potential significant contributions to their enterprise. Indeed, licensing and patents are less important in technology transfer than are faculty consulting, publications and the recruitment of students. Universities also serve as a public forum for idea exchange and partnership development.

Lester's four points on contributions to industrial transformations summarize the role of the university in innovation. The university offers:

1) education and training (human capital);
2) additions to the stock of codified knowledge (publications);
3) increased local capacity for scientific and technological problem-solving (mentoring programs and start-up clinics); and
4) space for open-ended conversations about pathways and opportunities (public space for conferences).

As such, universities can target their contributions to innovation in the local economy according to the following typology (Lester, p. 28):

1. Type I – Forefront of science and research, aggressive technology licensing policies, promote entrepreneurial businesses, cultivate ties because research and businesses, create industry identity;

2. Type II – education/manpower development, responsive curricula, technical assistance;
3. Type III – bridge between disconnection, filling 'structural holes,' create industry identity; and
4. Type IV – offer contract research, faculty consulting etc, education/manpower development, global best practice scanning, convening user-supplier forums.

In conclusion, no experience, according to Lester (2005), is the same across universities, but careful examination of local industry can help a university target their approach and identify potential contributions. In keeping with this notion, the relationship between university and industry should be considered as follows:

1. Realize that there are multiple ways to contribute to the innovation process;
2. Acknowledge that indirect support may be more important than direct contributions;
3. Understand that successful technology take-up depends on the specific characteristics of the industry and its transformation pathway;
4. Employ a strategic approach toward university planning that includes a specific role in local innovation; and
5. Ensure that the strategic approach taken is compatible with the primary university role of providing education and research.

2.3 Methodology

Reoccurring themes from the literature (modified from Perkmann and Walsh) are used to evaluate the resources and links to industry and government that exist at VT. The seven links outline how to look at VT facility and analyze the opportunities that VT has to strongly exercise open innovation. In order to gather information of VT ARI, it is important to examine existing institutes and programs coming to the facility and links that a person in industry or government would have access to on the website of Virginia Tech interviews with university representatives to examine the understanding of open innovation and industry links. Open innovation models used by other national universities will also be examined to address each programs' strategies and effectiveness to, in turn, apply some of these models appropriately to the new facility. The primary links and services that can help VT become a prominent player and resource for industry and government in open innovation is an important part of the findings of our research. In order to discover a strategy and if open innovation can work in the existing structure, we need to see what is available and the current infrastructure. In addition, our research on open innovation programs of other universities across the United States and their experience will provide valuable lessons for VT.

2.4 VT Findings

2.4.1 Research Partnerships

Research partnerships are funded research programs with clear goals and objectives provided by the sponsor - usually government or industry. Partnerships are important for disseminating the products of research and development to industry partners and receiving compensation for the work. The new facility at Ballston will hold offices for some of Virginia Tech's largest research centers including the Virginia Bioinformatics Institute (VBI), the Institute for Critical Technologies and Advanced Science (ICTAS), the Virginia Tech Transportation Institute (VTTI)

and others. In examining the role of Virginia Tech in open innovation, it is important to look at the existing links between university and industry.

One of the most important links between university and industry in open innovation are research partnerships. In the case of Virginia Tech, there will be a significant number of existing research partnerships that the programs moving to VT-ARI in Ballston will bring with them. It is important for Virginia Tech to understand the work at the new facility in order to effectively advertise the progress of and research coming from these partnerships to potential future partners. For example, the Virginia Bioinformatics Institute (VBI) is a research institute dedicated to transdisciplinary biological sciences and bioinformatics research. One current VBI partnership includes the Virginia-Maryland Regional College of Veterinary Medicine and the Virginia Tech Department of Computer Science. Through the partnership, "a five-year, $10.3 million contract by the National Institute of Allergy and Infectious Diseases to establish a national Bioinformatics Resource Center" was awarded (www.vt.edu). Another research center, the Center for Energy and the Global Environment (CEAGE), examines issues related to energy and its role in the global environment. Through one of it's current partnerships, CEAGE is engaged in the Modeling and Simulation of a DG-Integrated Intelligent Microgrid, a one year research project funded by the U.S. Department of Defense's Strategic Environmental Research and Development Program (SERDP). Clearly, VT-ARI can leverage existing partnerships and facilitate open innovation through cross-disciplinary work.

During an interview, a researcher noted that industry and government partners seek researchers out based on their expertise. One of the key findings from the interview was that the interviewee's partnerships and collaborations (one with a major defense contractor and the other with federally funded research and development corporation) are efforts that he was approached to work on due to his expertise. He is also proactive and reaches out to find funding for research he wants to pursue. This reciprocal interaction of research partnerships is important to open innovation because it highlights that the university can be a proactive participant in R&D.

The interviewee stated that the risks for his partnerships arise during the formalization ("many moving parts") of the partnership. From a legal and contractual perspective, any portions of the agreement that do not pass, can degrade or obstruct the success of the project. He believes the opportunities for open innovation will arise if projects get funded as they "will establish Virginia Tech's leadership role within communities of interest (including stakeholders) as well as provide platforms for innovations and advancement of knowledge, science and technology and problem-solving. This results in policy influence, the generation of new programs, the publication of papers on new topics (for VT personnel and collaborators), the generation of revenue (new sources) and training for students." The findings of the interview demonstrate that the university can foster open innovation in many ways through even a single partnership. The potential for research partnerships can inspire entrepreneurialism because they provide researchers with the opportunity to reach out and find support for their interests.

2.4.2 Research Services

The services that universities provide to industry and government are consulting and contract research. The difference between consulting and contract research is that, consulting work requires the research to bring their expertise to the project whereas contract research is often new

research into unexplored issues that is performed at the request of the client. One way to access Virginia Tech's academic expertise is through the Virginia Tech Expertise Database (VTED), a listing of researchers and their expertise that can be accessed by industry, government and general public on Virginia Tech's website. Individual researchers are responsible for posting their own profile. Another resource for industry and government is the Technical Assistance Program (TAP). The program allows businesses to contract with university consultant services. Researchers have the option to engage in private consulting or through Virginia Tech. Consulting is an important component of open innovation as it allows industry and government to benefit from faculty research and expertise.

2.4.3 Academic Entrepreneurship

Academic entrepreneurship occurs when researchers, using their unique ideas, are able to develop a business or project. Currently, in Blacksburg, Virginia Tech KnowledgeWorks offers incubation services to small business at the Virginia Tech Corporate Research Center (VT-CRC) in Blacksburg. VT-CRC offers office space to companies developing cutting-edge technology. An interview with a representative of VT KnowledgeWorks, revealed that a tenured professor is very unlikely to participate in entrepreneurship because of self-selection into the low-risk academic environment, and that out-licensing is a more common method of technology transfer. Additionally, the interviewee noted that universities are an early stage feeder into the innovation process and university research lies on the boundary between idea and invention.

2.4.4 Human Resource Transfer

Another main university linkage to industry and government is through human resource transfer. Consulting services are an example of how human resource transfer occurs. A more permanent transfer comes from the university trained and educated labor force. Industry is looking for candidates that are well-prepared and accessible to them. The Virginia Tech facility in Ballston and its researchers will represent the university throughout the region. As such, meaningful contributions and community involvement on the part of VT-ARI will be important.

2.4.5 Informal Interaction

The university plays very important role in the provision of public space. As a land grant university and state institution, VT-ARI will have valuable space that should be made available to community members. The new facility will have conference space and lecture areas. It will also feature, the Café Scientifique, a coffee shop style spade intended to promote science and discussion within the community. This will be one of the more structured public spaces that will facilitate informal interaction. The concept of Café Scientifique is that "for the price of a cup of coffee or a glass of wine, anyone can come to explore the latest ideas in science and technology" (www.cafescientifique.org). The café is structured such that it lies outside of the formal academic setting which allows for the promotion of public engagement and the public accountability of science. This type of café is representative of open innovation as it is a place where ideas and debate can take place outside traditional avenues.

2.4.6 Commercialization of Intellectual Property

VT-ARI will focus on R&D and increasing R&D expenditures. The existing resource for commercialization of intellectual property is Virginia Tech Intellectual Properties (VTIP). VTIP was created in 1985 to identify, legally protect and market Virginia Tech's intellectual property.

Intellectual property is group of intangible assets of knowledge and ideas (OVPR). Protections for intellectual property include copyrights, trademarks, patents and trade secrets. VTIP is a financially self-sufficient branch of Virginia Tech funded with money left over after royalties are paid to inventors. VTIP plays a very important role in the formal links in open innovation as it provides a mechanism whereby researchers are able to protect their ideas and research products.

In an interview with a VTIP representative, the role that VTIP plays in open innovation was discussed. The interview revealed that "since VTIP manages the commercialization process for technologies arising from research at Virginia Tech, it is the net input for the open innovation process." The advantages of VTIP in open innovation is "if companies recognize VTIP and Virginia Tech as a source of ideas to feed open innovation, positive collaborations result in new research finding, revenue generating licenses, consulting projects and opportunities for students seeking employment." VTIP's success in working with industry and government is dependent on others being interested in open innovation and the sharing of the success stemming from commercialization of intellectual property. However, the interviewee noted that some companies seek university resources at no cost, and that VTIP needs to address and effectively communicate both Virginia Tech's capabilities and its limitations. A major risk for VTIP comes from the University's ability to produce technologies that adequately address companies' needs.

A great deal of research examining the use of intellectual property as an incentive in the adoption of an openly innovative approach exists. One major finding of said research is that, the focus on revenue can be a deterrent. Litan and Mitchell (2008) note that a university has no choice "whether" to be entrepreneurial, and as such, should focus on "how" to best go about being entrepreneurial. When they employ the traditional approach to commercialization of intellectual property, university officials ask the impossible "-to generate substantial profits for the university *and soon* – with insufficient numbers of people with the right combination of skills required to perform at peak levels" (p. 132). In an effort to address some of the drawbacks of the traditional approach to commercialization, the Kauffman Foundation, a philanthropic entity engaged in entrepreneurship education and research, suggests that universities should experiment with alternative commercialization models:

> "*allowing other commercialization "agents" to compete with the university TLO (technology licensing office), forming multi-university TLOs to generate economies of scale and to take advantage of industry-specific expertise at other institutions, or even giving university faculty the intellectual property to their discoveries and relying on their post-success donations to the university as the (more than) equivalent of up-front compensation for the IP rights and the ability to commercialize without the involvement of the TLO." (p. 133).*

Arizona State University and the University of Washington's College of Engineering have followed this advice and are currently experimenting with alternative models. Additionally, the state of Texas is the first state to require public universities to add commercialization of research, specifically the number of innovations patented, as a factor affecting faculty tenure decisions.

2.4.7 Global Engagement

Universities must be involved globally, using technology as a basis to connect for connecting

with other regions. Unfortunately, as noted by President Alan Merten of George Mason University, traditional American universities engage in few global partnerships. In the past two decades, George Mason has sought to reach out globally through its international commerce graduate program. It has experienced steady growth in new programs addressing the economy, communication, and the environment, all through an international lens.

Merten states that in order to become a "global university," entities should establish priorities that recognize the importance of globalization, realign resources to promote its growth, provide intellectual leadership for research that seeks solutions to global problems, coordinate efforts well, and embrace the wave of change due to globalization. The current state of the world's economy, health and environment, require that universities, governments and industry, have to work collaboratively to find solutions to the issues that arise in an ever-changing world.

2.5 University Case Study Findings

Four universities' programs were examined. Each selected university initiative has a research institution or initiative combining labor and capital assets that, government, industry and university, share in an open forum.

The universities and programs examined are:

- Research Foundation of University of Akron
- SkySong Center at Arizona State University
- Michigan Initiative for Innovation and Entrepreneurship and the University Research Corridor of Michigan (constructed of several major universities throughout Michigan)
- Microsoft iCampus at Massachusetts Institute of Technology

Several key factors of each case were examined. They include: 1) Role, 2) Structure, 3) Advantages, 4) Disadvantages, 5) Opportunities, and 6) Risks, that each university manages.

2.5.1 Research Foundation of the University of Akron

The University of Akron has a university technology nonprofit foundation, the University Akron Research Foundation (UARF), which establishes technology transfer guidelines. The state of Ohio does not allow universities to actively hold ownership in companies or move forward with legal procedures against research sponsors. As such, the UARF acts a resource for the university take such actions. Virginia Tech has established a similar foundation, Virginia Tech Intellectual Property, Inc., that manages intellectual properties for the university. Approval is not necessary to transfer title to VTIP. However, if the university chooses to transfer ownership, the Bayh Dole Act of 1980 stipulates that, the university has to share royalties with inventors and the remaining royalties from the invention must be put into the university. If ownership is not elected, then the federal agency sponsoring the research retains ownership.

The UARF is responsible for negotiating and making recommendations that result in contract agreements which ensure that intellectual property is managed to best serve the public interest. Net revenue resulting from the intellectual property is allocated as agreed between the inventor and the University according to State guidelines. UARF has set standard terms of agreement to include an allocation of revenue into specific shares. Typically, forty percent of net revenue derived goes to the inventor/author, ten percent is allocated to a research account in the UARF, forty percent is dedicated for the UARF, five percent for research accounts in the UARF for specific colleges, and another five percent is allocated to a research account in the UARF for the department in which the inventors have primary appointment. Through the foundation, all income received from license fees, royalties and equity positions, is allocated by the UARF in accordance with the policies of the university. These funds support intellectual property functions at the University and research throughout the University (UARF, 2002).

The role of the UARF is to allow private companies to contract university services while reducing barriers to working with the University. The technology center allows spin-off companies to rent offices, and access the university and its resources. The foundation provides office space for cooperation with other universities, industry and governments. With the establishment of the research foundation, University of Akron has facilitated a greater rate of

return for industry beyond the return offered by larger universities in the state. In an interview with *Bizworld*, a technology innovation publication, Kenneth G. Preston, Associate Vice President for Research and Director of Technology Transfer, noted that the inability of the university to take equity in private enterprise is a real disadvantage. The interview further details the hesitance to work with universities because of the politics involved, and the time it takes to develop partnerships. With the establishment of the UARF, University of Akron can engage more efficiently and effectively in these partnerships.

Reasons for success of the UARF include: a willingness to focus on technological transfer; a staff that is supportive of the business community; a supportive faculty; a risk-taking attitude; a strong drive to make projects feasible; and the mechanisms and resources necessary to successfully develop intellectual property (Soder, 2007).

2.5.2 Arizona State University

Through a new paradigm, known as the "New American University", Arizona State University (ASU) works to establish its campuses as partners in the growth of the local economy, society, culture and environmental health. The "New American University" will redefine the role of higher education. The "New American University" operates on the basis of specific design principles established on the basis of a model of differentiation that will help transform ASU into a major research institution. A 2002 policy paper "A New American University: The New Gold Standard" outlines the eight principles underlying ASU's transformation. They are:

1. Embracing cultural, socioeconomic, and physical settings of the educational environment;
2. Becoming a force in societal transformation;
3. Creating a culture of academic enterprise;
4. Using inspired research;
5. Focusing on the individual using outcome-determined excellence and a commitment to intellectual and cultural diversity;
6. Supporting an intellectual fusion over cross discipline;
7. Socially embedding university through public service, community engagement, outreach; and
8. Engaging in global programs and practices to provide diversity research opportunities available.

These new standards of university participation are essential in transforming American universities from academic to enterprising.

To utilize these principles, ASU embraces a "college/school-centric model" that empowers each individual college to take responsibility for the quality of its programs. The objectives of this model are the following (p. 11):

- Build the university around strong entrepreneurial colleges and schools;
- Devolve intellectual and entrepreneurial responsibility to colleges and schools;
- Create a design that allows colleges and schools to prosper to extent of intellectual and market limits; and
- Create a federation of unique colleges and schools that are the foundation of a premier research institution.

In an effort to improve the built environment of the "New American University" and create an interactive model, ASU has developed a mixed use project with over one million square feet of office, research, retail, hotel/conference, and multi-family residential space. SkySong is located in the urban core of the city where it brings together university researchers, entrepreneurial services, high-tech businesses and global industries (Larson, 2007). SkySong has worked with many international companies through the open innovation process whereby smaller firms are able to work hand-in-hand with larger, more established firms. The University also provides its resources (training and entrepreneurial coaching programs), market-entry services, business development, and R&D collaborations to companies. The purpose of the university is to rethink the current organizational structure of most American research facilities and experiment with models, particularly those that commercialize intellectual property.

ASU and the SkySong Center provide strong examples of the how social interaction and global engagement can achieve operational success in the open innovation model. The SkySong facility engages in global operations that produce optimal operations of start-up business and partnerships. At SkySong there are many other advantages that include but are not limited to: 1) connectivity with the ASU community, programs, and facilities; 2) clustering of knowledge-businesses within the Center and the region; and 3) regional quality of life: climate, recreational amenities.

2.5.3 Michigan Initiative for Innovation and Entrepreneurship and the University Research Corridor

In an effort to boost the economic climate of Michigan, the state created new university research funding opportunities for product innovation and entrepreneurship. The Michigan Initiative for Innovation and Entrepreneurship (MIIE) works to create relationships between industry, academia and government, promote sustainable innovation and achieve economic prosperity through a diversity of industries (MIIE, 2006). The universities' goals are to raise $75 million statewide in support of this plan. The funds will be applied to three approaches used to create entrepreneurial spirit within Michigan's universities. Other significant goals of the MIIE program include:

1. Generating risk capital;
2. Making education and investment in entrepreneurship;
3. Developing a sustainable entrepreneurial environment in universities and across the state; and
4. Creating a culture of innovation in universities and across the state.

Appropriately named The Gap Fund, the first program focuses on nurturing innovation to being venture ready. The fund moves ideas through institutions to a phase that attracts venture investment for new businesses to grow in Michigan. Requests for proposals and processes for selecting funding decisions are based on experience and models of the innovation. The funds granted have a university matching requirement as well as a repayment schedule to fund new innovations sponsored by MIIE.

The Industry and Economic Engagement program is the second mechanism in MIIE funding. It is used to help transfer knowledge from universities to Michigan's local industry. This approach

establishes a context for researchers, practitioners and the business community, to benefit from new ideas. This approach will expand the economic base of the state, and form collaborations with universities and industry using not only intellectual property, but also industry resources. This final approach will use funds to foster entrepreneurial education for faculty. The Talent Retention and Entrepreneurship Education Fund is the final mechanism. The purpose of this fund is to improve the universities' understanding of commercial success by providing educational courses, seminars and training, by faculty, staff and industry professional.

Wayne State University works as part of the MIIE. With use of MIIE funds, the University hopes to create 12 new starts-ups. The universities within the MIIE also provide a technology-advisory board to: screen potential new technologies; develop proof-of-concept and business-development plans; set up and identify seed funding opportunities for promising technologies; and provide a new commercialization education program to faculty, students and staff of research programs. In an interview, Randal Charlton ("Entrepreneur in Residence" at Wayne State), states "the challenge Wayne State and other universities face is to push more new research out into the commercial world faster to create new jobs and industries."

Jeffrey Loeb, principal investigator on the MIIE commercialization center grant, states that another disadvantage with this program is finding the best way to do it, considering everybody has their own formula, and every tech-transfer office has their way of doing it. Developing a way to streamline the process, draw some extra interest and support, and find people who are going to better match these technologies is what is needed but not necessarily established.

The University Research Corridor (URC) is an academic alliance tasked with diversifying Michigan's economy. Participants include, Michigan State University, the University of Michigan and Wayne State University. This program also connects universities throughout Michigan with leading Michigan industries. These universities receive 95 percent of Michigan's research and development dollars. The Research Corridor combines resources to: speed up technology transfer; make resources more accessible; and help attract new jobs to the state. Collectively, there have been more than 500 new license agreements from these universities. The goal of the corridor is to enhance state and national, and to create and engage Michigan's universities in meaningful activities to establish a dominate research and development corridor. The URC has taken on responsibility for the transformation of Michigan's economy.

The role of URC partners is to provide tools and university resources to improve their outreach and collaborative efforts. The most "promising" growth sectors for the area are: 1) alternative energy; 2) medicine; 3) life science; 4) nanotechnology; 5) homeland security; and 6) transportation. Companies like Toyota, Google and Hyundai, all moved to the state because of its progressive research and development. Using URC connections, Wayne State University is partnering with Henry Ford Medical Hospital to study the use of medical technology. The hospital trained medical students at the university to use portable ultrasound equipments. The university has integrated this availability of these resources into the everyday class curriculum. Creating similar connections can be useful for VT-ARI because of the limited university resources that it can take advantage of. Partnering with other universities who also use satellite campuses in Arlington can improve networks and create new resources for the center.

2.5.4 Massachusetts Institute of Technology

Many reputable universities research the open innovation model to maximize their potential. In this case study, Massachusetts Institute of Technology's (MIT) role in university-industry collaboration is examined. The MIT/Microsoft partnership is an example of the ways in which the established model can positively work in university-industry collaborations.

MIT has taken a strong approach to identifying the attributes necessary for sustainable, productive, industry-university collaboration. A study based on interviews of over 70 project managers at 17 major companies in the United States and the United Kingdom, examined "best-practices" in university-industry collaborations (Calder, 2007). Calder (2007) concludes that having an agent to facilitate knowledge transfer was important. This so-called boundary agent can come from either university or industry, but must work as a project manager and engage in all aspects of activity. Additionally, adoption of open innovation requires the establishment of long-term partnerships between universities and industries. This produces a better relationship due to strategic commitments to the university. Calder (2007) also identified three modeling techniques that are beneficial to university-industry collaborations. The first technique is an internal exploitative alignment which allows collaborative research to begin only after the main phase of the project is complete and seems feasible. The second is external alignment through regular meetings with university researchers and industry. The third is internal exploratory alignment which encourages participation in open discussion and research with various business affiliates. It was found that these techniques had substantial positive impacts to university-industry collaborations.

Lastly, Calder (2007) examined the geographic distance of partnership and its affect on collaborative success. Surprisingly, there was no real impact on the outcome of projects as long as parties were attentive to the needs of project and supported its goals.

MIT and Microsoft formed university-industry partnership; the so-called iCampus program, has lasted for seven years. iCampus seeks to develop innovations capable of improving information technology-enabled teaching models and educational tools. The Council for Educational Technology at MIT serves as the agent for information transfer between university members (including students, faculty, and researchers) in the partnership with the Microsoft research team. Microsoft has further supported the university by funding fifty additional projects. The goal of this partnership is to use the strength of interactive teaching and learning at MIT to better integrate the vast research resources and knowledge that MIT offers. The project will focus on technology as a learning tool and provide new academic approaches to learning, integrating information technology throughout the research, and development phases, while addressing the changing environment of university education (MIT, 2004).

2.6 Conclusion and Recommendations

In conclusion, VT-ARI has many existing links to industry and government to foster and facilitate open innovation at the new facility. VT-ARI will need to leverage these resources to their advantage and focus on forming new relationships. VT-ARI has long lease terms and established research institutes occupying the center, because of this, putting together a team to decide the direction of the center may not be a priority.

- **Establish a task force to develop guiding principles to embrace open innovation for VT-ARI.**
    - To sustain the vitality of this Research Institute, efforts must be made to put together a task force to establish guiding principles and models for open innovation at Virginia Tech. Understanding the university role in university-industry partnerships and having a strategic plan in place will be one of the best ways to guarantee success. ASU structured a set of guiding principles. This group had the role of debating and investigating the issue and presents it in a concise manner to ASU. Through this model, the university has flourished internationally as a strong powerhouse through the use of open innovation. In the same way, a task force would help put together a report and plan for aligning the research facility with the goals of Virginia Tech. The case studies demonstrate that if innovation is the focus of a facility or program at a university, then operations and administration may be very different from the main campus and these details need to be worked out ahead of time.

- **Conduct research interviews with representatives from industries and government to identify goals for university collaboration.**
    - Align interview findings with the mission of the University. Another recommendation is to conduct research interviews with industries and government to examine their goals for university-industry collaboration and align those findings with the missions of the University. Through an in depth study, conclusions can be drawn from the interview process to determine the best practices for such collaboration. This synthesis can then be used to guide the principles of the center. Through the MIT study it was found that having a boundary agent to oversee the project's success and maintaining long lasting relationships can provide industry commitment to academic excellence.

- **Consider multifaceted funding structures to include "gap funding," industry-university knowledge transfer, and entrepreneurship education as well as faculty development.**
    - Examination of the Michigan model has made clear that research should be multifaceted not only in program structure, but also funding. Through "gap funding" entrepreneurial innovations can be guided towards venture capital investment. Incorporating funding for transfer of knowledge from Virginia Tech to outside entities will encourage the free flow. Further funding should be used to foster entrepreneurial education and faculty development. Limiting research space and funds only to a specific research source can become unsuccessful if the

intended subgroup changes focus. Providing multiple thematic approaches to open innovation allows for different research groups to participate on multiple levels fully utilizing university resources.

- **Market VT-ARI as an entrepreneurial and innovative facility through membership in the iBridge Network.**
    - One of the findings is that the partnerships and collaborations are traditional in the sense that Virginia Tech is connecting through funded project and social networks. Virginia Tech wants to continue to grow as a research facility and can focus on areas that will give them a competitive advantage.
    - The iBridge Network is run by the Kauffman Innovation Network Inc., of the Kauffman Foundation, which is the largest foundation that supports entrepreneurial activities. The iBridge Network is a website and database established because "Kauffman's research into technology transfer from universities suggested that formal programs tended to ignore many inventions and discoveries that could have commercial potential" (Lohr). The iBridge Network allows researchers, industry representatives and entrepreneurs to have access to university developed innovation. There are 40 universities represented and about 3,000 innovations available that scientists and engineers have posted. The ideas cover everything from software to chemical compounds (Lohr).
    - Even though iBridge Network address one way that Virginia Tech can gain exposure for innovations and research, commercialization of intellectual property will be one of the most important ways for Virginia Tech research to reach industry and government. Virginia Tech Intellectual Property will be an important group to have onsite. This would help facilitate and manage many new partnerships that will spring up from the center. In addition, intellectual property coming out of research conducted at the new facility would be a great way to quantify the project rewards.

- **Consider advertising in magazines or brochures to market the facility to federal contacts, local government contacts and industry contacts.**
    - Communicate stories about the types of research that is conducted by faculty at the Ballston facility.

- **Experiment with a new model for commercialization of intellectual property.**
    - Virginia Tech should also consider experimenting with a new model for commercialization of intellectual property.
    - ASU received money from the Kauffman Foundation in return for experimenting with their commercialization model for intellectual property in addition they allowed departments to have different models based on specific industry needs.
    - The satellite facility may be a great place to experiment and then in turn use the experience to modify the existing VTIP department. Clearly, Virginia Tech has greatly increased their research funding in the last few years but a new model may be a jumping off point for Virginia Tech to reach the next level and become a Top 30 research university.

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Appendices

Appendix 1: Open Innovation Expert Interview Questionnaires

Questions to University Research Program at VT and external contacts:

1. What is the role of your program in open innovation?

2. What is the structure of your program in relation to open innovation?

3. What are the advantages for your program through open innovation?

4. What are the disadvantages for your program through open innovation?

5. What are the opportunities for your program through open innovation?

6. What are the risks for your program through open innovation?

Chapter 3: The Role of Government in Open Innovation

Sarah Sturtevant and Samantha Archibald

Executive Summary

Government's role in open innovation is the facilitation of collaboration among actors (government, industry, and university), development of the built environment and enhancement of its resident talent Analysis of WIRED Regions, yielded recommendations for the development of innovative approaches to economic and workforce transformation, specifically by forging successful regional partnerships to develop and promote industry-specific programs.

Arlington County should foster collaboration between innovation actors.

Promote business sectors at VT-ARI facility.

- The lack of a major research university in Northern Virginia was seen as a weakness for Arlington County. With the new ARI center coming to Arlington, Arlington should take advantage of this opportunity by helping attract investment to firms as well as promoting certain business sectors in an incubator setting.

Promote cluster meetings with all actors and networking opportunities.

- Convene cluster meetings with actors from industry, government, and universities and engage in networking discussions in order to focus on the promotion of specific industry groups. Connect fields like engineering with cyber security in the ARI facility.

Create an innovation database.

- Foster partnerships to develop an innovation database, like the Kauffman Foundation's *IBridge network program*, to aggregate local research materials, technologies, and discoveries in an online, easy-to-search forum. It should be made accessible to university, industry, government, as well as venture capitalists.

Provide innovation grants for industry-university research partnerships.

- Support emerging sectors with innovation grants that will help accelerate innovation and technology transfer/commercialization activities, and help develop research partnerships between industry and academia.

Arlington should foster a built environment/creation and attraction of talent.

Create more affordable and workforce housing.

- Create more affordable and workforce housing in partnership with the Arlington Partnership for Affordable Housing (APAH) to accomplish this.

Promote industry-specific incumbent training and career fairs.

- Promote industry-specific career fairs and education for incumbent employees.

Arlington should encourage entrepreneurship.

Build an economic development toolkit as the community sees fit and include effective measures of success.

- Build an economic development toolkit, and track enrollment and success rates in business development classes/practices.

Work with the Arlington employment center to create a school of management.

- Work with the Arlington Employment Center to better train/promote industry managers.

Promote venture forums for target industry start-ups.

- Encourage the Ballston Science and Technology Alliance to host venture forums for target industry start-ups looking to get face time with venture capitalists.

Create a public relations/internship program.

- Utilize student interns to develop a marketing plan that promotes "Arlington as openly innovative" using new and innovative ideas that are low cost.

Table of Contents: The Role of Government in Open Innovation

3.1 Introduction

Local government promotes economic development. Fostering innovation is one of the many ways to induce community economic growth. As a facilitator, government has great opportunity in promoting open innovation. According to Henry Chesbrough, open innovation is "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively (2003). The main question this chapter attempts to address is: How can government better operationalize open innovation? While there seems to be no simple answer, many local governments have taken it upon themselves to be the best possible facilitators of open innovation. From fostering built environments, promoting entrepreneurship programs, focusing on talent and collaborating with actors from universities and industry, local governments are helping make their communities more openly innovative and economically successful.

3.2 Methodology

3.2.1 Background

We defined open innovation from the government perspective as well as the role of government in open innovation. We looked at various roles local government can play in fostering open innovation and their relevance to innovation-based local economic development including: fostering collaboration between actors, creating a built environment and attracting talent as well as encouraging entrepreneurship.

3.2.2 Arlington

This chapter, about Arlington, Virginia, includes a background on local economic development and how the county is approaching economic development. It includes weaknesses identified in *"Fostering Emerging Technology Sectors in Arlington, Virginia,"* as well as current approaches from interviews in the county and region, and finally a SWOT (Strengths/Weaknesses Opportunities/Threats) analysis.

3.2.3 WIRED (Workforce Innovation in Regional Economic Development) Region Case Studies

First a background section on the U.S. Department of Labor WIRED Regions was developed. Then each case study included a general description, in addition to a break down of collaboration, built Environment, talent, and entrepreneurship activities taking place in each region. Lessons learned for Arlington were gleaned and a SWOT analysis was performed on the material collected.

3.2.4 Recommendations for Arlington

Interviews with various economic developers and other key individuals were made in various Northern Virginia jurisdictions and findings from those interviews were incorporated into recommendations. Additionally potential economic development weaknesses for Arlington County were incorporated into recommendations.

3.3 Background

3.3.1 Government role in open innovation

Open innovation is a paradigm that assumes that firms can and should use external ideas, as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology (Fredberg, 2008, p. 5). Some, not all, industries are starting to lean towards the open innovation model, in that the control that was once considered as highly necessary, in order to protect internal innovation (closed innovation), is being re-evaluated, and an alternative, the "open innovation model" is now being utilized as a way industry can commercialize internal innovation and ideas through channels outside of their current businesses in order to generate value for the organization (Chesbrough, 2003, p. 37). If ideas are kept internally without capital to channel the investment to the market, that company's ideas would be left stagnant. The open exchange of innovation and ideas between the company and its surrounding environment enables innovations to move more easily between the two (Chesbrough, 2003, p. 37). Open innovation allows innovation to move more quickly to the marketplace.

Large companies are now going beyond their central R&D laboratories and are positioning themselves among the environment of various start-ups, universities, research consortia and other outside organizations (Chesbrough, 2003, p. 38). Through open innovation companies can seek out partnerships with private venture capitalists in helping to finance their efforts and help to commercialize their ideas that have been developed in their corporate research labs. It is becoming very difficult for corporate companies to hold on to their knowledge workers, who have the knowledge and expertise to innovate. This is where government can help in acting as the regional leader to promote open innovation. Government can act as a facilitator to bring together industry, university, venture capitalists and other organizations in developing new approaches for economic and workforce development that stimulate innovation and build new pathways that would lead to economic success and build their global competitive advantage.

3.3.2 Innovation-based economic development

Local and state government can play a major role in promoting open innovation, particularly in forging partnerships with local universities and industry; developing a built environment that support successful innovation networks; developing a talented and highly educated workforce that support leading industries' needs, as well as forging partnerships with venture capitalists to support and/or help channel innovation to the market; and support workforce development programs that promote entrepreneurship in emerging technologies.

3.3.3 Why focus on collaboration, built environment, talent and entrepreneurship?

The research question is, "What role can government play in open innovation, specifically in creating a neutral exchange of information and ideas between university and industry?" University has specific needs in term of research interests, as well as industry. Both groups, in some way, channel and/or utilize their research discoveries for the development of further major research and/or commercialization activities. In the process, there are certain elements, such as research partnerships, infrastructure, and highly-skilled researchers that are necessary to channel research from an idea to a product, in the R&D process. These elements, used in interchangeably throughout the R&D process (open innovation), can be developed, with the assistance of government, who can play a role in shaping the built environment, fostering

partnerships, and working locally, to develop a highly skilled and talented workforce for targeted industries.

Universities are known for their cutting-edge research that has led to major discoveries and the commercialization of new products to the marketplace (i.e. Gatorade sport beverage). Corporate firms, on the other hand are constantly developing ideas and innovation in their R&D laboratories in hopes that these ideas would develop enough to be channeled to the private market for commercialization. However, innovation sometimes gets lost in the research, development and/or commercialization phases. In order to develop a efficient R&D and commercialization process, industries must engage in open dialogue with universities, other businesses, venture capitalists, and government in 1) developing a local workforce of highly-skilled and talent experts to perform R&D, who will 2) channel internal innovation and ideas to external businesses and venture capitalists who can either 1) develop or add to the corporate firm's internal ideas, or 2) channel new external innovation into the firm, where, through partnerships, 1) venture capital can be utilized to commercialize the product to the private sector, and 2) investments made in new start-up companies that would manufacture and/or support the product. "A key lesson from this activity is that clusters are important to the growth of local, regional, and national economies (Kaufmann Foundation, 2008)."

Local government economic developers, industries, and universities themselves, are realizing the critical importance of institutions of higher learning to their global competitive advantage, and to regional economies (U.S. Department of Labor Employment and Training Administration, Council on Competitiveness, March 2008, p. 20). With the need for firms R&D laboratories to be near their knowledge workers, universities are becoming economic drivers for the creation and attraction of well paid, high quality jobs, and knowledge workers equipped with the training and expertise.

In addition, to forging partnerships between university and industry to create and channel innovation to the private sector; and developing a highly skilled and knowledgeable 21st century workforce, local government can also play a role in developing a built environment that supports successful innovation networks. Government can play a key role in developing their built environment by implementing policies that focus on advancing and creating old and new technology transfer networks, transportation infrastructure, housing stock, and commercial infrastructure, which will result in regional networks equipped for the successful open exchange of information between various stakeholders. By enhancing the built environment, particularly in those areas that help the economy, specifically its high demand/fast growing industries, local educational institutions, and workforce, to engage in safe, neutrally open exchange of ideas and innovation (open innovation). Government can develop a regional and global reputation, as a region that is actively, through collaborations among its top leaders, building an environment and overall quality of life that supports its current workforce and industries, which will help attract future talent (human capital) and economic growth.

The collaborations that are essential to developing comprehensive regional strategies that promote successful economic and workforce development between a region's top leaders/practitioners in the field can be seen in a "new breed of regional developers and development-conscious institutions of higher education (U.S. Department of Labor Employment

and Training Administration, Council on Competitiveness, March 2008, p. 20)." These leaders are building a "new culture of collaboration;" as the pressure to remain competitive in this global market, is stimulating collaborations across regions--- with all stakeholders working together to "redefine both their goals and missions (U.S. Department of Labor Employment and Training Administration, Council on Competitiveness, March 2008, p. 20). The U.S. Department of Labor Employment and Training Administration, WIRED regions can serve as examples for examining how government (local policy makers and regional developers) is operationalizing, through collaborations, initiatives that would help to better position their region in the ever-evolving globally competitive economy.

3.4 Arlington

3.4.1 Introduction

Arlington County's economic development arm has three specific departments: the Business Investment Group, the Real Estate Development Group, and the Arlington Convention and Visitor's Service (Arlington Economic Development). As a subset of those groups, Arlington Economic Development (AED) also supports the following services: BizLaunch, the Arlington County Visitor's Center, the Arlington Business Center, Incubator America, and the Economic Development Commission. The county's approach is inclusive of varying programs that are both the endogenous and exogenous in nature. Endogenous, being the approach where the county is promoting economic development using the tools that the county already has including promotion of the talent in the county by creating great K-12 school programs and strengthening local entrepreneurship programs. The exogenous approach can be found in Arlington's willingness to create a desirable built environment by improving infrastructure and incorporating smart growth principles into development. This makes the county an attractive place for people to live and companies to want to locate (Brosman, 2008).

3.4.2 Arlington strengths and weaknesses as a growing economy

Arlington County has many strengths in economic development and is by all accounts very successful in their endeavors. The document entitled, *Fostering Emerging Technology Sectors in Arlington County, Virginia* written by Dr. Terry Holzheimer, Dr. Heike Mayer, and Hal Glidden, says, "Arlington County is at the center of a cluster region, and is in a key position to leverage its strength in that cluster offering a talented labor pool, entrepreneurs, supportive business services, cutting edge customers, and suppliers and a "brand" for which the region is known," (Mayer, Holzheimer, Glidden, 2004, p. 2). With that said the document also identifies key weaknesses that Arlington County needs to address in further reaching their economic development goals. The following is a set of strengths, weaknesses, opportunities, and threats that are identified from various sources including the *Emerging Technologies* document.

3.4.3 Collaboration

Café Scientifique is a monthly Arlington gathering aimed at "making science more accessible and accountable by featuring speakers whose expertise spans the sciences and who can talk in Plain English," (Café Scientifique, 2006). The Ballston Science and Technology Alliance hosts the event. The event is a lecture series, as well as a networking opportunity for interested community members to collaborate and speak further regarding the month's topic. Additionally, according to the Northern Virginia Economic Development Coalition, "Arlington is the epicenter of scientific research for the defense and homeland security industries," (Holzheimer). In fact,

the Ballston area of Arlington has the nation's greatest concentration of scientific research agencies, anchored by the National Science Foundation, Defense Advanced Research Projects Agency (DARPA), the Office of Naval Research (ONR) and several top academic research institutes. Their ability to collocate within a compact, urban environment creates tremendous synergy and drives limitless ingenuity and innovation." Opportunities may exist in recruiting educational institutions (Mayer, Holzheimer, Glidden, 2004, p. 3). Focus groups indicate that there is a need for government, industry and academia to collaborate as well as to foster the emergence of new industry sectors. There needs to be more done to target specific economic development activities that could include the facilitation of interactions between governmental agencies, venture capitalists, academic institutions, and potential entrepreneurs, making flexible office space available, and developing incubator facilities, mentoring programs, and the support of technology transfer programs (Mayer, Holzheimer, Glidden, 2004, p. 10)." "Opportunities exist for Northern Virginia's information technology industry to leverage Maryland's biotechnology for Bio IT applications." According to one economic developer, "This interdisciplinary interaction is key in creating a more openly innovative environment," (T. Holzheimer, personal communication, October 8, 2008). The federal government is doing most of the work with relation to setting standards for policy relating to encouraging innovation (Mayer, Holzheimer, Glidden, 2004, p. 2). "The federal government plays a key role in policymaking; funds high risk research and development, and are the world's largest customer for emerging technologies." Arlington County is strategically positioned in the government-industry-university triangle (Mayer, Holzheimer, Glidden, 2004, p. 3). The county should position itself at the center of the triangle and facilitate interaction between the three sectors (Mayer, Holzheimer, Glidden, 2004, p. 8)

In Arlington there is a lack of a major scientific research university in the area which was seen as a major weakness for the county, additionally there was no national direction/strategy for some fields (like cyber security and homeland security) according to the *Emerging Technologies* study.

3.4.4 Built environment

There is a high quality of life in Arlington. Additionally Arlington County's reputation for emergency response is very good. Arlington County's information and communication technology network (fiber optics) is excellent. Universities are strong in some fields (i.e. law, policy). The region and especially Arlington County specifically possess several advantages that can support the growth of emerging technology sectors (Mayer, Holzheimer, Glidden, 2004, p. 3). Despite the great quality of life that Arlington has to offer, there exist, is a very high cost of living and labor, which may prevent from certain researchers and high quality talent seeking more affordable housing in County.

3.4.5 Talent

"Arlington should promote workforce and education development through making sure the local and regional labor force have the skills needed to implement strategy, as well as to seek to expand educational opportunities at all levels," (Mayer, Holzheimer, Glidden, 2004) (p. 11). Arlington has a high educational attainment. The region's industry and workforce capacity (IT, telecommunication, biotech) is excellent. In terms of workforce development Arlington has employment centers that help match employees with employers (Arlington Economic Development). It's a great resource for job counseling as well.

3.4.6 Entrepreneurship

Arlington is doing a great deal to promote entrepreneurship in general (Arlington Economic Development). The small business department of the Office of Economic Development has a Biz Launch facility that caters specifically to small business networking and assistance, making it very easy to start a business in Arlington with few of your own resources. There is very talented pool of potential entrepreneurs and funders: retired government scientists, cashed-out/serial entrepreneurs.

There is a perception of a stodgy environment in Arlington (Mayer, Holzheimer, Glidden, 2004, p. 3). In particular, a more deliberated focus on entrepreneurship and innovation would help to change these perceptions (p. 8). It is said in the *Emerging Technologies* document that there is a lack of "Silicon Valley like" entrepreneur and investment culture. Additionally it is said, "The region is not known for innovation and technological advancement ("too stodgy") and there is a need for more entrepreneurs and venture capitalists."

3.4.7 Current approaches

While the information above provides insight into some of the current practices, strengths and weaknesses of Arlington County, to get an even deeper perspective of what is occurring and ideas for what should be occurring, various officials from Arlington County as well as other Northern Virginia jurisdictions were interviewed. With the current economic climate being less than desirable one Arlington economic developer says, "Right now, we need to sustain folks in this bad economy who have had businesses for 20 plus years. Their businesses are having difficulties and their ability to sustain them is not at an innovation level at all. They are focused on working at the purely strategic survival level, however, ultimately, they still need to be able to sustain innovation," (T. Miles, personal communication, November 10, 2008).

With regards to more investment in start-ups and other entrepreneurial activities she says, "In Arlington we are seen as a stagnant area because tried and true things have always been happening. Arlington really needs to be looking at the tech business model. Funding for the next Microsoft doesn't happen in part because of the type of universities in the Arlington area." When asked what additional things she thinks Arlington could do to further promote innovation through entrepreneurship and workforce development, she said, "It would be great to become a member of the Center for Information Technology (CIT). There are a number of events where they do match making, innovative companies included. They match seed money. Started by state partnerships and a partnership between Loudon and Fairfax Counties, CIT is able to provide innovation and technology, collaborate, and have synergy. More staff members are needed on the Arlington side to make something like this work, however. A lot of organizations do things like join CIT to put a check in the box. It would be great to join this to accomplish goals like establishing where are the needs, strategic planning during tough economic times, making sure businesses are sustainable, etc." Ultimately, she says, "I think the key to a successful entrepreneurship program understands the resources you've been allocated and bringing true value to your clients that can best benefit them, this is a challenge for many governments."

Fairfax County offered their ideas when it comes to economic development. One employee of the Fairfax County Economic Development Authority (FCEDA) said, "The FCEDA pursues the "older" model of ED: marketing the county to industries and businesses that make sense to us (e.g., primarily the technology, defense and corporate regional HQ/federal sales/marketing

sectors). Over the past 50 years, we've been considered very successful (for reasons of proximity to the nation's capital and a multitude of attributes (highly skilled workforce, quality educational system, desirable place to live and recreate, consistently positive business environment, etc.), as well as our own consistent and effective promotional efforts. Switching to a regional cooperation model might make sense in some ways, but there is some inherent conflict on a practical level: As long as localities are judged (by others and by our own, self-generated performance measures) on the number of companies we bring in and expand via job growth within county limits, other jurisdictions within the region will be viewed as competitors for a finite number of jobs and firms, which tends to erode the notion of regional collaboration. This also is the case with other jurisdictions in this area, not just us. That said, in the case of issues affecting the region (such as transportation, pollution control), working together collaboratively with neighboring localities to address common problems is the only way to go," (I. Richards, personal communication, October 16, 2008). This approach while tried and true offers little adaptation for future situations where changes in the regional talent or other situations may occur.

The approaches in Northern Virginia are varied and fairly sophisticated. Overall we found that the role of Arlington in promoting open innovation can be found in Arlington being a facilitator of networking and disseminator of information among university, industry, and government actors. Arlington is an actor in developing the built environment and talent pool, through creating suitable infrastructure including affordable housing and the promotion of industry specific talent. Lastly Arlington is an advocate of entrepreneurship in open innovation through: internship programs, degree programs, grants in continuing education, work in public relations, and fine-tuning instruments to track results in workforce success. Approaches from across the United States also offer many good examples of open innovation applied to economic development principles. Those examples are found in the next section.

3.5 WIRED Regions

The U.S. Department of Labor, Employment and Training Administration, launched a WIRED Initiative in November 2005 that focused on workforce development in "creating effective regional economic development strategies" that focuses on developing a high skilled, talented workforce for the 21st century economy. WIRED serves as a good example as to how regional leaders from different areas can work together to develop a regional strategy to prepare the workforce to compete in the today's global economy. Specifically, WIRED brings together state, local and federal entities; academic institutions (including K-12, community colleges and universities); investment groups; foundations; and business and industry to address the challenges associated with building a globally competitive and prepared workforce (U.S. Department of Labor Employment and Training Administration, 2008).

As part of the WIRED Initiative, the U.S. Department of Labor, Employment and Training Administration has develop a grant program where federal funding has been awarded, since 2006, to 39 WIRED Regions, selected through an application process, from among the 50 United States of America. The grant awards have been broken down over a two year time span and the applicant pool has been broken up into First, Second and third generation WIRED regions. Each generation receiving, ranging from the first, received $15 million (first), 4.5 million (second) and 5 million dollars over a three year period, to develop regional strategies to address economic and workforce development for their respective regions (U.S. Department of Labor Employment and Training Administration, 2007).

3.5.1 WIRED Region -California Innovation Corridor

Background

The California Innovation Corridor (CIC) was initiated by a U.S. Department of Labor grant to the state of California and the California Space Authority (California Innovation Corridor). This corridor consists of 13 counties across southern California. The CIC has brought education and business leaders together through the creation of talent development programs, and created events where these talent organizations work closely with local entrepreneurs and venture capitalists to encourage innovation and new job growth. With the tools adopted by the corridor southern California is hoping to lead the critical effort in promoting innovation as it is said, "Innovation will be the single most important factor in determining America's competitive success through the 21st Century," (California Innovation Corridor). It is also said, "Innovation occurs only when three dynamics are achieved: support innovation tools, instruments, and programs have to exist." Also industrial rejuvenation must be occurring via models and methods employed with talent development, educational workforce, and economic development systems. The goal is to produce high skilled workers with high skilled jobs. Collaboration is key for all of this to occur. The CIC has stated that the three main goals of the program are: innovation support, talent development, and industrial rejuvenation (WIRED California Innovation Corridor, 2006, p. 1). The following is a compilation of many programs to be exemplified in a comprehensive study of actions occurring in the WIRED Region. Although the below case studies and programs are not necessarily specific WIRED programs the innovative actions and programs occurring in the WIRED Region have been captured. The document titled, *"The Innovation Driven Economic Development Model, A Practical Guide for the Innovation Broker,"* lists a large number of programs and case studies that illustrate the role of open innovation in economic development.

The 1999 Partnership for the New Economy

The 1999 *Partnership for the New Economy* was created in San Diego, California to promote a cluster-based economic strategy (Collaborative Economics, 2008, p. 48). The partnership includes the City of San Diego, the San Diego Institute for Policy Research, and the San Diego Regional Economic Development Corporation in addition to many other corporate and civic institutions (Partnership for the Global Economy). The partnership contributed to the growth of employment in the San Diego science and technology clusters by 25% between 1990 and 2005. The partnership focused on creating technology entrepreneurship and management, quality of life, access to capitol, and educational excellence. Below, as with each case study and program, is a breakdown of the type of programs affected based on actor collaboration, built environment, talent, and entrepreneurship.

Built environment

Addressing quality of life issues, the focus is on articulating the voice of the employees needs in affordable housing in close proximity to employment centers, balanced land use, airport infrastructure, and improved transportation mobility to name a few. This lead to EDC's leadership role in the passage of Proposition A, the extension of the half-cent sales tax for transportation initiatives (Collaborative Economics, 2008, p. 48). If quality of life issues like affordable housing and decent infrastructure are left unaddressed there could be massive exodus of a community and no influx of a population.

Talent
The idea behind educational excellence is that the partnership will work to produce a workforce that meets the needs of the regional economy, including the high tech sector. One example program is Project Lead the Way (PLTW), a not for profit organization that promotes engineering and technology courses for middle school and high school students (Project Lead the Way California). Every summer teachers from PLTW schools attend the Summer Training Institute at San Diego State University.

Entrepreneurship
The goals were to grow the regional pool of technology industry managers who could transform promising ideas into business plans and start-ups and those who could manage the growth of existing technology companies, helping create the $70 million Rady School of Management at UCSD as well as initiatives at other universities (Collaborative Economics, 2008, p. 49). The idea behind access to capital falls in improving the accessibility of growth capital for technology companies. At both BIOCOM and CONNECT there are initiatives to attract investment capital to San Diego. Venture capital funding has grown significantly and investment banks are establishing offices in San Diego. "Face time in front of Venture Capitalists is a very difficult thing to obtain. At the conclusion of three to five months of mentoring CONNECT will put you in front of a panel of San Diego's most established Venture Capitalists, successful Entrepreneurs, and Veteran Business people, allowing you to make your business pitch (Connect).

California Partnership for the San Joaquin Valley
The California Partnership for the San Joaquin Valley was created as a public-private partnership focused on improving the region's quality of life and economic vitality (Collaborative Economics, 2008) (p. 58). Since its inception in 2006 thus far the San Joaquin Partnership has accomplished much success. A $5 million grant was appropriated by the state legislature in order to jumpstart action of the Strategic Action Proposal (Swearengin, p. 1). The plans and actions of the partnership are listed below.

Collaboration
All eight Valley counties and their respective councils of government are collaborating on the Regional Blueprint Process and were awarded $2 million in grant funding.

Built Environment
CalTrans accelerated completion of the Highway 99 Business Plan (274 miles from Bakersfield to Stockton), which calls for $6 billion to be invested over the next 10 years. One billion dollars was earmarked by the governor and state legislature to jumpstart Highway 99 improvements; it was approved in November 2006. Just below five and a half million dollars in general obligation bonds was approved by voters in November 2006 to be used for water projects in California. The partnership designated five enterprise zones in the Valley: City of Arvin, City of Delano, City of Fresno, County of Fresno, and Merced County. San Joaquin Valley Air Pollution Control District provided grant funding to plan for a Clean Energy Office as recommended in the Strategic Action Proposal.

Talent

The California Labor and Workforce Development Agency's Employment Training Panel awarded Kern Community College District $500,000 for training in high-wage occupations, such as manufacturing, logistics and construction. The Hospital Council received a $500,000 grant from the state to establish the San Joaquin Valley Nursing Education Consortium. A $2 million Community-Based Job Training Grant was awarded to State Center Community College District and West Hills College to provide training through the "Ensuring Agriculture for Tomorrow" (EAT) program. The program will provide specialized training for workers in the agriculture related fields of food processing, logistics, warehousing, and manufacturing, therefore providing regional employers with qualified, well trained workers (Regional Jobs Initiative). The grant will initially train over 1,000 workers. The U.S. Department of Labor awarded $1.85 million to expand nurse training at community colleges in Merced and Modesto, as well as SCCCD's Madera Center. Superintendents from the eight Valley counties have convened to improve K-12 education.

The Massachusetts Technology Collaborative

In 1996, the Massachusetts Technology Collaborative (MTC) set out to develop a new way to understand the state's changing economy and create a framework that could help Massachusetts align its investment properties with the needs of its changing economy (Collaborative Economics, 2008, p. 28). Thus, the Massachusetts Innovation Index was created. It measures the strength of the region's resources and how well they are being turned into results. The region's assets are taken into account in the assessment. Not only are traditional assets like raw materials accounted for, but more importantly, assets such as universities and research institutes in the community are assessed, in addition to talented people, industry clusters, and financial capital and physical infrastructure. Some of the key questions to ask of your region are listed below.

Collaboration

Questions are asked including, what networks connect assets that support regional innovation and how strong are they? Additionally, what connections are missing?

Built Environment

In terms of the built environment, what are the strengths and weaknesses of assets for regional innovation? What is missing?

Talent

Questions to pose with relation to talent are: what are your driving clusters and how innovative are they? Is innovative and entrepreneurial talent attracted and retained? How does the region's quality of life contribute or hinder regional innovation? How does the regional mindset or culture support or inhibit innovation and entrepreneurship? Finally, how does the region compare to benchmark regions with regard to the cornerstones of innovation?

Entrepreneurship

How is innovation and entrepreneurship contributing to regional vitality and quality of life?

3.5.2 WIRED Region - Southeast Virginia, SEVA-PORT

Background

The Southeast Virginia WIRED Region is working on M&S (Modeling and Simulation) projects to further foster innovation in the TWD (Transportation, Warehousing, and Distribution) industry through workforce development primarily (WIRED Southeastern Virginia). This program is a good example of two different disciplines working together to find a better solution for product development. "The SEVA-PORT proposal focuses on aligning workforce, economic development and education program planning and delivery with current and emerging demands of a dramatically growing port in order to diversify and expand the economy and increase higher paying job opportunities." SEVA-PORT stands for the Southeastern Virginia Partnership for Regional Transformation. "With it's $5 million WIRED grant received in July of 2007, members of the Greater Peninsula, Hampton Roads, and Crater Workforce Investment Boards and their support organizations have leveraged existing region-wide partnerships to establish a broad-based coalition of over 35 senior-level leaders in economic development, workforce development, civic, business, education, local, state and federal government and entrepreneurial organizations from the southeastern region of Virginia," (SEVAPORT). The Region consists of 35 counties (M. Robinson, personal communication, October 23, 2008). The following are programs and ideas compiled from the SEVA-PORT WIRED Region that Arlington could utilize in county wide economic development.

Collaboration

One of the major goals of the SEVAPORT WIRED Region is to strengthen organization/partnerships within the Hampton Roads area (p. 4). Through meetings, workshops, symposia, etc. SEVAPORT will bring local and regional economic development organizations together to focus on supporting the TWD industry and integrating with the M&S industry. The SEVA-PORT Collaborative is a strong regional partnership with a history of collaborative public-private policy planning and implementation in economic and workforce development, research and education (WIRED Southeastern Virginia) (p. 1).

Talent

Because studies show that more than half of all new jobs are created by small business and entrepreneurial business, it is critical that the regional job creation plan include a supportive culture in which entrepreneurial businesses are encouraged and supported," (Begland, 2008, p. 2). Funds will be linked with training opportunities developed through a comprehensive, coordinated outreach strategy. Efforts to engage young talent and underrepresented populations will be included (Begland, 2008, p. 4). According to one SEVA-PORT administrator, SEVA-PORT has been successful in creating a high school modeling and simulation curriculum which is currently being pilot tested at a career and technical education center. She says, "We are researching plans to deploy the class in an online format, as well as posting the curriculum with the online State CTE Resource Library. We also successfully launched summer technology camps for youth. This was a promising pipeline activity and we'll be expanding the programs summer 2009. Over 60 people have entered M&S and TWD training programs through the WIRED grant," (M. Robinson, personal communication, October 23, 2008). "Goal 1 recognizes and addresses the limiting factor that many of the region's citizens will not necessarily seek out skills improvement opportunities on their own; SEVAPORT, must, as leaders expose them to the many exciting career opportunities available."

Entrepreneurship
Increase entrepreneurial activity and small business development in M&S and TWD areas (Begland, 2008, p. 9). Business development funds would facilitate these activities. The increased activity would provide outreach and identification of entrepreneurs and new business in TWD and M&S. "The funds would provide business management counseling, training programs and seminars on topics relevant to starting a small business." According to a SEVA-PORT official they are enacting certain programs as follows, "We will be launching an online entrepreneur-training program with the Crater Small Business Development Center. Entrepreneurs in the M&S and TWD fields will be targeted to enroll in training. Outreach will also be made to existing and retiring military based out of Ft. Lee. The Ft. Lee area is undergoing substantial growth and is a logistics hub for the military. The online training program will be accessible to all small businesses in the SEVA-PORT region. Another example is the technology incubator at the Virginia Modeling Analysis and Simulation Program (VMASC). VMASC houses a small number of business start-ups and provides business support as well as research resources and state-of-the-art technology. These start-ups are in a prime position to access government contracts," (M. Robinson, personal communication, October 23, 2008).

3.5.3 WIRED Region-Central New Mexico

Background
Emerging as one of the nation's top high technology hubs, the New Mexico central region economic growth is driven by a strong nonprofit regional development alliance called the Technology Triangle (T^2), who is affiliated with the New Mexico Tech University. T^2 is a leadership board made up of stakeholders from "education, economic development and employers (E3) --- NM's 21st century workforce education system. The NM WIRED region is made up of eight counties (Valencia, Sierra, Torrance, Santa Fe, Los Alamos, Socoro, and Bernalillo). Greater Albuquerque Mexico is a third tier WIRED region (part of the newest WIRED tier), that have recently developed an implementation strategy for the region's economic development (U.S. Department of Labor Employment and Training Administration, 2007).

The New Mexico Workforce Solutions Department applied for federal funds through the WIRED program to further the regions goals to support the growth of 1) entrepreneurship, 2) talent, and 3) public policy, developed to create an environment that supports and rewards innovation in New Mexico's Green Manufacturing industries, specifically in renewable energy (green building), aerospace/aviation, microelectronics and optics. New Mexico's economic strengths are in advance manufacturing, clean energy and R&D (research and development), due to the strong presence of several world-class science laboratories and research universities (U.S. Department of Labor Employment and Training Administration, 2007).

Collaboration
NM WIRED is a federally funded comprehensive effort that brings together an alliance of businesses, national laboratories, investors, economic developers, educational institutions, workforce development and advocacy organizations, and government officials (Whitcomb, 2008). NM Wired passed public policy to build "pilot innovative public and public-private partnerships within the alliance that demonstrate the ideal public policy conditions needed to

produce New Mexico's 21st century economy and workforce (Whitcomb, 2008)." This alliance, also known as T^2 is the Executive Leadership Board is made up of civic leaders representing business and industry in the eight county regions. The T^2 alliance serves as the overall advisory board to the implementation of the WIRED grant. The dynamic network of leaders serve as a human capital incubators of high tech talent, ideas, and innovation and are the driving force behind the sustainability of WIRED's programs (Whitcomb, 2008). The Board leverages the discrete strengths and mutual responsibilities of all stakeholders, including those at the state, regional, and larger cluster levels (Whitcomb, 2008). These human assets give T^2 the capacity to create a regional system-wide transformation in New Mexico for continued growth in high technology (Whitcomb, 2008).

Our team's task, through interviews and research, will be to find out, in what capacity, have state and regional government stakeholders have contributed to the development of the New Mexico WIRED regional strategy and program development. In order for Arlington County to operationalize the implementation of a plan, (similar to what NM WIRED has accomplished) a broad regional partnership must be established and be committed to the effort. Such a partnership can be critical in maximizing the impact of WIRED and executing all program initiatives (Whitcomb, 2008). The NM WIRED partnership consists of a "dynamic mix of private industry, government, economic development, workforce development, education, and entrepreneurial support" for the region (Whitcomb, 2008).

Green manufacturing jobs pipeline

Talent

New Mexico WIRED board developed an implementation plan geared toward developing a pipeline of talent for entry, expansion, innovation and growth of the green manufacturing cluster, in an effort to develop a highly skilled workforce for numerous points of entry.

The WIRED implementation plan is designed to develop talent at several critical points for the population's interest, advancement, growth, and fulfillment in the target high-tech industries. This mission is accomplished through a series of trainings, activities, scholarships, events, and structures. The issue with New Mexico is that they don't have the supply of talent to match the supply of high-tech jobs available in the region. According the NM WIRED implementation plan (p. 21), "The high-tech jobs are here now, but there is a shortfall of the talent required"

NM WIRED developed a goal to construct a training pipeline for green manufacturing occupations in the region. The intent of goal one is to better define all the skills, knowledge, and competency requirements of the green manufacturing cluster and then to structure and reward regional mechanisms that are successfully directing workers into the targeted areas including educational institutions to best prepare students for these requirements.

NM WIRED developed a strategy for rewarding best practices through training partnerships, and by offering scholarships to technologists in these key areas. Scholarships for teacher training in science, technology, engineering and math position the region to provide students with the best instruction at early ages.

The New Mexico WIRED Project also provides college scholarships through the New Mexico WIRED Community College Scholarship Program and New Mexico WIRED University Scholarship Program. A partnership between the New Mexico Department of Workforce Solutions and New Mexico's Higher Education Institutions have been formed for scholarships to pay for tuition, books and other educational expenses as needed, for students enrolled in programs related to aerospace/aviation, green construction, microelectronics, optics, or renewable energy at local university and community colleges.

Built environment
NM WIRED developed an initiative called *Seeding Innovation in New Mexico's Green Manufacturing Cluster*, which focuses efforts on their community cluster of high-tech companies growing in the region, combined with progressive environmental standards and compliance established throughout the state. New Mexico is second in the nation in solar energy potential. NM WIRED is a world leader in hydrogen fuel cell research and development and has abundant biomass, wind and geothermal energy potential. NM WIRED will address talent and entrepreneurship needs for industry cluster: renewable energy, green building construction, microelectronics, optics, aerospace/aviation, and advanced manufacturing.

Entrepreneurship
As part of the NM WIRED implementation plan, a goal has been established to "develop the entrepreneurial and innovative capacity of the region around Green Technology (NM WIRED, (Byler, 2008)." The T^2 region's is in a great position, now to promote their clean, green technologies and industries which they hope, by supporting them, will result in economic growth and wealth creation. NM WIRED recognize that in order to maintain the region's momentum in research product development and commercialization, there must be a focus on broadening the skills and knowledge base for the population to facilitate research, ideas, and laboratory technologies into the commercial marketplace.

The training of entrepreneurs and people to develop green technology remains an important economic driver of the region due to a strong workforce of scientists and engineers in their federal laboratories. *Entrepreneurial training and technology maturation skills projects* are included in the NM WIRED Implementation plan as a strategy to maintaining high-quality management talent to retain the best New Mexicans in the region (Byler, 2008)." Opportunities at *jobs and venture fairs* will give opportunities for important networking and connectivity that will link the region on key economic opportunities (Byler, 2008)."

3.5.4 WIRED Region, Kansas City - One KC

Kansas City is one of the 39 WIRED (Workforce Innovation in Regional Economic Development) model regions, that was awarded a $15 million WIRED grant from the U.S. Department of Labor, Employment and Training Administration's to support the state's innovative plans for regional workforce and economic development. One KC WIRED developed an entrepreneurial partnership that aimed to bring together current independent activities into a "comprehensive system of economic development, workforce development, and education and training" (One KC WIRED, 2008) for the 18 county, bi-state region (Kansas and Missouri). The OneKC regional strategy focuses on building a highly-skilled, educated and trained workforce, capitalizing on its already highly educated working class and abundance of educational institutions, both secondary and post secondary, to build a 21st century knowledge-based workforce.

OneKC realized that targeting their high-demand knowledge-based industries --- advanced manufacturing, biotechnology, and healthcare--- and developing a comprehensive support system of education, training, workforce development, and economic development strategies, will help the OneKC WIRED region to remain globally competitive in the current and future economy. One KC WIRED partners are integrating and leveraging all existing initiatives, resources and relationships to help build a reputation as a region "working together as one" to improve the OneKC WIRED region's economy.

Collaboration

The OneKC WIRED region is a strong partnership made up the economic development community, business and industry, education, state and local government, philanthropic and civic organizations (OneKC, 2008). One KC's seven Local Workforce Investment Boards have joined together and have developed a campaign focused on *"Regionalism,"*- building a strong identity as a region that "act, think, work and grow" as a one. There are currently two regional branding campaigns: "OneKC" and "ThinkKC" that focuses on building a regional identity for the Greater Kansas City region. As part of this "Regionalism" branding campaign, stakeholders are working together to create a common platform to improve the region labor market and workforce services (OneKC, 2008).

OneKC also established a Local Investment Board developed as part of their *Public Outreach and Education initiative* that utilizes the knowledge and expertise of OneKC WIRED partners to develop and implement strategic efforts to increase awareness of OneKC WIRED-related initiatives, foster participation by key stakeholders, and ensure the sustainability of transformational activities (OneKC, 2008).

Facilitating university research discoveries and channeling them innovative ideas for private sector commercialization is crucial and can be significant in sustaining and growing the Kansas City region global competitiveness. OneKC is supporting emerging sectors, like the Animal Health industry. Animal health represents a key industry cluster, contributing approximately 30 percent of the $15 billion world animal health market passing through companies in the Kansas City region. Through the development of *Animal Health Innovation grants* that support new partnerships between industry and academia to expand awareness for scientists in both communities regarding research interests and industry needs, and accelerate innovation and

technology transfer/commercialization activities (Kansas City Area Development Council, 2008).

Talent
The goal of One KC is to develop a highly skilled and educated workforce who will be prepared to enter into the workforce, specifically in the areas of biotechnology, manufacturing, and healthcare. OneKC developed partnerships with the secondary schools, local universities, and community colleges in providing advanced training to entry level, seasoned and non-practicing professionals.

OneKC is focused on improving the current and future workforce that clearly represents an effective economic development strategy by developing a highly skilled, talented, and more marketable workforce, both locally and globally.

Building Capacity Initiative Case Study
OneKC currently has a project focused on "*Building Capacity"* in the current workforce by forming partnerships between industry education and training and economic development in an effort to increase the supply of "highly skilled, educated and trained talent capable of entering into the knowledge-based workplace. The Building capacity project has several initiatives aimed toward workforce development; specifically in two of the region's top industries: manufacturing and nursing. Under the Building Capacity initiative, the *"Making it in KC"* program provides college students an opportunity to obtain entry level manufacturing positions and to develop their skills and qualifications to be given priority consideration with partner companies (OneKC, 2008).

Medical students are also provided the opportunity to gain real-life experience in six types of *"Human Patient Simulator (HPS),"* state of the art training facilities, housed in HPS labs located in one of the Metropolitan Community Colleges (MCC), MCC- Penn Valley. This initiative is a regional resource that helps to increase the capacity of nursing education and nursing (skills/qualifications) capabilities, and supported by the OneKC Council (Metropolitan Community College, 2008).

OneKC WIRED is also supporting industry-specific workforce training for life sciences/biotechnology company's employees, through the *"University of Kansas Bioscience Workforce Career Training Project"* which include partnerships with other community colleges, to improve the current skill set of the bioscience workforce. (http://biosciences.continuinged.ku.edu/grants.php).

OneKC WIRED partners are collaborating with key stakeholders to expand internships and teacher externships opportunities with area employers in advanced manufacturing, bioscience, and healthcare. The goal is to facilitate the connection and placement of young adults and transitional workers into available internship positions leading to entry-level career opportunities, and to provide teachers with meaningful work-based learning experiences that bring rigor and relevance to the classroom (OneKC, 2008)

In addition the workforce development projects that are being implemented in the One KC area, partners and key stakeholders of OneKC WIRED have developed a scorecard that measures the regions *Human Capital Index*, which will allow to assess the regions' economic performances to track accomplishments/best practices, change in industry needs, gaps in workforce development, education and training to guide them in developing strategy plans to address those gaps (OneKC, 2008)

Current challenges
Given the frequent changes in technology, the bioscience fields need to stay up-to-date on technology trends in the market. Biosciences companies are now faced with the challenge of continuously training their technology (knowledge-based) professionals, in order to remain competitive. Some companies, especially the smaller companies can't afford to send their employees to training, and thus is running the risk of not having properly skilled employees. As a result OneKC has implemented several workforce development and career training programs for companies for in-house training and as well off-site trainings, which has been made possible through the use of employee "Life Long Learning Accounts" that employees can use to take training courses outside the job. A *Lifelong Learning Account (LiLA)* is an innovative tool for employers and employees to address education and training needs in an affordable manner. In a LiLA program, employers match employee contributions (to a pre-determined cap) to create a special account for education and training purposes. In some cases there is also a third-party match. The combined LiLA funds are used to pay for a broad range of education and training activities. Classes are usually located at local community colleges, universities, and technical institutions.

Through the "Seeding Innovation in Green Manufacturing Clusters" Implementation Plan, the region would like to also recapture older professionals who have left the region to come back and work. Current job supply in the region largely outweighs the supply of talent. NM's WIRED implementation plan seeks to develop the current talent capital through workforce development initiatives.

Built environment
The Kansas City wired region is made up of two communities—Kansas and Missouri, with two of its top industries, Biotechnology and Advanced Manufacturing clustered around the Kansas City urban core. OneKC's biotechnology and manufacturing clusters benefit from their close proximity (location) to major transshipment center, known as the nation's largest rail transshipment center by tonnage, due to it's the intersections of three interstate highways (1-29, 1-35, and 1-70) at Kansas City and where several north-south and east-west rail systems intersect at the city center. The regions' economy is driven by both sides of the border that divides it.

Animal Health Corridor Case Study
The Kansas City Area Development Council (KCADC), the Kansas City Area Life Sciences Institute (KCALSI), the Greater Kansas City Chamber and several leading animal health companies have come together to create what they are branding nationwide as the "Animal Health Corridor." Companies and universities in our area lead the nation in animal health and nutrition research, innovation, business functions and production. The three pronged effort is focused on recruiting new animal health companies, stimulating research investments, cultivating

the work force for the industry and creating a favorable business climate for animal health companies (OneKC, 2008)

Regnier Technology Center Case Study

One KC has over "a total of 56 institutions of higher learning to support productivity innovation," ranging from small community colleges to large state-of- the-art training and research facilities. Partnerships are being built between K-12 and post-secondary education (universities and colleges), industry and economic development agencies, with a collaborative goal to build a highly skilled and educated current and future workforce, prepared to enter high-tech jobs in top industry sectors, such as biotechnology, manufacturing and healthcare (OneKC 2008). Johnson County Community College (JCCC) is the third largest institution of higher education in Kansas and the largest of the state's 19 community colleges. Johnson has more than 100 transfer agreements with area colleges and universities. JCCC opened the "*Regnier Technology Center*, a state-of-the-art facility for biosciences that offers K-12 faculty and student training in biotechnology related areas (Johnson County Community College, 2008).

Regional identity

The Kansas City Area Development Council is a private, nonprofit organization operates "ThinkKC" marketing campaign and website to highlight Kansas City metro assets: the regions communities and areas for business relocations in Kansas City Downtown area and surrounding metro communities. ThinkKC markets the following about the OneKC region: The Kansas City Downtown area is currently experiencing a $9 billion redevelopment transformation and attracting new highly educated professionals and companies to the Kansas City region.

The One KC region has above-average income levels and population growth compared to other surrounding Midwestern states, due to the dense concentration of highly educated workers. The Kansas City region is also known for having affordable housing and ranks high at 95.3 on the affordability-housing index, close to the City of Atlanta who ranks 95.1. Kansas City will continue to see population and business growth as long as their doing their part in developing a regional economic development strategy that focuses on workforce development, education and training, and economic development to meet the region's current and future needs.

Jobs/Industry threatened

Manufacturing Industry is being threatened by the loss of the baby boomer workforce, and a result has caused the WIRED region to focus on educated younger professionals and the K-12 generation about range of high-tech jobs available in manufacturing to rid of the "assembly-line jobs" perception of the industry. The outsourcing of manufacturing jobs oversees and relocation of manufacturing plants, in its entirety oversees, has resulted in a tremendous economic loss in the manufacturing sector over the past decade. OneKC is also implementing workforce development programs focused on preparing K-12 youths and college graduates with the proper skills and education to work in high-skilled jobs in manufacturing such as scientists and product designers.

Entrepreneurship

Kansas City built a $57 million Kansas Life Sciences Innovation Center (KLSCI-C) in 2007 on the University of Kansas Medical Center (KUMC). KLSCI-C provides a variety of resources to

fast growing companies in the Kansas City region. KLSCI-C partners with Mid-America Angel Investors who invest primarily in early-stage technology and life sciences start-ups. The center also provides networking opportunities with Large CEOs companies and universities. Funding resources are also available for fast growing companies. The Center also participated in the I-Bridge network, which is a program that is part of the not-for profit Kaufmann Innovation Network Inc. To remain competitive in the global economy, through the IBridge network database, university research is being put to practical use. The Network aggregates research materials, technologies, and discoveries in an online, easy-to-search forum (Kaufman Innovation Network, Inc., 2008).

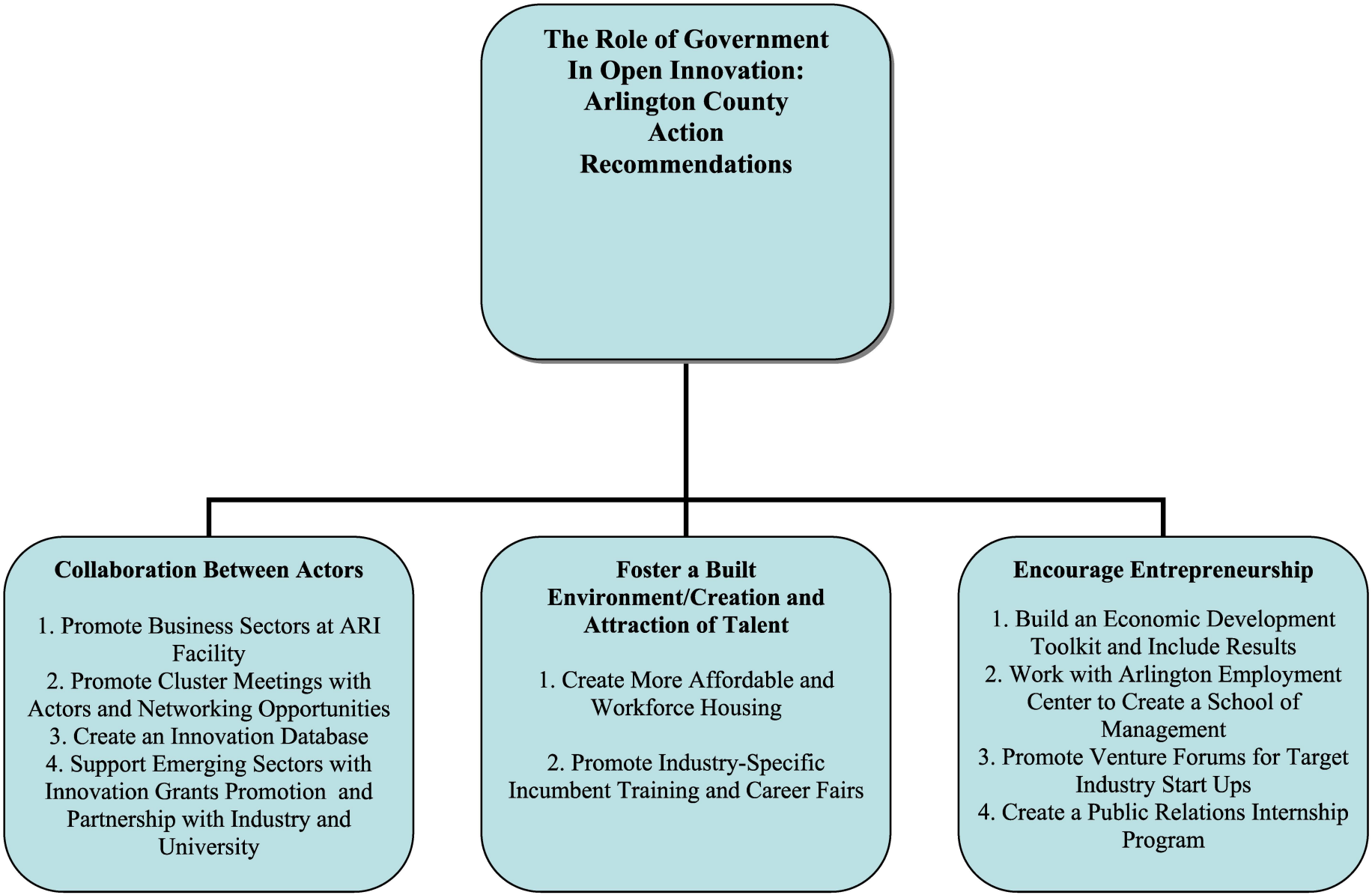
3.5.5 WIRED Regions conclusion and findings

By analyzing the best practices of the selected WIRED regions, we were able to gain a broader understanding of the role of government in fostering collaborations among different groups, creating a supportive/complementary built environment for innovation, capitalizing and building a talented and highly educated workforce, as well as supporting entrepreneurships for the future and current workforce and innovative researchers. Arlington County can use the best practices of the WIRED regions, through the support of other industry and government stakeholders, to develop a regional strategy for economic and workforce development that incorporates the core principles of the open innovation model.

3.6 Recommendations for Arlington

Background

All recommendations were developed by addressing several questions. The most important question addressed in each of the recommendations was how can you operationalize open innovation? Secondly, we addressed improving each of Arlington's weaknesses as named in, *Fostering Emerging Technology Sectors in Arlington, Virginia*, addressing: entrepreneurship, talent and built environment, and collaboration. Next we explored what Arlington is already doing to try and link recommendations to what is being done so there is no overlap. Lastly we looked at other government jurisdictions and WIRED Regions to see what they are doing and to add key ideas into the recommendations for how to strengthen what is already being done and incorporate new ideas.


The Role of Government In Open Innovation: Arlington County Action Recommendations
Collaboration Between Actors
1. Promote Business Sectors at ARI Facility
2. Promote Cluster Meetings with Actors and Networking Opportunities
3. Create an Innovation Database
4. Support Emerging Sectors with Innovation Grants Promotion and Partnership with Industry and University
Foster a Built Environment/Creation and Attraction of Talent
1. Create More Affordable and Workforce Housing
2. Promote Industry-Specific Incumbent Training and Career Fairs
Encourage Entrepreneurship
1. Build an Economic Development Toolkit and Include Results
2. Work with Arlington Employment Center to Create a School of Management
3. Promote Venture Forums for Target Industry Start Ups
4. Create a Public Relations Internship Program

3.6.1 Collaboration between actors

1. Promote business sectors at VT-ARI facility

Virginia Tech University's research and development center will be the new major scientific research university presence in Arlington addressing Arlington's need for a major scientific university presence to foster more innovation on the university side. Now that this major university is in the Northern Virginia area, Arlington can use it to create ideas and a strategy to attract investment and firms to Arlington. Relate those ideas to the new Virginia Tech facility attracting certain anchors perhaps creating an incubator catering specifically to the industries that will be working out of VT-ARI.

2. Promote cluster meetings with actors and networking opportunities

Convene cluster group meetings with all actors (government, nonprofit, and industry), focused on identifying and acting on issues important to further promoting the regions most innovative growing businesses, looking particularly at creating direction for fields including homeland security and cyber security. Perhaps work to help cyber security and homeland security work with other fields like engineering that will be doing their R&D at the new Virginia Tech facility in Ballston. Brokers should create innovative networks and spaces for the creative and innovative to gather and collaborate. Do more in addition to the current Arlington *Café Scientifique* program, possibly for other budding industry sectors.

3. Create an innovation database

Create a database that collects names and stories of innovation as they're developed overtime. Research the local and national media for past stories on local innovators and entrepreneurs is also critical to add to the database. This will be another database, using the same idea of the *IBridge network program* in Kansas City, to aggregate research materials, technologies, and discoveries in an online, easy-to-search forum, should be made accessible to university, industry, government, as well as venture capitalists. Easy access will be provided to innovation from various partners which helps to stimulate networking and idea sharing, which can lead to partnerships, product commercialization, and/or start-ups.

4. Support emerging sectors with innovation grants promotion and partnership with industry and university

Arlington County can support their emerging sectors, through the development of *Innovation grants* that support new partnerships between industry and academia to expand awareness for scientists in both communities regarding research interests and industry needs, and accelerate innovation and technology transfer/commercialization activities. This initiative will help in facilitating university research discoveries. Channeling their innovative ideas for private sector commercialization is crucial and can be significant in sustaining and growing the Arlington County region global competitiveness.

3.6.2 Foster a Built environment/creation and attraction of talent

1. Create More affordable/workforce housing

Create more affordable housing options including with the development of workforce housing. The *Arlington Partnership for Affordable Housing (APAH)* has made some good inroads.

2. Promote industry specific incumbent training and career fairs

OneKC WIRED proudly identifies their region as having a thriving economy, with high-incomes, high-paying employment and a highly educated workforce. The Northern Virginia region can capitalize on the fact they have had a growing economy with a high share of the educated working class and build on that by providing high-tech training opportunities to help advance the skills of the current employees and to help sustain businesses that may be suffering in an overall downturn of the economy. Arlington should also focus on providing industry-specific incumbent training for large and small companies, specifically targeting small companies in the region's targeted industry sectors; in making sure that employees are well-equipped to handle the changes in technology and to create high-skilled workforce that can be competitive globally. Additionally, Leaders ought to expose citizens to the many exciting career opportunities available. Show the citizens that skill improvement classes are available in many different fields including in innovative and technological advancement courses. Promote career fairs.

3.6.3 Encourage entrepreneurship

1. *Build an economic development toolkit and include results*

   Expand on the already existing economic toolkit for the first 18 months of a project including incorporating effective economic development roadmaps (Arlington Economic Development). The goal of the toolkit is to provide support to entrepreneurial businesses that drive innovation across the Arlington/Northern Virginia area. Like the SEVA-PORT Wired Region, measure what is working and track results such as the number of individuals trained in selected industries, number receiving credentials, number obtaining employment in selected innovation industries, and salary. Track curriculum developed and number of students enrolled in courses promoting innovation. Track small businesses involved in training and peer-to-peer forums. Look at economic indicators such as number of new jobs created in selected industries, unemployment rate, number of new business and start-ups in selected industries and leveraged resources.

2. *Work with Arlington Employment Center to create a school of management*

   Work with the Arlington Employment Center to create a school of management or regular/annual program for better management and training of industry managers whose goals are to start their own businesses or take over the management of current technology firms.

3. *Promote venture forums for target industry start-ups*

   After a few months of mentoring, establish face time in front of venture capitalists via a science association group, like BIOCOM in San Diego. Perhaps the Ballston Science and Technology Alliance could fulfill that role holding these events at VT-ARI calling them "V Tech Venture Forums". Arlington County can host venture forums for target industries' leading firms, new entrepreneurs, and start-ups. The goal of venture fairs would be to increase innovation commercialization, small business development, generate a strong cluster professional network.

4. *Create a public relations internship program*

   Create a marketing campaign promoting Arlington as an entrepreneur's paradise. While *Speaker Box* is Arlington's Public Relation's arm, it is not widely accessible by the everyday Internet user, make it more widely known and accessible using interns to foster this campaign. Look for college students interested or majoring in public relations and utilize their interests and ideas in promoting Arlington as an entrepreneur's paradise. This will not only promote the creation and investment in talent, but it will also help address the county's lack of funding in utilizing resources like low cost labor to build a public relations campaign.

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Overarching Themes

Each of the case studies contained within this chapter arrived upon a key set of findings specific to the sector in question – industry, university, or government. From these, several themes, common across the cases, emerged. They are:

Establish linkages based on talent.

- Industry wants and needs talent and views its "connection" to university to be the "talent pipeline". Universities and governments educate and train individuals thereby developing the human capital that keeps industry and government running. The three entities – industry, university and government – are inextricably linked by talent.

Actively promote collaboration.

- All actors – industry, universities and governments – must actively engage in making connections outside of their particular entity. The open innovation model relies on dynamic relationships in the capture of value from knowledge and information flows. Maximum value can only be achieved if all involved make concerted, collaborative efforts toward harnessing available information.

Utilize current resources and models to create open innovation environment.

- "Operationalizing" open innovation does not require "reinventing the wheel". Current resources, in particular, communication and networking technologies capable of linking different entities across geographic locations exist, e.g. Instant Messanger, Web 2.0, Facebook, etc. Additionally, the models highlighted by the cases studies contained in this report provide templates that can be combined and adapted to develop an approach that addresses the circumstances specific to VT-ARI, Arlington County and Washington D.C. metropolitan area industry sectors.

Define roles.

- Virginia Tech and Arlington County will both need to define their roles in and potential contributions to open innovation in the Washington D.C. metro area. Capturing value from the mass amounts of information and ability available in the marketplace requires active engagement based on a timely understanding of current opportunities. While the open innovation model presents a scenario in which multiple actors stand to benefit, it implies a responsibility on the part of those actors to continuously seek out potential partners, to identify the nature of potential partnerships and to keep up-to-date as to their needs and capabilities as well as the needs and capabilities of their partners.

Recommendations

Virginia Tech should:

- Develop intellectual property models that center around flexibility and adaptability.
- Approach industry relationships on to a case-by-case basis.
- Develop networks with industry through graduate placements.
- Use available technologies to develop strong networks.
- Increase its awareness of industry developments and needs; engage in targeted self-promotion.
- Provide the infrastructure necessary to perform collaborative research – increase the "stickiness" of industry presence.
- Serve as the facilitator of project-specific funding.
- Put together a task force to establish guiding principles and models for VT.
- Conduct a research interviews with industries and government to find what goals industry hopes to achieve through the university collaboration and align those findings with the missions of the University.
- Consider multifaceted funding structures to include "gap funding," transfer knowledge from university to industry, and foster entrepreneurial education and faculty development.
- Market VT Research Institute as an entrepreneurial and innovative facility by considering a membership on the iBridge Network.
- Consider a magazine or brochure to market the facility to federal contacts, local government contacts and industry contacts as a way to tell them what research is going on at the research facility.
- Experiment with a new model for commercialization of intellectual property.

Arlington County should:

- Promote cluster meetings with actors and networking opportunities.
- Create an innovation database (I-Bridge).
- Support emerging sectors with innovation grants promoting partnerships between industry and university.
- Create more affordable and workforce housing.
- Plan to provide integrated K-12 college preparatory education with career development programs.
- Promote industry specific career fairs and incumbent workforce education.
- Build an economic development toolkit as community sees fit; include effective measures of success.
- Work with Arlington Employment Center to create a school of management.
- Promote venture forums for target industry start-ups.
- Create a public relations internship program.