Reaching Across the Pond: Extending a Regional Innovation Ecosystem Strategy

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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 in mid-2009, it sought to strengthen its thought leadership and impact through the implementation of a global innovation ecosystem strategy. The Institute serves as the integrating focus within its region to promote disruptive thought, use-inspired research, experimentation, and accelerated implementation through novel educational, research, and industry partnership programmes. Since 2009, there has been a marked increase in economic development impact. This paper describes an implementation of a system-focused strategy for a regional innovation ecosystem in the Southeast United States, a research methodology for its continuous improvement and assessment with results and analysis over a multi-year period, and lessons learned. It postulates necessary ecologic, economic, and societal attributes for an innovation ecosystem, illustrates how these attributes are the basis for success within the region, and describes how this is a basis for extension to its affiliated programmes in France.

Keywords: innovation, ecosystem, leadership, collaboration, partnerships, strategy

1. Introduction

This paper describes ecologic, economic, and societal attributes of an emerging global innovation ecosystem centred on the work of the Georgia Institute of Technology in Atlanta, Georgia, USA and its affiliated programmes of education, research, and economic development at Georgia Tech Lorraine in Metz, France. Adner (2006) defines an innovation ecosystem as "…the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution." Such requires the alignment and collaboration of various organizations with a vested interest in realizing the value of innovation in the marketplace as illustrated in Figure 1. As described in Youtie and Shapiro (2008) and Valdivia (2013), research universities serve a central role in guiding and facilitating alignment among members of the ecosystem.

Georgia Tech pursues a system-focused strategy that integrates research and economic development activities as described in Cross (2013a). It is grounded in a culture of innovation that stresses part-

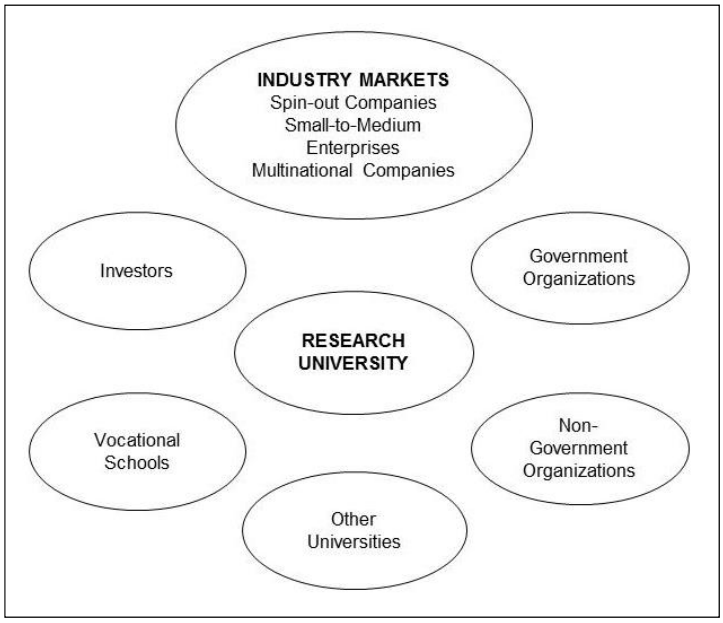

Figure 1: A notional innovation ecosystem

nerships in specific market segments to facilitate collaborative work with industry, government, and nonprofit organizations. Georgia Tech provides commercialisation support to regional partners while leveraging its research base and educational programmes to provide venues for partners to explore disruptive concepts. Effective coupling and integration of industry into the university can provide a means to ignite, and even provoke, disruptive thinking which is embedded into academic programmes that provide experiential learning opportunities for students as well as support for research.

Success of the regional innovation ecosystem is predicated on key ecologic, economic, and societal attributes. Ecologic attributes refer to necessary functions that span research to commercialisation within the ecosystem and how they relate to and support various components of that ecosystem. Economic attributes refer to characteristics necessary to facilitate conduct of commerce throughout the ecosystem. Societal attributes refer to the characteristics of relationships within the ecosystem; elements necessary to promote positive outcomes. A model based on these ecologic, economic, and societal attributes will be discussed in the next section.

2. Research Methodology and Related Literature

The approach taken to define and assess the regional innovation ecosystem, i.e., the research methodology, is based on benchmarking, surveys, and data analysis. Benchmarking is conducted through membership and active participation in forums sponsored by the U.S. National Academies through the Government University Industry Research Roundtable (GUIRR) and the University-Industry Demonstration Partnership (UIDP). In addition, benchmarking is supported by professional societies such as the Association of University Technology Managers (AUTM). Examples are provided in Fraser (2009) and Boccanfuso (2014). Independently conducted surveys, as in University Business Incubators (UBI) Index (2014) and AUTM (2013), along with economic development impact reports, such as Huron Group (2006), and periodic interviews with stakeholders provide insight into the effectiveness of best practice usage and insights into potential improvements. Representative data are presented and discussed later in the paper.

The work described herein is also influenced by the literature on innovation ecosystems. Wright (2014) observes "… that corporations turn to universities to investigate areas outside their core strengths, investing in speculative science in the hope of finding profit opportunities." In a similar vein, Fabrizio (2006) provides a comprehensive overview of open innovation practices increasingly employed by industry to engage research universities. Though much has been written about the importance of start-ups, and methods for start-up acceleration have been codified as described in Blank and Dorf (2012), Bresnitz (2014) has observed that the success of innovation ecosystems is not about start-ups alone, but about the platforms and differentiated value offered through different global locations. Carlson and Wilmot (2006) describe five rules for successful innovation focused on important needs, creation of value, innovation champions, multidisciplinary teams, and organizational alignment. UBI (2013) also provides a good summary of characteristics of successful regional innovation ecosystems. The following paragraphs briefly review the literature that captures these referenced characteristics in terms of ecologic, economic, and societal attributes.

Hage (2011) describes key ecologic functions that must exist within an "innovation network" (innovation ecosystem) to successfully translate research results into usable knowledge and valuable products. These functions span basic and applied research, design, manufacturing, quality control, and extension services as described in Table 1. Significantly, Hage stresses that technological innovation as enabled by research and design is by itself insufficient. Process innovations in manufacturing, quality control, and commercialisation research are also needed. In this context, what is commonly referred to as 'extension services,' in the American land grant university tradition, is synonymous with Hage's use of commercialisation research. For example, the US Department of Commerce sponsors a manufacturing extension partnership programme in each state to provide support for the manufacturing capabilities of small to medium-sized manufacturers located within that state. In the State of Georgia, these extension services are provided by Georgia Tech.

These works have prompted thinking and a focus for this paper in terms of the essential ecologic, societal, and economic attributes that must be present and integrated into an innovation ecosystem. As described in the next section, Georgia Tech has developed expertise in the key functions described by Hage and provides these routinely to its partners in its regional innovation ecosystem. For the purposes of this paper, these ecologic functions are summarized as research, development, production, and extension services.

Table 1: Necessary ecologic attributes for an innovation ecosystem

Arena	Definition	For purposes of this paper
Basic research	Experimental or theoretical work undertaken primarily to acquire new knowledge without any particular use in view	Research
Applied research	Original investigation undertaken to acquire new knowledge, but aimed toward a specific use objective	
Product development & innovation	Systematic work based on existing knowledge gained from research and practical experience directed at producing new materials, products, and devices (including prototypes)	Development
Manufacturing research & process innovation	Research to design new manufacturing products or processes to increase productivity and improve quality	Production
Quality control research	Research aimed at improving the quality of products as well as research to reduce risks to the user and hidden costs for the environment	
Commercialisation research	Research designed to understand needs of customers or to improve distribution paths and/or supply chains	Commercialisation

In a recently published book on successful innovation ecosystems, Tornatzky and Rideout (2014) describe societal and economic attributes that characterize successful innovation ecosystems based on case studies of twelve US universities. These attributes include boundary or interdisciplinary activities spanning entrepreneurship education, industry and community partnering, and technology transfer as well as the culture of the university and its leadership. The point is made that universities need to support and encourage student involvement in entrepreneurial activities and even view such activities as a focus for innovation in educational delivery. Such universities also commit to facilitating industry access to intellectual property and the development and enhancement of partnerships with members of the ecosystem (industry, government organization, and nonprofit entities). Lastly, the university culture must be accepting of entrepreneurial activity as a legitimate scholarly pursuit, and importantly university leadership must set the tone and direction for this to happen.

Figure 2 illustrates key ecologic, economic, and societal, attributes of an innovation ecosystem. Note that leadership is listed as a key societal attribute; leadership itself is fundamental throughout the ecosystem. The balance of the paper explores how these attributes relate to a successful regional innovation ecosystem centred on Georgia Tech and how this ecosystem is being extended globally through its European campus in Metz, France.

3. The Georgia Tech Strategy

Georgia Tech was created in 1885 with the mission to educate a cadre of technical leaders in order to build a manufacturing and economic base in the State of Georgia. Georgia Tech's strong engineering culture supports the co-existence of education, practical problem solving and discovery-focused research. Today, Georgia Tech consists of six colleges (engineering, architecture, computing, business, science, and liberal arts). The Georgia Tech Research Institute (GTRI), an outgrowth from the original shops and foundries, was created in 1934 to conduct applied, industry-focused research. In addition, the Enterprise Innovation Institute (EI^2) supports economic development. EI^2 houses the first and largest incubator in the United States.

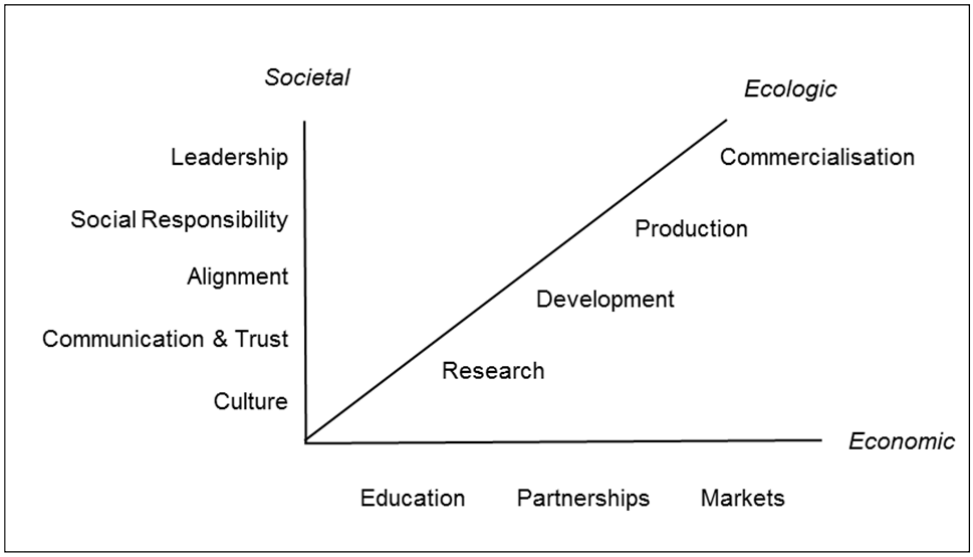

Figure 2: Innovation ecosystem attributes - ecologic, economic, and societal attributes.

As part of a strategic planning effort in 2009, Georgia Tech defined an industry-facing research and innovation strategy focused both on leading-edge research and economic development. The strategy sought to bring a systems approach to the vast array of faculty-led research projects across Georgia Tech. This was done to create more synergy between the colleges, GTRI, and EI^2 and also to more efficiently and effectively fund research infrastructure and support processes. For example, Georgia Tech uses a shared services model to support the acquisition, use, and maintenance of research equipment. Such equipment is situated in administrative units, called interdisciplinary research institutes, reporting to the central administration outside the colleges and other units. This is done, in part, to promote interdisciplinary work. Another example is the simplification of contracting and intellectual property processes in order to become more "industry friendly." In addition, 12 core research areas were selected to best represent the breadth and depth of research competencies and their mapping to strategic societal and market opportunities.

The core research areas are appropriate aggregations of core competencies represented in over 300 research centres, groups, and laboratories at Georgia Tech, their interdisciplinary nature, the alignment with strategic markets within the region, and the existence of industry and other 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" for research programmes and their economic development potential.

A concurrent approach to research and economic development through innovation means that teams of faculty, graduate students, application and economic development experts, and professional staff work together to define and pursue important problems, to foster earlier engagement with industry, and to accelerate the deployment of research results. It should be noted that to accomplish this, creative tension and a balance is required between high-risk discovery-focused research, use-inspired research, and development activities. The pursuit of discovery-focused research does not mean that every outcome will be successful in terms of usable outcomes for what is learned from creative pursuit and exploration must be a key focus. Research is an experimental pursuit where new insights and fundamental learning often come from failed attempts. The balance sought is to engender and support a culture that blends high risk, discovery-focused research with early identification of commercialisation potential.

Central to the successful implementation of such a strategy is a philosophy of maximizing collisions, reducing friction, and encouraging 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's research and innovation

strategy has three objectives: *create transformative opportunities, strengthen collaborative partnerships, and maximize economic and societal impact*.

Transformative opportunities occur when members of the faculty pursue high-risk, interdisciplinary research linked to important economic as well as societal impact. Members of the faculty are encouraged to provide thought leadership at the national and international levels. These and other initiatives are pursued in ways where the Georgia Tech campus and the surrounding region serve as a living laboratory to support scalable and relevant research on real-world problems. Professional support in licensing, industry contracting, commercialisation, business development, communications, and marketing are necessary to the strategy.

Partnerships with other universities and technical colleges, national and international universities, major corporations, local nonprofits, and State agencies are essential. Strategic partnerships exist with many major international companies headquartered in or with significant business operations in Atlanta. Along with improvements in industry contracting and intellectual property management, a customer service model was introduced to better serve to cultivate deep understanding of the partnered company's needs.

Maximizing economic and societal impact means that research success is not measured solely by standard metrics associated with scholarly productivity, as important as they are to academia. Success is ultimately based on research results being deployed beyond the laboratory and classroom into the real world. Success measures include companies formed, patents and licenses issued, outside industry investment achieved, and new jobs created.

Data collected over the past several fiscal years for Georgia Tech's business incubator, VentureLab (VL), is shown in Table 2. The UBI Index (2014) ranks VL as the 2nd most productive such incubator in the U.S. and the 17th globally. Patent productivity remains high, ranking #3 in the State of Georgia behind AT&T and Kimberly-Clark, and #9 among worldwide universities with U.S. patent filings per NAI-IPO (2014). An influential trend the past three years has been the increase in multinational corporation (MNC) innovation centre formation on the campus. These companies invest directly into start-ups and support education and research activities, thus enhancing the ecosystem. Besides internal productivity, new education and mentoring programmes in the region have helped launch 150 new companies and produced over 25,000 new jobs per annum. Extension services support over 700 SMEs state-wide. An unpublished update of an earlier study by Huron Group (2006) estimates a regional economic impact of over $3B.

4. Expansion Towards a Global Innovation Ecosystem

In 1988, Georgia Tech sought the opportunity to provide its students with an international experience while pursuing the same rigorous education provided at the Atlanta campus. A partnership with the region of Lorraine, the city of Metz, and a top engineering school (Supelec) resulted in the establishment of Georgia Tech Lorraine. A unique feature of GTL is that the faculty is comprised of tenure-track academic faculty with home units in Atlanta and supplemented faculty from the Atlanta campus on one-semester rotations. Today there are 6 permanent faculty members affiliated with the schools of mechanical engineering, electrical and computer engineering, as well as in computer sciences, and about 20 faculty on annual rotation. Over 600 students attend GTL annually, including 140 graduate students. All academic matters are governed by the Atlanta campus. Most of the undergraduates are from the Atlanta campus, while most of the Master students are from top French engineering schools, spending a semester or two in Metz before finishing their degree on the Atlanta campus. Georgia Tech faculty members at GTL have established focused research programmes in advanced materials, optoelectronics, and robotics. In 2006, Georgia Tech established with the French Centre National de la Recherche Scientifique (CNRS) the first Unité Mixte Internationale (UMI) in France. Being a CNRS laboratory has been crucial to growing a successful ecosystem of R&D with key partners, locally, in France, and in Europe. Today, GTL is cited as a success upon which to base regional economic development as described in Consulate (2011).

Given a national desire to achieve greater economic development impact in the region Lorraine, focused in the areas of energy and materials, there has been significant recent investment and a strategic focus to derive greater economic impact from educational and research programmes. A striking example is the newly created *Institut Lafayette*, which is an open innovation platform, governed by a partnership between Georgia Tech and key local government entities (Conseil

Table 2: Georgia Tech business incubator data

	FY '09	FY '10	FY '11	FY '12	FY '13	FY '14 (estimate)
Number of Technologies Evaluated	149	125	219	199	200	219
Number of Deals Created	21	16	13	16	18	20
New Investment into Incubated Companies	$96M	$77M	$95M	$111M	$53M	$76M
Number of MNC Innovation Centres	0	0	0	1	3	6
Number of Jobs Created by Incubated Companies	457	433	519	599	677	720

Régional de Lorraine, Conseil Général de Moselle, Communauté d'Agglomération Metz-Metropole, Ville de Metz, and with support from the French government and the European Union). The Institut Lafayette is managed by Georgia Tech and located on the European campus of Georgia Tech (Georgia Tech Lorraine or GTL). The newly created institute, which opened in May 2014, is housed in a brand new 2,350 m^2 building comprised of offices, laboratories and a 465 m^2 cleanroom fully equipped with state-of-the-art characterization, fabrication, and pilot manufacturing equipment to enable innovations and training in optoelectronics. The new partnership further grows and supports the local innovation ecosystem in collaboration with other local higher-education institutions (e.g. Supelec, the University de Lorraine). Following the successful Atlanta model, a faculty member skilled in research management and economic development with extensive European industry experience works closely with GTL and the Institut Lafayette to collaborate with European MNCs and the regional innovation ecosystem led by Georgia Tech in the Southeast US. Lastly, new revenue generating partnerships have been initiated. For example, GTL, and its campus in Atlanta, participates with PSA Peugeot Citroën as a member of their OpenLab initiative as stated in PSA (2012). Research collaborations have been initiated with major international corporations with operations in France and in Georgia. While the innovation ecosystem in optoelectronics in the Lorraine region is emerging, initial signs are very positive. The next section describes the progress to date and the lessons learned.

5. Discussion and Key Lessons

In this section, the progress and plans for the international innovation ecosystem will be reviewed using the ecologic, economic, and societal attributes previously discussed.

5.1. Ecologic

There are strong collaborative research programmes between the Atlanta and Metz campuses in materials, optoelectronics, and robotics. Federal funding for basic and applied research are provided for specific projects by both the US and French governments. Careful attention has been paid to national policies and regulation, such as the US export control laws, to ensure such work meets the common definition of fundamental research. While development and production capabilities have been quite strong in the programme in Georgia, the new Institut Lafayette, described at Jager (2014), provides the opportunity to enhance these functions in France through partnering and alignment with extension services within the Provence, such as those offered by ISEETECH, a nonprofit organisation in Metz, France that assists SMEs. The constant flow of ideas and people between the Atlanta campus and the Lorraine campus makes for a truly global ecosystem.

5.2. Economic

As described earlier, the State of Georgia has defined strategic markets spanning information/telecommunications technology, biomedicine, energy, materials and other areas. There

has been a rapid expansion of start-ups coupled with recruitment of large companies thus enhancing the regional innovation ecosystem. The curriculum for undergraduates in Atlanta has been revised to support more entrepreneurial education and experiential learning via innovation competitions. A faculty member on leave during the spring 2014 semester initiated the first innovation competition with students at GTL and it was a huge success. The plan going forward is to offer the same entrepreneurial education in the courses offered in Metz and to engage students from across the region in competitions with students from Atlanta. While the economic impact in France is still to be determined, applications to Georgia Tech overall increased by 46% in the past year. Given the critical role of tuition for university budget support in the United States, demand for admittance was a stronger factor in the decisions to raise tuition and to admit approximately 5% more students over the past several years. Technology transfer programmes are being harmonized based on new "industry friendly" intellectual property and contracting agreements to allow any international company conducting business in Europe or the United States to provide the full array of services.

5.3. Societal

Despite recently cited cultural inhibitors, e.g., as cited in Floc'h (2014), the authors have found that France has taken a proactive approach to embracing and applying best practices in innovation. The Georgia Tech experience in Metz has been very positive with respect to local receptiveness and support. Critical to this is the long-standing commitment of the city of Metz and region of Lorraine to the Atlanta area and the State of Georgia, and vice versa. Historically, the role of the Marquis de Lafayette during the American Revolution, and more recently the continued honoured role of the US military in the region during WWII provides the backdrop for a friendly and trusted relationship. That is not to say there have not been challenges or issues between Georgia Tech and its partners in the region during the past 24 years. But there has been willingness, based on shared cultural heritage and the dedication of leaders involved, to work through those issues and to find 'win-win' solutions. An annual Atlanta–France event, see Clavé (2014), which brings government officials, technologies, business leaders, researchers, and artists together both in Atlanta and in Metz, further enhances the key attribute of communication and trust. This has, in turn, enhanced the willingness to share resources and to align programs. For example, the clean room in the new Institut Lafayette is supported by IP-based functions similar to those implemented in the clean rooms on the Atlanta campus. A last key attribute is the role of leadership. Randles et al (2012) discuss how responsible innovation is more than risk mitigation or harm avoidance, but the pursuit of doing good. Such social responsibility is encouraged as part of Georgia Tech's experiential education through a variety of innovation competitions supported by its business and policy programmes. These are being extended to its French campus as evidenced by a first student innovation competition held in April 2014. Georgia Tech has developed a leadership model based on the attributes of servant and adaptive leadership Cross (2013b) and provides mentorship in its use by all those in research and economic development leadership positions.

5.4. Key Lessons

There are six key lessons.

A systems approach has proven to be effective: Transforming the Georgia Tech enterprise by viewing it as a system has led to an effective approach for promoting more synergy between discovery, application, and deployment activities.

Alignment is necessary throughout the system: Alignment of vision, strategy, process, culture, and outcomes is very important. Moving dedicated teams of support professionals into faculty research areas to focus on offloading administrative burden and to support the functions related to curiosity, experimentation, maturation, and value have enabled faculty to spend more time on their research while others focus on transition to use. Further, alignment of core research areas with strategic markets important within its regions of operations and with its industry strategic partners has both produced support for research and for deployment activities.

Excellence in scholarly output is a necessary condition: The excellence of faculty, students, educational programmes, and research are all linked inextricably to high-quality scholarly output. Equally important is the translation of scholarly output into usable technologies and knowledge that have social and/or economic value. Directors of new MNC-based innovation centres have noted the importance of access to technical expertise and motivated students engaged in experiential educational programmes.

Effective communication and trust are fundamental: A team-based approach, common in large engineering projects, is more challenging in a research university environment. Frequent communication (including active listening) is crucial in order to gain support and trust with external stakeholders.

Innovation happens in such an interdisciplinary environment: It has long been recognized that "breakthrough ideas" often occur at the boundaries of different points of view. The approach implemented at Georgia Tech supports interdisciplinary research (across academic disciplines) and across the life cycle of discovery, application, and deployment.

Leadership and the willingness to change: Leadership within the university and in key nodes within the innovation ecosystem is fundamental to ensure collaboration and alignment of strategies in order to maximize the opportunities for market and societal impact. One key improvement opportunity learned in the past year from the data shown in Table 2 was the importance of early technology scouting by economic development personnel trusted by faculty. Staff previously focused on those activities was diverted to support new start-up acceleration courses and related mentoring activities in the regional innovation ecosystem resulting in an "input decrease" in investment into and formation of new university-based start-ups. A recent change was made to increase the effort in technology scouting. This is an example of a "lesson learned" that will be shared with the benchmarking groups and professional societies discussed earlier in the paper.

6. Summary

Georgia Tech in Atlanta, Georgia (USA) is the centrepiece of a very successful regional innovation ecosystem. The success of this system is predicated on key ecologic, economic, and societal attributes embedded in a systems-focused strategy that strives for concurrent execution of education, research, and economic development activities. The impact of the system is measured in the overall societal and/or economic value that is generated (e.g. jobs created, research volume, and the increased trend of companies locating operations adjacent to the central campus). Educational programs have evolved to further support workforce development needs and to provide venues for companies to explore disruptive concepts in a university setting. Through its long-standing relationship with its affiliated campus in Metz, France, Georgia Tech is extending its innovation ecosystem in the region of Lorraine and the city of Metz. The approach is based on the lessons learned through leading a regional innovation ecosystem in Atlanta, Georgia, and the transposition of the model to Lorraine melding the rich differences in two cultures with a long tradition of cooperation.

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