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Strategic Considerations in Leading an Innovation Ecosystem

Stephen E. Cross, Fellow, IEEE

***Abstract* - The Georgia Institute of Technology has been a catalyst for economic growth in the Southeast United States since its founding in 1885. Over the past 30 years, it has become known as one of the top technological universities in the world. As part of a strategic planning effort commenced in mid-2009, it sought to strengthen its thought leadership and impact through the development and implementation of an innovation ecosystem strategy. The Institute serves as the integrating focus within its region to promote (and provoke) disruptive thought, use-inspired research, experimentation, and accelerated implementation through novel educational, research, and industry partnership programs. Since 2009, there has been a marked increase in economic development impact. This paper describes the guiding principles, strategy, innovative programs, benefits, and lessons learned associated with a regional innovation ecosystem.**

Keywords - innovation, ecosystem, university-industry-collaboration, entrepreneurial university

I. Introduction

The Georgia Institute of Technology (Georgia Tech) was created in 1885 to develop an educated cadre of technical leaders to support industry and economic development in the Southeastern United States. Today, Georgia Tech is recognized as one of the top research universities in the world as evidenced by its recent top ten listing by Thomas Reuters [1]. Its six colleges include the largest engineering college in the United States. It ranks as the #3 producer of patents in Georgia [2] behind AT&T and Kimberly Clark, and #8 in the country among research universities in economic development impact [3]. Its incubator has launched more than 75 companies in the past 10 years. A new strategic vision, *Designing the Future* [4], was created in 2009.

The strategy pursued is based on guiding principles. Such principles guide an organization irrespective of a change in goals, strategy, management, or the nature of the work pursued. The four guiding principles, summarized here [5], are the basis for success of Georgia Tech's regional innovation ecosystem. First, research and economic development activities are concurrent. This is distinct from a more commonly practiced sequential approach. A key benefit is the early engagement of commercialization experts with researchers and the routine involvement of industry partners throughout Georgia Tech's programs. Second, the university and its surrounding region provide a real world environment in which research and economic development activities are jointly pursued. This provides a vibrant ecosystem in which promising new ideas are created, explored, and tested as part of the Institute's educational programs. The result is accelerated maturation and transition into commercialization activities either through spin-outs or by licensing to established companies. Third, the research activities are grouped into core research areas each with a well-defined interdisciplinary focus and commercial market focus. Fourth, the culture has transformed to provide effective and efficient administrative support both for researchers and for industry partners. The latter two key ideas provide critical mass, administrative agility, and efficiency. As stated, the paper will describe the strategy, programs, results, and lessons learned.

By assiduous pursuit of an industry focused strategy influenced by guiding principles and with enhanced synergy between research and economic development activities, the regional innovation ecosystem has thrived and been extended globally. A recent example is the partnership Georgia Tech has structured with the Provence of Lorraine, France resulting in the formation of the Lafayette Institute in April 2012 [6]. The work of this institute, its relationship to Georgia Tech and its regional innovation ecosystem, as well as results to date will be discussed later in this paper.

This paper will discuss the innovation ecosystem strategy and provide examples of initiatives pursued through the strategy. It is first worthwhile to explore in more depth what is meant by an innovation ecosystem and how the guiding principles apply.

II. Innovation Ecosystem

With the view that people will pay for "fresh thinking that creates value …" [7], Georgia Tech defines innovation as insight plus invention plus implementation. All three are essential and all three require collaboration within a supporting ecosystem that brings together a university, investors, industry, government, and other stakeholders. Georgia Tech supports both disruptive and incremental innovation. Following the writings of Christensen [8], disruptive innovation equates to "game changing" ideas that combine insight of new opportunities and unique ways to achieve them. This is pursued through competitive experimentation and accelerated commercialization initiatives.

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S. E. Cross is with the Georgia Institute of Technology, Atlanta GA 30332 USA (phone: 404-894-8884, fax: 404-894-7045, email: cross@gatech.edu).

Universities increasingly are expected to support economic development within their region [9], providing a venue through which companies can explore disruptive ideas. There are several reasons why this is true and increasingly successful. The risk of failure is typically less severe in the university setting than in a company's business unit in part because the investment cost is significantly less and because competition between competing ideas is culturally acceptable. In addition, students and faculty are predisposed to disruptive thought. Effective coupling and integration of industry into the university can provide a means to ignite, and even provoke, disruptive thought. The desire to experiment with new ways to facilitate innovation in educational and research settings grounded in codified best practices [10], and accelerating the products into commercialization activities forced a reassessment and refocus of Georgia Tech's strategic vision.

An ecosystem consists of the alignment and integration of various organizations whose vested interests in realizing the value of innovation are shown in Fig. 1. These include industry markets that strive to establish and sustain market relevance, individual investors (e.g., venture capitalists), those who educate and train workers for the marketplace, government organizations, and non-governmental organizations (e.g., trade associations). Georgia Tech plays an effective and perhaps unique role in providing an integrating focus across these areas. Research universities, such as Georgia Tech, serve a central role in guiding and facilitating alignment among members of the ecosystem. This is done as part of a strategy that integrates research and economic development activities.

III. Transforming Research Into Economic Development Impact

As part of the strategic vision, Georgia Tech defined an industry facing research strategy focused both on leading-edge, use-inspired research and economic development. While most universities pursue a linear, sequential flow of discovery-based research followed by occasional declaration of intellectual property and subsequent licensing or company formation/spin-out; Georgia Tech pursues a concurrent strategy centered on the core research areas as illustrated in Table 1. These theme areas were selected because they are appropriate aggregations of core competencies represented in over 300 research centers and laboratories at Georgia Tech, their interdisciplinary and trans-disciplinary nature, the alignment with strategic markets within the region, and the existence of industry partners interested in working with the Institute. The process to arrive at this aggregation involved a year-long discussion with faculty, administrators, and regional stakeholders in an effort to achieve shared understanding and agreement on how to best provide an effective industry face to research programs and their economic development potential.

Concurrency means that teams of faculty, graduate students, application and economic development experts, and

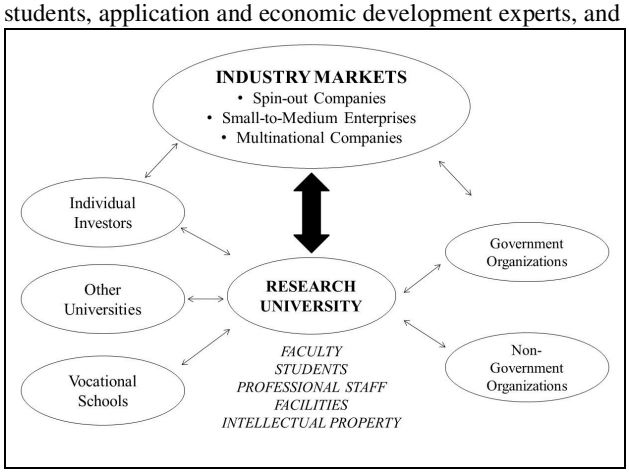

FIG. 1 GEORGIA TECH INNOVATION ECOSYSTEM

professional staff work together to define and pursue grand challenges, foster early engagement with industry, and accelerate the maturation and transition of technology to the marketplace. It should be noted that to accomplish this, balance is required between high-risk, discovery focused research, and economic development activities. Not every research task is successful. Research is an experimental pursuit where new insights and fundamental learning come from failure. The balance sought is to cause and support a culture that blends high risk, discovery-focused research with early identification of commercialization potential. The value to industry, besides access to know-how and technology, is that research universities, through their innovation processes, provide a venue for exploring and realizing disruptive innovations outside the constraining and often bureaucratic confines of their profit/loss units.

Central to the successful implementation of such a strategy is a philosophy of maximizing collisions, reducing friction, and prudent risk taking. This requires a culture and a work environment where novel ideas can be explored and where faculty have the freedom and support to do that with minimal administrative burden. It also requires that work is done in ways that are meaningful to the pursuit of scholarship while responding to the needs of industry and other important external stakeholders. As a result of these observations, Georgia Tech developed a concurrent innovation strategy based on three objectives: *to create transformative opportunities, to strengthen collaborative partnerships, and to maximize economic and societal impact.*

A. *Create transformative opportunities*

The first objective means that members of the faculty pursue high-risk research grounded in grand challenges facing our society within a culture that supports and celebrates use-

inspired and translational research. Use-inspired research [11] brings together basic and applied research to have greater societal impact. Translational research, as typically referenced in the medical literature (e.g., as advocated by the Coulter Foundation, see www.whcf.org), involves research that codifies findings from basic research into new knowledge, devices, therapies, and/or medicines that can be used in medical treatment. The approach pursued at Georgia Tech integrated use-inspired and translational research to create a focus on accelerated maturation and transition of fundamental research findings to use. It also stresses the importance of understanding challenging problems in the application domain as a focus for research. Members of the faculty are encouraged to provide thought leadership at the national and international levels. An example includes the creation of a national robotics roadmap [12] cited by the President of the Unites States when he announced an advanced manufacturing partnership initiative in June 2011. These and other initiatives are pursued in ways where the Georgia Tech campus and the surrounding region provides the infrastructure (commonly called test bed or pilot plant) for conducting scalable and relevant research in the real world. An important aspect of the strategy is to assemble professional support in licensing, industry contracting, commercialization, business development, communications and marketing into commercialization impact teams. The teams directly support research and economic development activities in a concurrent manner in each of the theme areas.

B. Strengthen collaborative partnerships

Partnerships with other universities and technical colleges, national and international universities, major corporations, local nonprofits, and State agencies are essential. The Georgia Research Alliance (GRA) [13] has been a key partner of Georgia Tech, and other research intensive universities in Georgia, helping to attract top talent, and to pursue critical issues to society and to the State's economic vitality. The outcomes obtained, as will be later discussed, over the past 2-1/2 years, are through strengthened partnerships with member organizations of the innovation ecosystem. A good example is the strategic partnership [14] between Children's Healthcare of Atlanta (the largest pediatrics health provider in the United States), the State of Georgia Department of Community Health, Georgia Tech, and regional health care providers. Through this partnership, a transformation is being pursued to institute electronic patient records across the state, to enhance the business model for health care delivery, and to focus more on wellness outcomes. Strengthening such partnerships is a key element of the State of Georgia's first strategic plan for science and technology (see scitechplan.georgia.gov).

C. Mazimize economic and societal impact

The third objective means that research success is not measured by papers published or other standard measures of faculty achievement, as important as they are to the academy. Success is predicated on research results having demonstrable impact beyond the laboratory and classroom in the real world. Success measures include companies formed, licenses issued, outside industry investment achieved, and new jobs created. The value Georgia Tech's strategic partners attribute to the work conducted under this strategy is ultimately most important.

TABLE 1
CORE RESEARCH AREAS

"Big Data"
Biomedicine and Biotechnology
Electronics and Nanotechnology
Energy and Sustainable Infrastructure
Manufacturing, Trade, and Logistics
Materials
National Security
Paper Science and Technology
People and Technology
Public Service, Leadership, and Policy
Robotics
Systems

IV. SUMMARY OF RECENT INNOVATION INITIATIVES

Georgia Tech builds on a solid foundation that includes one of the top ten incubators in the United States [15]. Since 1980 and with support from the State of Georgia through its Georgia Research Alliance, Tech's incubator – Venture Lab – has launched more than 75 companies based on Georgia Tech research over the past 10 years. Perhaps more significantly, Georgia Tech manages the State of Georgia's Advanced Technology Development Center (ATDC). ATDC is the first such incubator in the United States and currently the largest. With 25 operating locations in the State of Georgia, it has raised more than $1 billion in outside financing and now has more than 350 companies in its state-wide program. In addition, a well-established business plan competition is in its 13th year fostering entrepreneurship among Georgia Tech students and alumni. This is significant as approximately 70% of Georgia Tech's intellectual property declarations involve students. Since its inception in 2001, over 750 students and alumni have participated in this annual competition; and in total over $640,000 have been awarded in cash and services. A body of impressive scholarship in innovation and entrepreneurism also exists [16,17,18]. The Institute sought to scale its thought leadership and impact in innovation through experiments with new programs that stressed competition to provoke disruptive ideas, maximize experiential opportunities for students, accelerate the

formation of spin-outs, and facilitate greater involvement of multi-national corporations (MNCs). A brief summary of each new program is provided below.

A. *Student competitions as a venue for industry innovation*

Industry funded projects involving competition between student teams is becoming a productive way for MNCs to explore disruptive ideas. It has also provided a useful means to directly support education activities and research infrastructure. One recent example involves a major energy company and teams of first year graduate students in engineering and business. Called the "smart grid challenge" [19], student teams compete against each for cash prizes on projects supervised by faculty and industry mentors. Since 2009, 23 patent applications have resulted from this work. Companies involved in such efforts across technology fields spanning biomedicine, biofuels, energy, aerospace systems, and mechanical systems cite return on investments higher than achievable in their own business units. Another popular venue for encouraging innovation and entrepreneurism as an educational activity is the InVenture Prize [20] which involves over 300 student teams competing for cash prizes to cover company start-up costs and patenting. Since 2010, over 10 student-owned companies have been formed as a result of this competition.

B. *Accelerated commercialization*

Georgia Tech supports three programs to accelerate the formation of start-ups. These are based on commercialization of its own IP and as a service to the region and the National Science Foundation in mentoring others in the same.

The Georgia Tech Integrated Programs for Start-ups (GT:IPS) supports faculty, students, and staff who wish to create a spin-out company. After participating in a training course, where the basics of business planning, fund raising and regulatory and policy issues related to company formation are discussed, faculty receive a "right of use" license for Georgia Tech held IP. An innovative aspect of this program is the development of a template and streamlined licensing document. This document was vetted by four local law firms that have represented start-up companies and sought to license Georgia Tech IP over the years. The later was itself something of a disruptive idea that reflected an internal cultural change. As a result of this work, Georgia Tech now has four template industry contracting agreements that span basic, applied, service support/testing, and commercialization activity.

The internal program is complimented by FlashPoint [21], a professional development program in *start-up engineering*, a term coined to connect Georgia Tech's engineering heritage with its new strategic focus on innovation. With support from an angel fund established by local investors, 15 teams formed in October 2011 completed a 10 week course in which they rolled out their business plans resulting in over $7M in investment funds from firms across the United States (including the first investments in Georgia made by well-known Silicon Valley firms). Each team has a successful entrepreneur as a mentor. The program is motivated by the widely publicized *y-combinator* program in the Silicon Valley [22], but significantly is the first such university-based program.

A third program commenced in July 2012. The National Science Foundation selected Georgia Tech as one of its initial nodes for the Innovation Corps (I-Corps) program. See http://www.nsf.gov/news/news_summ.jsp?cntn_id=124856. Based on the lean start-up principles of Blank and Dorf [23], the recipient of a NSF research grant can make application to NSF for commercialization funding with the condition they attend and be mentored at one of the I-Corps nodes.

These programs, together with Tech's existing education, research, and economic development activities have reinvigorated an innovation ecosystem in the State of Georgia and attracted significant outside venture capital investment. To date in calendar year 2012, Georgia Tech has created, or helped others created, over 125 new companies. The dual concepts of competition to provoke disruptive thought and to accelerate innovative ideas into commercialization reflect the concurrent strategy of research and economic development activity previously discussed. Increasingly, companies, both small-to-medium enterprises (SMEs) and MNCs, are engaging with Georgia Tech to pursue initiatives that support problem-based learning and research activities. The interplay between the educational programs and research activities are highlighted in Fig. 2. In most of these activities, students own the intellectual property created, and depending on the nature of the commercialization program pursued, the patent costs are paid for by the Institute or industry.

Others have taken notice. Based on a long standing research relationship with the Centre National de la Recherche Scientifique (CNRS), the renowned government-funded research organizaiton under the Frnech Ministry of Research, the Provence of Lorraine formed the Lafeyyete Institute as a partnership between Georgia Tech's 22 year old campus in Metz, France, the University of Lorraine, local polytechnics, and ecojnomic development agencies within the provence. Construction on a building to house translational research and economic development activities commenced in October 2012. With an initial focus on advanced materials and automotive applications, Georgia Tech will work with MNCs headquartered in Europe, many with operating locations in the United States, to replicate the innovation ecosystem in Atlanta, Georgia.

The above are a few of the recent initiatives Georgia Tech has undertaken in response to its new strategic vision and plan. Leveraging its already highly acclaimed reputation for research and economic development, Georgia Tech seeks to drive innovative thinking into all aspects of its programs.

V. EVIDENCE OF SUCCESS

Since 2006, Georgia Tech's sponsored research from competitively selected awards has increased by 60 percent. The Huron Group is currently updating a 2006 report [24], and while the analysis is not yet finished, their preliminary finding indicates that Georgia Tech's impact has resulted in at least 60,000 jobs - through direct and indirect employment, and at businesses founded, attracted or supported by Georgia Tech personnel, technology and programs. Remarkably, Georgia Tech's investment into economic development activities leverages external funding in a ratio of 26:1 to state funding (both state appropriations for economic development support and state funded competitively selected awards). As a direct result of the previously described innovation programs and the Institute's innovation strategy, significant results have been realized over the past 30 months as shown in Table 2. Industry engagement has increased both with respect to the creation of new companies and in direct support to established companies in each of the strategic theme areas. Further evidence of the importance of Georgia Tech's role in the innovation ecosystem results from its use as a "test bed" to explore important new concepts. For example, the State of Georgia and local hospitals are working with Georgia Tech to develop and test a health information exchange as a means to facilitate interoperability between and sharing of patient health information encoded in digital form.

VI. LESSONS LEARNED

A. *Alignment*

Georgia Tech takes the view that it is a necessary, but by itself not sufficient, entity to foster increased economic development impact throughout the state. Alignment across all means of support to industry within the region is necessary to ensure industry receives not only the benefits of research enabled innovation, but access to a trained workforce and investment incentives that can be provided from government organizations. Tech's mission to educate future leaders in key areas of engineering, technology, and related areas are crucial for enhanced economic development. But the desired impact in Georgia cannot be achieved in isolation. Alignment of Georgia Tech's strategic theme areas with strategic market areas defined by the Georgia Department of Economic Development (GDEcD) is underway. For example the area of robotics in manufacturing, autonomous vehicles, and medical applications is an increased focus area for GDEcD and one in which Georgia Tech can provide great assistance. Other examples include the 3rd largest solar cell manufacturer in the United States, Suniva (a Georgia Tech renewable energy spin-out) which works closely with the Gwinnett Technical College (GTC) to ensure skilled factory line workers for its manufacturing needs. Similarly, the two institutions work closely to ensure that nurse training programs reflect advanced in health care technology.

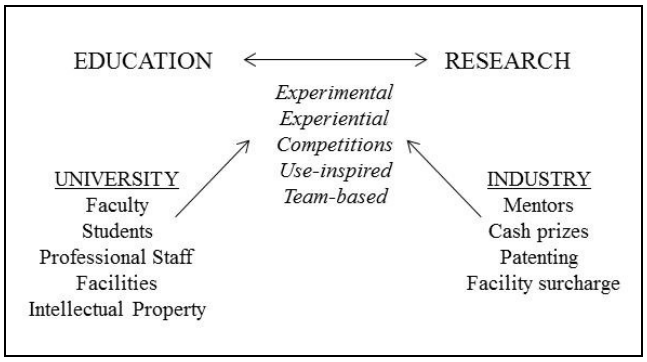

FIG. 2 RELATIONSHIP BETWEEN RESEARCH AND EDUCATIONAL OFFERINGS

B. *Networking*

The innovation ecosystem is comprised of a critical mass of personnel with rich and diverse experiences. Facilitated by alignment, there is a willingness to share experiences. For example, the Flashpoint experiment benefited greatly from mentors with previous experiences in creating and leading start-up companies. There is also a cadre of very experienced executive talent to support new companies and to form business partnerships with existing companies. Executive talent to support new companies and to form business partnerships with existing companies.

C. *Resource accessibility*

Besides the obvious importance of investment funds to support commercialization activities, many industry partners have found value in the ease of access to the "know how behind the IP." That is, access to faculty, students, and professional staff engaged in both research and economic development activities. Facilities and the services they can provide (e.g., materials testing) are often too expensive to replicate in start-up companies. Ease of access at affordable price points thus became an attractive feature of this innovation ecosystem. As part of the Institute's overall strategy and master building plan, more pilot plants for industry embedded work will be pursued.

D. *Culture*

Most importantly, Georgia Tech has become more industry friendly and industry facing. It has changed its licensing approach from one of recovering costs and maximizing licensing revenues to one of "getting the IP into play." The cultural change has recognized that individual success at Georgia Tech relates significantly to making an industry partner successful. Another significant change in culture is the value placed on team-based work as evidenced by the internal alignment of work between faculty and student researchers and the commercialization teams formed to support the concurrent strategy described earlier. The previously described smart grid challenge is but one example

TABLE 2.
INDICATORS OF GEORGIA TECH'S ECONOMIC DEVELOPMENT IMPACT

	2012	2011	2010
Research expenditures	$736M	$641 M	$603 M
Disclosures	407	383	407
Patents	79	78	58
Technologies transferred	142	127	85
Research contracts with industry	930	980	843
Licenses	90	83	90
New incubated companies	52	17	16
Investment into incubated companies	$145 M	$100 M	$61 M

that would not have been possible without the culture changes.

VII. CONCLUSION

Georgia Tech's approach to creating, sustaining, and extending an innovation ecosystem is based on four guiding principles: concurrent pursuit of research and economic development, use of the surrounding region as a test bed, focus on core research areas in strategic markets, use of the surrounding region as a test bed, and facilitating a culture that embraces industry. A strategy has been developed and implemented to support a regional innovation ecosystem based on transformational research, strengthened partnerships, and economic development impact. Already recognized as one of the top research universities in the world, it seeks to enhance its thought leadership and impact. It ranks as the #3 producer of patents in Georgia and #8 in the country among research universities in economic development impact. Georgia Tech's industry-facing research strategy is focused on 12 core research areas and the economic development potential therein and it has implemented new innovation initiatives, including a streamlined licensing and industry contracting program and start-up acceleration programs, as a down payment on its future plans to generate more economic development impact within the region through the innovation ecosystem it helped create and that it currently helps sustain. In calendar year 2012, Georgia Tech has help launch over 125 new companies to date during calendar year 2012.

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Stephen E. Cross (M'74-SM-86-F'02) is the Executive Vice President for Research of the Georgia Institute of Technology and a professor in the School Industrial and Systems Engineering. Previously, he was the Director of the Software Engineering Institute at Carnegie Mellon University He received his PhD from the University of Illinois at Urbana-Champaign. He has published over 70 technical papers and book chapters on artificial intelligence, technology transition, and innovation. Dr. Cross is a former Associate Editor for the *Journal of Information, Knowledge, and Systems Management*, and a former Editor-in-Chief of *IEEE Intelligent Systems*.