

INNOVATIVE START-UP COMPANIES CAPITALIZING ON BRAINPOWER IN THE KNOWLEDGE ECONOMY

The Partnership for Knowledge Entrepreneurship
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Abstract

Technology transfer and University research spin-offs play an imperative role in the partnership for knowledge entrepreneurship. Several research articles maintain that a region's economic growth includes the amount of human capital that start-up or recently established small businesses are using. A university's intellectual property and its commercialization policies affect the transfer of technology through university offices and academic-private sector partnerships. Talent is also incorporated into start-up companies through internships that may lead to employment. Furthermore, four best practices in this paper discuss the cultivation of intellectual capital, property, and student invention. The first is the Enterprise Innovation Institute and VentureLab at Georgia Institute of Technology. The second is Binghamton University's Innovative Technologies Complex, including the Office of Technology Transfer and Innovation Partnerships, Small Scale Integration and Packaging Center (S3IP), and CAMM. In addition, the Southern Tier Opportunity Coalition (STOC) and a recognized start-up company, Diamond Visionics, will serve as local best practices. To conclude, recommendations for Binghamton University and the community are discussed in detail.

Keywords: Small business creation; Innovation; Emerging technology; Knowledge entrepreneurship; University Research Spin-Offs; Georgia Tech VentureLab

Binghamton Keywords: Innovative Technologies Complex; Binghamton University Office of Technology Transfer and Innovation Partnerships; Southern Tier Opportunity Coalition; Diamond Visionics; NYS Center of Excellence

I. INTRODUCTION

The knowledge economy encompasses the capabilities of people rather than industrial machines through the exploitation of talent at universities. Graduating with a top quality education, college students are major assets of the knowledge economy possessing a great capacity to learn and to engage within the professional world. They can incorporate knowledge from a university into the workplace, known as technology transfer, through startup companies or further an existing company's development. Such a transfer of knowledge is crucial for technology and relies upon companies to identify, capture, and sustain the attention of recent graduates.

There are community and university offices that serve as an alliance to the business world and, in turn, form academic-private sector partnerships. One example is technology

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complexes, which serve students and faculty by providing lab and research facilities, technology transfer offices, and assist in the process of licensing and the formation of start-ups, while another example is community organizations that may link students directly to a business for internship opportunities. Ultimately, in order for innovative start-ups to fully utilize the intellectual capital of college students at a university for the progress of technology and to stimulate economic growth in a region, it is essential to raise awareness of a university's innovative facilities and to connect them to the opportunities available.

II. INTELLECTUAL PROPERTY AT THE UNIVERSITY

There are three types of intellectual property: patents, trademarks, and copyrights. In Universities, patents are the most commonly handled intellectual property. A patent provides the inventor a degree of rights to ownership of a good, service, or an idea for a tangible innovation. The University owns 60 percent of the rights, while the inventor owns 40 percent.

A. Policies for Intellectual Property Rights

Several policies regarding intellectual property rights arose in response to the issue of how to patent academic research discoveries. From 1925 to 1945, a greater number of patents came from public universities than private, however, after 1970, patenting in private universities surpassed the inventions of solely public universities. As a result, a change in the University's function of licensing ideas laid the foundation to propose the Bayh-Dole Act (Mowery, pg. 21-22). The Bayh-Dole Act of 1980 states that universities own intellectual property rights of student and faculty innovation even if they are funded by research grants (Florida, 1999, pg. 68). The act replaced the Institutional Patent Agreements (IPAs) between universities and federal organizations. Such a transformation pursued more patents. However, the policy fails to comprehend that not every research project is sufficient intellectual property, but assumes all basic research ideas are applicable for licensing (Mowery, pg. 22).

Although the Bayh-Dole Act has satisfactory objectives, the policy limits the intellectual property rights of researchers to a university. For example, studying a field of "open science" instead of a specific idea is no longer permitted by grant regulations. If a discovery is made, initial consideration for federal funding and eventually for a patent, requires the researcher to state their exact intentions. Author of "Universities in national innovation systems", David Mowery, supporting these laws, states, "These 'emulation' initiatives are based on a misreading of the empirical evidence on the importance of intellectual property rights in facilitating the 'transfer' and commercialization of University inventions..." (pg. 21). Furthermore, the process of innovation is delayed and as a result affects the transfer of technology. Fortunately, intellectual property attorneys are diligently trying to modify regulations in order to overcome these obstacles.

B. Policy Effects on Collaboration Partnerships Between the University and Industry

Expectedly, the Bayh-Dole policy has had an affect on the University-industry collaboration partnerships and the transfer of technology. Some companies hesitate to collaborate with university faculty and students because the policy places restrictions, which, in turn, makes it difficult for companies to work with a university (Florida, 1999, pg. 68). For

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students, the process of licensing while interning at a company is much simpler than researching at the University. The student can claim their intellectual property and apply for a patent through the company, as opposed to all the steps at the University. Companies favor interns based on the University they attend and previous experiences with other students (Florida, 1999, pg. 68). Therefore, companies strategically plan for their sources of innovation through internships or new hires.

III. TECHNOLOGY TRANSFER

In this context, technology transfer is defined as the movement of a concept from the college campus to the market for production. The majority of universities have an office for the transfer of technology to provide assistance and support students and faculty in their endeavors. If an idea has strong potential after reviewed, the University will patent it and the office will locate an existing or start-up company that could benefit (Coker, pg. 41). Thus, increasing the licensing of ideas and/or inventions for commercialization has a beneficial impact on technology.

A. Exploration of Academic-Private Sector Partnerships

Partnerships that link campuses to industry can benefit both a university and the business community. A university has a lot to offer to businesses: talent, knowledge, innovation, education, and publications (Florida, 1999, pg. 68). It is up to the businesses to identify and harness this talent through internships and new hires. In addition, the students must also put forth effort into the process. Universities strategically serve as the focal point by matching students with a company according to the student's major and/or interests. Offices devoted to technology transfer on campus play a major role in this relationship (Mowery, pg. 19). According to a study, 73 percent of participating parties in a partnership said a university initiated the relationship after new federal science and technology policies (Florida, 1999, pg. 69). Technology transfer offices help to facilitate a relationship to promote the initial transfer of knowledge.

B. Industrial Research Office at Penn State University

For example, an excellent illustration is the Industrial Research Office located on every Penn State University campus to handle licensing of the University's intellectual property. With Penn State's main campus educating more than 40,000 students it has devoted an area purely to research, licensing, and start-up companies called the Penn State Research Park (Tornatzky, pg. 1). The park provides students and faculty with opportunities to establish connections with local businesses. The Industrial Research office does not limit its services to engineering or science-related fields. It is open for all disciplines and encourages all students to research and commercialize their ideas (Tornatzky, pg. 3).

In addition to licensing through the University, the Industrial Research Office promotes partnerships with local businesses. Students and faculty may develop business models to patent their research for integration into the market through a company or utilize the space to brainstorm. They also host events at the office in order for companies to visit and speak with students about internship opportunities. A database maintains records of all research at Penn

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State for interested companies to view as well as a list of the status of University patents. A comprehensive database allows businesses to remain updated on research within the University with the intention of increasing technology transfer (Tornatzky, pg. 4-5). There is also a Pennsylvania Technical Assistance Program (PENNTAP) that supplies free technical help to small companies and other businesses for up to twenty hours. Faculty and students engage in the program for hands-on experience. Penn State University's efforts to promote the transfer of technology through academic-private sector partnerships has shown success and has been awarded a best example of a practice from the United States Economic Development Administration. The award is presented for PENNTAP's support, strategic location on campus, assistance for all disciplines, and with state-sponsored as well as private sector companies (Tornatzky, pg. 6-7).

C. Office of Technology Transfer and Innovation Partnerships at Binghamton University

Binghamton University's Office of Technology Transfer and Innovation Partnerships is analogous to B.U.'s students and faculty as Penn State's Industrial Research Office. From 2007 to 2008, the amount of new ideas that faculty submitted for licensing consideration that may have received approval for a patent increased by 59 percent. The increase indicates a dramatic rise in funding for research from state and federal grants as well as an abundance of innovative ideas. The assistant vice president for Technology Transfer and Innovation Partnerships, Eugene Krentsel, said:

When you talk to faculty, what excites them is an opportunity to make an impact on people's lives, both in their community and, more importantly, nationally and globally... That's where technology transfer comes in, because by transferring that knowledge, we're able to change people's lives.

Jiayuan Fang, a former associate professor of electrical engineering, is an example of a faculty member who the University and local businesses pressed to apply for a patent for his software package. His software now supplies almost all computer manufacturers (Coker, 2009, pg. 42-43). Scott Hancock, assistant director of technology transfer at B.U., emphasizes the importance of a partnership and connection between students and faculty with the region. Patents capitalize on University brainpower and, the more creativity and innovation that is developed, the greater chance for innovation to spread. Furthermore, Hancock emphasizes that the University's role is "... the creation and dissemination of knowledge. Now think about what technology is. It's part of knowledge. When you look at technology transfer as a part of the creation and dissemination of knowledge, it becomes part of the critical mission of any university" (Coker, 2009, pg. 43).

IV. UTILIZATION OF TALENT FOR START-UP COMPANIES

The University is sometimes dubbed an "engine of innovation" by people who weigh the amount of technology transferred from a university with greater significance than the talent that it attracts, develops, and produces. However, these individuals fail to recognize that talent and innovation are very much connected to each other, and one could not exist without the other. Richard Florida argues that a university is much more than an "engine of innovation" and that, instead, it is the backbone upon which our industry lies (2006, pg. 5). If the amount

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of technology transfer increases in terms of intellectual property, there is more innovation to fuel industry. An increase in technology transfer requires more funding and support from the state and federal governments, but will give a university an opportunity to serve a strategical role (Mowery, pg. 3). The licensing of university research leads to commercial innovation and start-up companies. However, this is a linear thought process, and does not truly capture the magnitude and strength of relationships that exist between each entity (Mowery, pg. 22).

Although the creation of intellectual property in a university serves an important role in determining the strength of the knowledge economy the relationship is non-linear and the method in which technology transfers is more significant. Richard Florida asserts, "Universities are far more important as the nation's primary source of knowledge creation and talent. Smart people are the most critical resource to any economy, and especially to the rapidly growing knowledge-based economy on which the future rests" (1999, pg. 67). To promote evolution of the knowledge economy, the number of industries capitalizing on brainpower from a university must rise (Mowery, pg. 2). However, it is important to note that a university is also an attractor of talent and its human capital is a critical resource. Mowery emphasizes five major economic yields of a university: science and technology, equipment and instrumentation, skills or human capital, networks to facilitate the transfer of knowledge, and innovations (Mowery, pg. 4).

Richard Florida calls a university an "engine for regional development". Although a university's brainpower contributes greatly to economic growth, it is the use of a university's products that truly count. Companies need to capitalize on the science, innovation, technology, and overall talent that a university generates in a region (1999, pg. 71). However, the street travels in both directions, and universities need to market their knowledge and spin off start-up companies (Florida, 2005, pg. 14). The strong ties between universities and companies are essential for the economy's growth from technology advancements (Mowery, pg. 7).

In order to capitalize on student's talent, regions must adequately prepare themselves. Data shows that high-tech regions more likely experience economic success through the use of readily available human capital. Cities such as Boston, San Francisco, New York City, and their surrounding areas are recognized for their large populations and popularity. Each year they receive an influx of intellectual property, including brainpower in the form of patents for entrepreneurial endeavors or new hires. Some interest originates from the colleges nearby, but a majority of the influx of human capital is from older industrial regions that fail to retain their University's graduates, such as Cleveland and Detroit (Florida, 2005, pg. 13). Furthermore, universities want their graduates to stay in the area to promote regional growth, which may spur attraction of new talent and set the stage for future graduates to follow. But, if the region does not have sufficient resources, students must leave to find other sources of employment.

In order for Universities to continue to produce the best and brightest graduates, regions must strive to create suitable environments for students that include opportunities for employment. Companies must engage the students early to fully capitalize on their brainpower either through internships or when recruiting them as prospective employees. Policy makers need to devote their attention to attracting the smartest students to universities and figuring out how to retain them in the area. Sustainment of talent in an area will lead to regional and national economic growth because human capital is proven to have the strongest influence on economic growth (Florida, 2005, pg. 11). The creation of academic-private sector partnerships

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within communities is important and will help to grab the attention and retain some students, although it is not the only solution for economic development (Florida, 1999, pg. 72). Without the academic-private sector partnerships as previously discussed, new knowledge, new energy, and new talent from the local University, a region cannot experience economic growth.

V. BEST PRACTICES: CULTIVATION OF INTELLECTUAL CAPITAL, PROPERTY, AND STUDENT INVENTION THROUGH UNIVERSITY OFFICES AND PARTNERSHIPS

A. An Enterprise Innovation Institute at Georgia Institute of Technology

Georgia Institute of Technology's Enterprise Innovation Institute offers a selection of services to companies, entrepreneurs, economic developers, and communities. The four major areas it encompasses are commercialization services, entrepreneur services, industry services, and community policy and research services. In particular, two departments of the Enterprise Innovation Institute that exemplify a best practice for this paper are the Strategic Partners Office and the VentureLab, which is a branch of commercialization services (<http://innovate.gatech.edu/Default.aspx?tabid=1525>).

The Strategic Partners Office at Georgia Tech successfully establishes connections with industry through encouraging faculty and students to pursue tangible ideas into marketable innovations. It is fully aware of the Institutions 's research initiatives, academic departments, and faculty expertise enabling them to direct an interested business in the right direction for collaboration. Furthermore, the Strategic Partners Office offers services and facilities for business R&D and strives to initiate interactions between Georgia Tech students, faculty, and businesses (<http://innovate.gatech.edu/Default.aspx?tabid=1525>).

The goal of Commercialization Services is to transfer innovations from Georgia Tech into the market. After evaluating research for potential discoveries, the commercialization specialists offer guidance on an approach to market the product. The 'Georgia Tech Innovation Process' instructs the inventor to file an invention disclosure through the Office of Technology Licensing (OTL). Then, the commercialization specialists decide the value of the invention by conducting a market-based assessment. If an invention has potential, there are three possible directions to explore: create a start-up company, license to an existing company, or use the product for consultation purposes. In addition, Commercialization Services supports faculty, research staff, and graduates in commercializing their inventions, as well as assisting members of the community. One example of providing assistance is to help companies decide if they are applicable for R&D funding from the federal Small Business Innovation Research (SBIR) Program (Fleming, NCET2, April 22, 2009).

Another recognized entity of Commercialization Service's is the Georgia Tech VentureLab, which is a major force behind Georgia Tech inventions. The VentureLab offers high-quality support to faculty, research staff, and graduate students interested in entrepreneurship. It serves as the focal point between research labs and the market by aiding in forming a business plan, linking inventors with an experienced entrepreneur, finding investment sources, and preparing for obstacles (<http://innovate.gatech.edu/Default.aspx?tabid=1525>). It also helps the inventor to decide if their discovery is marketable and the type of market. Since 2001, VentureLab has proven its success by assisting in more than 300 invention disclosures and filing for about 70 to 80

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patents per year at Georgia Tech (Fleming, NCET2, April 22, 2009). VentureLab is conveniently located across the street from a building in the business school for MBA students in the program. After completion of the project, graduates of VentureLab can apply to start their own business in an incubator called the Advanced Technology Development Center (ATDC), which is shared with Emory University (Fleming, NCET2, April 22, 2009).

For example, one program in the VentureLab for both Georgia Tech and Emory University is called the Tiger Innovating Generating Economic Returns (TIGER). Five graduate students are selected for each TIGER team based on a survey that evaluates their desire to build a start-up. Each team consists of one PhD student, two MBA Georgia Tech students, one corporate law student and another studying intellectual property or patent law, both from Emory School of Law. After deciding on an idea for a product, the team develops a business plan to enter into a competition against other student teams, exposing them to angel investors. Typically ten TIGER projects enter a competition each year and about two or three receive investment offers (Fleming, NCET2, April 22, 2009).

Another successful program of Commercialization Services is the VentureLab Fellows, which use experienced entrepreneurs to assess research discoveries. The majority of fellows are retired CEOs from Atlanta interested in investing in a start-up or helping to guide one based on a knowledge of the market (Fleming, NCET2, April 22, 2009). Clearly, VentureLab Fellows builds connections between graduate students, faculty, research staff, and entrepreneurs to utilize knowledge for the creation of innovative spin-offs. Thus, it exemplifies a successful academic-private sector partnership that has proven success along with the entire VentureLab.

B. The Innovative Technologies Complex, the Office of Technology Transfer and Innovation Partnerships at Binghamton University

The Innovative Technologies Complex is a facility devoted to facilitating new research developments in the biotechnology and biomedical fields and the transfer of technology into industry. The first building, called the biotechnology building, officially opened on October 3, 2006 with 92,000 square feet for multidisciplinary research in biomedicine, bioengineering, biosensors and biotechnology. It contains research laboratories, offices, clinics, and the bioengineering department. It is located adjacent to main campus on Vestal Parkway making it accessible to students, faculty, and visitors eliminating the hassle of parking on main campus. There are also plans to complete two additional buildings in the next 3 to 4 years with a \$66 million grant from New York State; the second building is currently under construction. The ITC construction shows the University's dedication to interdisciplinary and multidisciplinary research opportunities. Overall, sponsored research activity has more than doubled over the past decade (Coker, 2006).

One of the offices located in the ITC is the Office of Technology Transfer and Innovation Partnerships. It aims to protect the intellectual property of faculty and students, encourage development for the market, and provide services to the faculty interested in entrepreneurial endeavors (Hancock). It accomplishes this by assisting in patent filing, marketing and licensing of inventions, creating start-up companies, copyright law, and lastly overseeing industry partnerships (<http://research.binghamton.edu/TT/>).

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Moreover, the ITC houses a New York State Center of Excellence, the Small Scale Systems Integration and Packaging Center (S3IP) for advancing microelectronics research and development. It performs R&D, creates cutting-edge electronic applications, and brings together partners from the government and private sector to work with the University faculty and students for collaboration. Some of these partners include Endicott Interconnect Technologies, Kodak, Corning, BAE systems, General Electric, IBM, and Lockheed Martin (<http://s3ip.binghamton.edu/>). One significant research initiative of S3IP is the Center for Advanced Microelectronic Manufacturing (CAMM), established in 2005, located at Endicott Interconnect facilities, but owned by Binghamton University. CAMM is a national microelectronics center creating flexible, lightweight electronics with roll-to-roll manufacturing. These flexible electronics are applicable to the fields of medical diagnostics, military and homeland security, space and energy, and electronics. Clearly, S3IP and its research initiatives aid in the transfer of technology from the University to industry (<http://camm.binghamton.edu>).

A start up-suite and equipment are available for B.U. faculty use at a reasonable price at the ITC for research spin-offs. However, there are currently four companies occupying space in the start-up suite. One is Nanomas, led by a B.U. professor researching nanotechnology and nanomaterials engineering. Another named NSC Technology arose out of research to create materials for chemical and biological sensor and fuel cell catalysts (<http://research.binghamton.edu/TT/>). A third company called Sonostics, founded by Steven Pittari, Schwerin and Chief Operating Officer and a former manager at printed circuit board manufacturer Sanmina-SCI in Owego and Kenneth McLeod, chairman of BU's bioengineering department and a professor, serving as its chief scientific officer. Dr. McLeod oversees the company's research conducted at the ITC (Nguyen, pg. 3). The company has developed a product called AccuForce, which "collects muscle vibrations as a person exercises and converts that information into absolute force using a technique called wavelet packet analysis, the company said. The result is a measurement of muscle force and balance" (Nguyen, pg. 1). Therefore, the resources available at the ITC are part of the greater research initiative to transfer technology from B.U. to industry.

C. Southern Tier Opportunity Coalition

The Southern Tier Opportunity Coalition (STOC) is a private sector-academic partnership initiative founded by local business leaders in 2002 to promote economic development of the Southern Tier. It is comprised of companies from industries including engineering, finance, law, strategy and business planning, and marketing and business development. Members have experience in areas such as academia, large aerospace and electronic companies, start-up companies, and successful small businesses. The mission of STOC is to foster growth and entrepreneurial interests for existing and new companies in the area by serving as a contact for regional business development resources. This can help new companies evolve and also supplies resources to encourage existing technology businesses (<http://www.stoc-ny.com/>). Additionally, STOC strives to utilize sources of B.U. through its connections with B.U. faculty and professors for incorporation into the Southern Tier's industry (Hayek).

To maintain its mission, STOC provides services to entrepreneurs and start-ups, small, medium, and large businesses, universities, individuals, and its members. For start-ups and

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entrepreneurs, it offers a plethora of local resources and knowledge to achieve success, as well as guidance on sources of investment. For small to medium businesses, STOC offers contacts for potential customers and networking opportunities to grow, while for large businesses it provides chances for innovation through local resources, methods for commercializing research, and other benefits. Likewise, STOC serves as a focal point for individuals and its members to network and develop relationships that church company growth (<http://www.stoc-ny.com/>).

Furthermore, in order to sustain a level of innovative resources to its members, STOC has established connections with Binghamton University. Both deans of the Thomas J. Watson School of Engineering and Applied Sciences and of the School of Management are members of STOC. Also STOC's 1st Vice President, Dr. Bahgat Sammakia is a professor of mechanical engineering and director of the Center for Advanced Microelectronics Manufacturing (<http://www.stoc-ny.com/>). Through these connections with B.U., STOC can link an employer with a department or professor to acquire recommendations on students for interns or inquire about R&D. For example, there are small businesses that join STOC with the intention utilizing STOC's ties with the University. While interviewing John Hayek, the executive director of STOC, he mentioned three companies who recently reached out or joined STOC to establish closer ties with B.U. All three companies, Superior Technical Resources, New Vision Industries, and the Sheltered Workshop, were looking for engineering and technical students to intern (Hayek).

D. Diamond Visionics

Founded as a technology services company in Vestal, NY in the mid-90s by David L. Peters and David P. Gdovin, Diamond Visionics (DVC), serves as a local example of an exceptional start-up company. Before forming DVC, as Singer-Link flight simulation engineers, both partners worked in Binghamton, for CAE, a provider of simulation and modeling technologies headquartered in Canada from 1988 to 1995. In 1995, CAE sold the simulation engineers to Hughes Aircraft, a company in Texas. But, neither wanted to move to Texas because they grew in Vestal and had established lives here. At CAE, Dave was also a V.P. of Marketing and New Business Development and had dreamed of starting a business one day. In May of 1996, DVC contracted their first simulations project with CAE for computer designed surgical training. It created demos using funds from the Federal Government Small Business Innovation Research Grant Program (SBIR), a grant that removes a percentage of money from Research & Development funds for small business use to create jobs. In order to fully reap the benefits of the grant, DVC had to fulfill the federal government requirements, which is exactly what the company did, leading on a path to success. In total, DVC has completed 21 Phase I projects at \$100,000 each, has had success at higher phase levels, and is a recipient of many other prestigious awards developing a strong reputation in the field of visual simulations (Gdovin).

Similarly to other companies in the region, DVC can attribute a recognizable degree of its success from academic partnerships with universities in the area, and specifically with B.U. On the first level, over the past 13 years DVC has used students as interns and offered some a permanent position. Second, DVC collaborates with B.U. professors on projects as subject experts, but DVC heads the grant proposal because it is an SBIR grant. Third, the reverse can

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also occur if the funding is a University grant. Fourth, DVC has supported President Lois DeFleur's proposal for increased R&D funding to the University from the state. Fifth, DVC's role in STOC is to represent small businesses and all high-tech companies in the area to advocate for B.U. In support of this relationship, DVC is written into a lot of grants along with IEEE. DVC hires interns from B.U. and B.C.C. through contacts with professors and deans at both colleges and also through networking with other companies in STOC. The graduate students interns were supplied through SPIR, a state program for companies to intern graduate students and "try them on for size". SPIR allows graduate students to work 20 hours a week, while undergraduate interns are only permitted to work 10 hours a week. The company pays 50-60% of the salary for interns and the rest is paid by the state (Gdovin).

While interviewing Dave Gdovin, he mentioned a story of one particular intern who has worked as an employee for DVC for the past seven years. The current employee, Rakesh Mehta, is an excellent example of the success DVC has experienced through interns. Over seven years ago, DVC asked the SOM dean for an intern to create a marketing plan. Thirty resumes were submitted to the dean, an SOM committee narrowed it down to 12, and Dave selected three applicants to interview. Rakesh came to the interview with a completed the marketing project with information he researched on DVC's website. He was offered the intern position and later a permanent position. Mehta was also of particular interest to Dgovin because he is also a certified doctor in India, but was earning his MBA in Finance and Marketing from B.U. He serves a true example of the many B.U. students who possess multiple talents, which contribute to their employers. Gdovin states, "These students are world class--- helping to build and grow the company." In addition, although in the 2008-2009 academic year, SPIR was less active than in previous years, DVC found ISSS (International Student and Scholar Services) to supply international graduate students. Gdovin is currently waiting to hear if the results of a proposal for a grant and if DVC receives, he will offer a permanent position to an intern (Gdovin). Clearly, collaboration between the students and industry through academic partnerships can stimulate economic growth.

VI. RECOMMENDATIONS

Therefore, the transfer of technology from Binghamton University to industry and academic-private sector partnerships both play significant roles in the development and success of innovative start-up companies. In order to compete in today's economy, it is essential to fully utilize the plethora of talent available at Binghamton University to retain some graduates in the area. Through researching examples of local best practices and in other universities that strive to achieve this goal, the following recommendations have the potential to benefit the greater Binghamton area and accomplish this vision as well.

One suggestion is to develop a program like SPIR for each school in B.U. If 3 to 5 percent of B.U. graduates stay out of 15,000 students this yields 750 graduates remaining in the area. The Watson school has 3,000 students and data shows that on average 60 to 70 percent stay after graduation. If one multiplies 70 percent by 750 this gives 525. If you divide 525 into 3,000 and convert to a percentage, it equals 17.5 percent. Therefore, the Watson school retains 17.5 percent of its graduates. If B.U. can increase its overall retention rate to 17.5 percent, through innovative start-up companies, as well as mid-size, and large businesses

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then the region would experience a significant growth in its economy.

Another recommendation is to model programs at B.U. similar to the "TIGER" and "VentureLab Fellows" program at Georgia Tech Institute. Although, B.U. does have a start-up suite for B.U. professors to use, there is not an established program in place that allows multiple disciplines of graduate students to develop a product and enter into a competition for exposure to investors with the possibility of creating a successful start-up. Developing a relationship with experienced entrepreneurs in the area could also assist in successful transfer of technology into industry, either through start-up companies or already existing companies.

As a sophomore bioengineer, I had never heard of the ITC until I entered the bioengineering program. However, the second floor of the biotechnology building, where the bioengineering department is located, is the only floor I was familiar with or had even explored before the CIC2020 class was given a tour of the biotechnology building on Friday, April 24, 2009 by Mike Frame, director of federal relations at B.U. However, I would like to point out that over the past academic year I have visited the ITC at least once or twice a week to meet with a professor or TA during office hours. For a dedicated and interested student who is in the biotech building as frequent as 10 to 20 times a semester and be unaware of every office and lab on the first floor, clearly shows that there may not be one sophomore bioengineer who is aware of anything else in the building besides our major's department. This leads to a third recommendation and has the potential to be the one of most importance, despite its simplicity. I propose that tours are given to all technical, science, and business students of the ITC. This could be done through a class field trip for engineering and computer science students, and open houses for business and science students and others who are interested. This could last for a few hours, I suggest 11 am to 4 or 5 pm, to maximize the number of students coming and there should be a schedule of tours every hour with a brief presentation about the history, mission, and visions of the ITC for B.U. and its students to promote awareness. As many staff members and faculty in the building should be present, or at least one to two from each entity allowing students with questions to fully reap the benefits.

Ultimately, there is an opportunity for more formal academic-private sector partnerships to exist and it is essential for industries as well as students at B.U. to be aware of these opportunities. Without the awareness of the students, they will not know who to contact, or search for when looking for opportunities.

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