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Plans versus Experiences in Transitioning Transnational Education into Research and Economic Development: A Case Study

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Abstract

The process by which universities internationalize their education mission and adopt the “third mission” of economic development in their local region is widely documented. However, little is known about how transnational educational campuses adopt research and economic development functions. This case study draws on interviews, historical documents, and bibliometric and patent analysis to describe the efforts of one of the longest standing US transnational campuses—Georgia Tech Lorraine—to integrate into the Lorraine region of France by adding research and economic development missions. In describing the campus’s evolution, this article highlights key markers indicating the transition to novel competencies. The results indicate that the adoption of new missions is characterized by plans, mixed success, and re-orientation rather than by a directed or designed process. Additionally, the study suggests that efforts to transplant successful programs from the home university to the Lorraine campus were less successful than those involving host region-led partnerships.
1. Introduction

Much has been written about how the mission of universities has evolved from a conventional teaching mission to the undertaking of a second mission of research and, most recently, a third mission of service to society (Gulbrandsen and Slipersaeter, 2007; Cai and Hall 2015). Economic development of the local region, transfer of technology based on research undertaken at the university, and greater connection with local social issues are among the targets of this third mission. While some question the appropriateness of the third mission, its presence persists.

This paper discusses the internationalization of these three missions. Universities in the US and elsewhere have set up global campuses, initially focused on expanding the educational mission. Efforts to expand educational programs outside the home country continue, but these are sometimes coupled, other times not coupled, with institutionalized research programs and even facilities. In addition, some of these efforts involve extending into technology transfer and commercialization.

Little is known about how this evolution of transnational educational campuses into research and technology transfer/commercialization missions occurs. The majority of the existing literature on transnational education campuses focuses on their educational activities (Wilkins, Balakrishnan, and Huisman 2011; Wilkins, 2013; Fang and Wang 2014; Ahmad 2015; Cai and Hall, 2015). Other researchers have studied the establishment, closure, benefits, risks and management of such campuses (Altbach and Knight, 2007; Wilkins and Huisman, 2012; Kinser and Lane, 2015). However, less is known about how transnational educational campuses expand into other missions. While a handful of case studies have emphasized the importance of designed architectural types over the life cycle of these campuses (Pfotenhauer et al, 2016), little is known about the role of proactive plans, architectures and designs compared to responses to host country needs and wants (Shams and Huisman, 2011) in the evolution of these campuses.

This paper examines the evolution of a transnational education campus into research and economic development missions through the case study of the Georgia Institute of Technology (Georgia Tech) Lorraine (GTL) campus, which was established in 1990 in Metz, France. Lorraine is not a region without educational and research institutions, as are some locations of transnational campuses, rather it has a complement of public research institutes, universities, and corporate R&D. The case study will draw on interviews, historical documents, and bibliometric and patent analysis to depict Georgia Tech’s efforts to integrate into the region through the addition of research and economic development missions. Key transitional markers and changes in publication and patent output associated with the campus will be highlighted. This paper will show that the evolution of the campus into research and economic development missions is marked by plans, mixed success, and re-orientation rather than a planned process. The case study suggests that efforts to transplant successful programs from the home university to the Lorraine campus were less successful than those that involved host region-led partnerships.

The remainder of this article proceeds as follows. In order to locate the case in its relevant historical and scholarly context, the following section briefly recounts three processes of institutional transformation that are directly relevant to the case at hand. Section 3 describes the methods used here. Section 4 reconstructs the empirical case of GTL’s evolution through interviews and analysis of historical documents and GTL’s research and innovation output. Section 5 generalizes the findings from Section 4 to construct one plausible model of university campus evolution involving expansion of university missions. Section 6 concludes.
2. Institutional Flux: the US University, the Rise of International Branch Campuses, and the French System

Three historical processes of institutional change have direct bearing on the case of GTL. First, because GTL is a satellite campus of a US university and, according to our observations, is isomorphic to larger patterns of US university change, we consider the changing role of the university in the US. This subsection also considers the prevailing scholarly models for explaining these changes more generally. Second, we situate GTL within a global trend of the expanding prevalence of international branch campuses. Finally, we consider the national higher educational context into which GTL entered.

2.1 US Universities, the State, and Industry

From their inception US universities, when compared with their European counterparts, have been places of practice. Indeed, Rosenberg and Nelson (1994) describe the US universities of the ninetieth and early twentieth century as “intensely practical.” For example, course offerings in mining, agriculture, accounting, and various types of engineering appeared within US institutions of higher learning earlier than in Europe (Rosenberg and Nelson, 1994, p. 327). This focus on applied knowledge owes to the strength of university-industry ties during this early period of institutional formation. Furthermore, university linkages to industry were, from inception, local. Ties to geographically proximate industries linked universities to their surrounding regions. Thus, the educational and research foci (and thus the organizational structures) of the US university were shaped by the geographies and industries in which they were embedded.

The close university-industry relations during the mid-to-late nineteenth century shaped the departmental structure of US universities. Industry demand for engineers, such as from the railways, resulted in the establishment of engineering departments in many of the US’s leading institutions of higher education (Grayson, 1980). Similarly, industry demand for electrical engineers was met by an “essentially instantaneous” response to establish courses in the subject within institutions such as the Massachusetts Institute of Technology (MIT) and Cornell (Rosenberg and Nelson, 1994, p. 327). Finally, chemical engineering departments emerged, first at MIT (1888) and then at University of Illinois (1895), in response to industry demand.

While the US university system has undergone significant changes (e.g. the surge in government spending on university research that began at the onset of World War II resulted in a lasting federal presence in the university research system), the modern US university remains strongly linked to industry. However, the nature of the university-industry-government relationship has changed. One prominent means of understanding the current state of this trilateral relationship is the Triple-Helix framework.

Etzkowitz and Leydesdorff (2000) contend that the US, and indeed most countries, is moving towards what they deem a Triple-Helix III mode of university-industry-government relations. In this mode, nation-states seek university-industry-government relations characterized

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1 This is not to say that universities from other countries do not have strong and productive ties with industry. See for example, Etzkowitz and Leydesdorff, 2000; Leydesdorff and Etzkowitz, 1998; Casper and Karamanos, 2003. However, our concern here is with the how one US university established ties with a region abroad and thus the appropriate historical context is that of the US.

2 Significant heterogeneity amongst universities exists in regards to the extent to which they conform to the characterization presented here. The description offered here is based on overall patterns of change observed by the authors and documented by the other scholars referenced here.
by shared roles in knowledge production and commercialization (e.g. firms and governments that conduct research and universities that spin-off firms) and implement policies directed at encouraging collaborative innovation production modes, creating boundary-spanning functions, and that erode traditional (e.g. universities produce knowledge, firms produce products) divisions of labor. Within a Triple-Helix III mode, universities, firms, and government agencies do not occupy static functional roles in technology production, rather their roles are dynamic and determined by interactions with each other and with technology itself. According to this model, the university is conceptualized as “entrepreneurial” in that it actively seeks to commercially exploit newly produced knowledge. Indeed, Etzkowitz et al. (2000) contend that universities are approaching a “common entrepreneurial format” characterized by the embrace of a third mission of economic development and explained by internal (the university’s desire for additional revenue) and external (the host region’s desire for knowledge-based development) demand factors. Etzkowitz concludes that the transition to an entrepreneurial university is a “global phenomenon” (Etzkowitz et al. 2000, 161).

Youtie and Shapira (2008) propose a three-stage model of the evolution of university missions. This model is based on the historical transition of an archetypical Western university and identifies three university stages (storehouse, factory, and hub) defined by the manner in which a university interacts with knowledge. Universities operating in the initial (“storehouse of knowledge”) stage primarily serve a pedagogical function. The primary novel function associated with the transition to the “knowledge factory” stage is the conduct of research (as well as the “production” of graduates). Universities operating in this second stage place increased attention on the “pursuit of scientific research based on rational inquiry and experimentation” (Youtie and Shapira 2008, 1189). Finally, the authors observe an emerging mode of university behavior; that of “knowledge hub.” Universities operating in this stage act as an embedded animateur within their regions, actively linking research to commercial ends.

These trends of institutional change, while not universally agreed upon, have been studied extensively. Less well specified, however, is a more recent phenomenon whereby universities are beginning to internationalize not only their educational functions but also their research and commercialization and economic development functions. That is, universities are increasingly attempting to extend their “second” and “third mission” into the regions in which their international initiatives are located. It is this most recent feature of the emerging role of modern university-government-industry relations that we aim to investigate here. However, two additional processes are critical to understanding the transition undertaken by GTL: the expansion of international branch campuses and change within the French university system.

2.2 The Rise of International Branch Campuses

The rise of international branch campuses (IBC) or transnational education campuses, one dimension of the larger process of the internationalization of higher education (Knight 2004, Altbach and Knight 2007), is well documented. An IBC is typically defined as an educational facility that is named after and owned (wholly or jointly) by a foreign institution in which students receive in-person instruction towards the completion of a credential granted by the foreign institution (Wilkins and Huisman 2012, 628). As of December 2016, the Cross-Border

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3 For example, Etzkowitz’s contention of the universality of the entrepreneurial format is questioned by Philpott et al. (2011) who, in a study of four departments within a prominent European university, found a significant cleavage amongst faculty members in attitudes towards the adoption of an entrepreneurial model.
Education Research Team (C-BERT) identified 247 IBCs located in 76 countries sourced from 33 “exporting” countries.

As IBCs have proliferated, so has research into their benefit, risks, character, and management. Recent empirical scholarship has sought to specify the role of organizational cultures on IBC operations (Tierney and Lanford, 2015), the host institutions’ motivations for establishing IBCs (Wilkins and Huisman, 2012), the effect of competing (i.e. host and home) isomorphic pressures in shaping IBCs (Shams and Huisman, 2011, 2016), student motivations for attendance (Wilkins, Balakrishnan, and Huisman 2011; Wilkins, 2013; Fang and Wang 2014), levels of student satisfaction (Ahmad 2015), the experiences and motivations of the expatriate faculty and staff working at IBCs (Cai and Hall, 2015), the most common managerial problems facing IBCs (Healey, 2015), the cost and benefits of different ownership strategies (Lane and Kinser, 2013), and the role of perceived legitimacy in IBC success (Farrugia and Lane, 2012).

In parallel to this large empirical literature, theoretical scholarship has conducted that describes IBC behavior as analogous to various types of firm behavior. For example, researchers have applied Dunning’s eclectic paradigm (Guimon, 2016), merger and acquisitions theory (Deschamps and Lee, 2015), and the integration/responsiveness paradigm (Shams & Huisman, 2011) to various aspects of IBC behavior. However, while research into various aspects of international educational campuses abounds, there has been little research on the transition of IBCs into other missions, including research and economic development.

2.3 The French System

Of particular relevance to the case of GTL are two changes: the increased participation by French universities in the production of research and the changing role of French public research institutes (PRI) such as the National Centre for Scientific Research (CNRS). These trends stemmed from the dissolution of Napoleon’s University of France in 1896, when the regional faculties were christened “universities” but remained under the control of the central government. The research productivity of these universities was low (Malva et al. 2011), which led post-WWII France to diverge from other Western models of research funding to create public research institutions (PRI) with few ties to universities and staffed primarily by full time researchers (Mustar and Laredo, 2002). PRI were assigned research responsibilities while the universities and the grandes écoles focused on teaching.

The reform of the university system in the 1980s and 1990s sought to address this legacy of low university research productivity and low university autonomy. Mustar and Laredo (2002) observe that as a result of the reform, during the final years of the 1990s research positions in universities grew at a rate that was ten times faster than that of the CNRS and by the end of the decade the research potential (measured in full time equivalent research positions) of universities was more than two times that of the CNRS. Whereas in the 1970s, CNRS researchers outnumbered all of the researchers in French university system, university researchers now outnumber those in all of the French PRI (Malva et al. 2011). Additionally, the grandes écoles are increasingly participating in research. Besides a reversal in the relative proportion of the

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4 While the CNRS is (by a considerable margin) the largest PRI in France, other mission-oriented government research entities also contribute to France’s research output (Muller et al., 2009).

5 In France, the grandes écoles refer to group of roughly 200 elite, often small, technical, professional, and management focused institutions that operate independently from the public university system.
The majority of CNRS research units are currently *unites mixtes* (UM)—university-CNRS co-staffed labs (Muller et al. 2009). Two types of UM exist: UM *de Recherche* (UMR) and UM *Internationales* (UMI). The former are joint CNRS labs with local universities or *grandes écoles*. The latter are joint CNRS labs with international partners and can be located in France or abroad.

The CNRS has in-house research units of varying size. UMR labs are joint labs with domestic universities or *grandes écoles*. In these labs, faculty members hold joint (academic/CNRS) appointments. Such labs seek to expand collaboration between universities, *grandes écoles*, and PRI. UMI labs are similar to UMR, yet are established with international partners. They may be located in France (GTL’s GT-CNRS UMI was the first such lab) or abroad. Critically, UMR and UMI are not permanent; they undergo regular evaluation by the CNRS and may be, based on these results, either renewed or discontinued.

University autonomy was strengthened through legislation. The Innovation Act of 1999 (Law on Innovation and Research) gave French universities greater control over their intellectual property. A 2007 law (Law Relative to the Liberties and Responsibilities of Universities) that explicitly sought to increase the autonomy of French universities in terms of the direction of research, curriculum design, and finances has been largely successful. Dosso (2014) observes that by 2012, the majority of French universities were autonomous.

Besides the transformation of the French university, the period of 1980 to 2000 witnessed the creation of ties between publicly funded research and industry. The old French model notoriously characterized the absence of linkages between research and industry (Muller et al. 2009; Mustar and Laredo 2002). Two pieces of legislation are primarily responsible for strengthening ties between public research institutes and firms. First, a 1982 law (Law on Programming of Research and Technological Development) sought to strengthen connections between PRI and firms by adding commercialization of research to the missions of PRI, allowing the creation of legal forms that would facilitate spinoffs and public-private cooperation on large research projects, and allowing public researchers to physically locate within firms (Vavakova, 2006). Second, the Innovation Act of 1999 sought to enhance the impact of research on the French economy by promoting technology transfer from PRI and increasing the number of start-ups generated at such organizations (Vavakova, 2006).

French universities and *grandes écoles* are highly internationalized. For example, C-BERT has identified 34 IBCs that have been established by French institutions. France also hosts many internationalization initiatives from foreign universities. These activities tend to focus on education and research in the arts and humanities. Prominent foreign university outposts located in France include the University of London Institute in Paris and the University of Chicago Center in Paris. To date, GTL remains the only non-French education and research institution in France that focuses on science and engineering.

### 3. Data and Methods

To describe the evolution of GTL, this paper draws on three research methods: interviews, the quantitative analysis of scientific publications and patents, and the analysis of historical documents. Semi-structured interviews were conducted with managers (two former directors of GTL), university administrators (an associate vice president for international initiatives, the principal director for industry collaboration), one faculty-member closely linked with the campus, and three local business experts. Eight interviews were conducted over the period of November 2015 to January 2017. Interview protocols were developed based on an initial
examination of the documentary record and were iteratively updated as more was learned about
the campus’ history. When possible, interviews were conducted in-person. However, in the case
of the local business experts, a set of open-ended questions was emailed to the respondents. In
four cases, follow-up questions or portions of this manuscript were sent to interviewees to
validate the accounts provided.

The scientific publication data are from the Web of Science. Patent data are from the
Derwent Innovation Index. The processing and cleaning of both the publication and patent data
was conducted using Vantage Point (https://www.thevantagepoint.com/).

Finally, we examine the documentary record. We consider three primary sources of
historical documents. First, we examine minutes and agendas from meetings of Georgia Tech
governing bodies and transcripts of speeches given by Georgia Tech and GTL administrators.6
Second, we consult the archive of Georgia Tech’s student, faculty and alumni newspapers,
scholarly publications, and news reports. Third, we trace the evolution of content from the GTL-
related websites by consulting their archived webpages from 1996 to the present. Towards this
end, we use the Wayback Machine (https://archive.org/).

This mixed methods approach was used to triangulate the findings of the various sources
of evidence (Creswell and Plano Clark 2007). For example, the historic documents enabled
confirmation of interview subjects’ memories of early campus development activities. The
bibliometric and patent analysis likewise enabled triangulation with the documentary record and
present day observations obtained from the interviews.

4. Georgia Tech Engagement in Lorraine

4.1 Internationalization at Georgia Tech
According to Li et al. (2016), based on having established many research centers abroad,
Georgia Tech is one of the most internationalized research universities in the USA. Georgia Tech
has a dedicated internationalization strategy and includes amongst its strategic goals to “Extend
and leverage Georgia Tech’s impact around the globe.”7 However, our analysis of the
documentary record suggests that the success of GTL does not appear to owe to Georgia Tech’s
early and planned prioritization of internationalization. Rather, GTLs success may have driven
university-wide institutional support and plans for internationalization.

Envisioned in the late 1980s and launched in 1990, GTL was Georgia Tech’s first
experiment of its kind. Many of the IBCs formed during this period failed (Lane 2011). As
described below, the combination of location (France was more economically stable than many
early IBC hosts such as Japan), individual skill and effort, and continual support from the
Georgia Tech administration and regional authorities, allowed GTL to persist. This early success
appears to have driven institutional support for subsequent international initiatives. In 1998,
Georgia Tech established its second foreign educational and research venture, the Logistics
Institute Asia Pacific, jointly with the National University of Singapore. Other initiatives in
China, Ireland, and various Latin America countries followed. Finally, in 2016 Georgia Tech

6 These documents have been made publically available at the Georgia Tech Faculty Governance webpage.
http://facultygovernance.gatech.edu/
7 “Global Positioning Strategy”, Georgia Institute of Technology. Accessed online at
announced the establishment of its second IBC, which is located in Shenzhen, China and is jointly administered with Tianjin University.

4.2 Region of Lorraine
Lorraine is located in the northeast of France and shares a boarder with Germany, Belgium, and Luxembourg. The region’s population in 2014 was 2.35 million (3.6% of France’s population). The region is divided into four departments: Moselle, Vosges, Meurthe-et-Moselle, and Meuse. The region’s two largest cities are Metz (the capital of Moselle) and Nancy (the capital of Meurthe-et-Moselle). In 2016, Lorraine, along with Alsace, Champagne, and Ardennes, became part of the Grand Est administrative region.

Lorraine’s economy, especially the northeast, has been characterized by industrial decline. A traditional center of mining (low-grade iron ore, coal, and salt) and steel production, the region has lost much of its market share in these sectors to competition from aboard. The region’s most active current sectors are metallurgy, automotive, rubber and plastic, chemical, wood, and paper. In 2013, Lorraine’s GDP was USD $64.32 Billion and GDP per capita was USD $27,388, only 64% of that of France.

Particularly relevant to the present analysis is the region’s lagging science, technology, and innovation (STI) metrics. Lorraine has a well-developed research and higher education system, the largest actor of which is the University of Lorraine. Formed in 2012 from a merger of four regional universities, the University of Lorraine has 52 sites across the region and student enrollment of 52,000. Other educational institutions include regional branches of top private engineering schools like CentraleSupélec, Arts et Métiers ParisTech (ENSAM), and Supinfo. More than 4,500 scientists conduct research in 61 laboratories of the University of Lorraine, three Carnot Institutes for applied research, and local establishments of French PRI. Despite this seemingly strong capacity for research and education, the region’s spending on R&D as a portion of GDP is only 62% of the national rate and private spending on R&D is less than 40% of the national average. According to the 2014 Regional Innovation Scoreboard conducted by the European Commission, the Lorraine region is classified as an “innovation follower.” Table 1 provides a summary of the region’s major social, economic, and STI indicators relative to those of France.

Lorraine has undertaken several efforts to enhance its S&T profile. In 1983 the City of Metz under the leadership of Jean-Marie Rausch established a large science and technology park called “Technopôle Metz 2000” (now simply known as “Metz Technopole”), the future site of GTL, to attract high-tech firms and higher education institutions specializing in telecommunications and software (Blau, 1999). In 2006, the region drafted an economic development plan that focused on developing the region’s higher education, research, and innovation capacity. The plan resulted in the establishment of five Clusters (or Poles) of Scientific and Technological Research (PRST) to coordinate institutional collaboration in particular research areas, seven Research Federations for interdisciplinary research, and programs for infrastructural R&D support to regional businesses.

4.3 Georgia Tech-Lorraine

Georgia Tech-Lorraine (GTL), established in 1990, is located in Metz (Lorraine’s capital and largest urban center). A timeline of the major events in the campus’ history is presented in Table 2.

4.3.1 Georgia Tech Lorraine Timeline

GTL’s advent owes largely to serendipity, individual relationships, and the efforts of individuals. According to our interviews, the effort of Jean-Marie Rausch, the Mayor of Metz in the 1980s, to decrease Lorraine’s reliance on a fledgling iron ore sector and increase the region’s focus on technology drove early efforts to locate a branch of an US technical university in Metz. An individual, working at a French trade mission in Atlanta recommended that Rausch visit Georgia Tech in Atlanta.10 This trip resulted in the establishment of the contours of an agreement between Georgia Tech, Lorraine, the city of Metz, and Supélec (a local branch of the renowned grande école specializing in electrical engineering) that would bring GTL to Metz.

International branch campuses sometimes fail to last beyond a few years; once early administrative energy or funding erode and tensions between partners rise, they have trouble maintaining momentum (Lane 2011, Sidhu 2009, Mills 2009, Sharma 2014). GTL’s survival beyond this initial period appears to owe largely to the efforts of GTL and city leaders. Specifically, our interviews suggest that the “relentless” efforts of GTL’s first director and then later president Teddy Püttgen were instrumental in establishing GTL’s lasting presence.11 Furthermore, Rausch, who served as Mayor of Metz and at various region-level positions during the 1990s, was said to be a critical local ally in assuaging local sentiment that a US institution was “eating up scarce French resources.”12

During its early years the campus was focused mostly on graduate education, starting with Ph.D. and double Master’s degrees in Electrical and Computer Engineering with Supélec and only “a handful” of graduate students and faculty.13 Graduate degrees in Mechanical Engineering (1997) and Computer Science (2005) were added later. A successful GTL undergraduate study abroad program for Georgia Tech students was launched in 1998, resulting in a continuously growing student population in GTL and improved financial sustainability. In 2015, roughly 700 students attended GTL.14 Of these, approximately 625 were undergraduates, 25 were full-time GTL PhD students and 50 were master’s students. The vast majority of undergraduate students attending GTL at a given time are from the Atlanta campus. The educational exchange is reciprocal; GTL students also spend time on the Georgia Tech Atlanta campus. Indeed, GTL master’s students are required to spend a semester at the Atlanta campus to complete their eventual (dual) degree. Two groups of faculty are charged with the

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10 Authors’ interview, February 20, 2016
11 Authors’ interview, February 20, 2016
12 Authors’ interview, February 20, 2016
14 Authors’ interview, November 2, 2015
primary research and educational missions of the campus. The first group of full-time tenure track faculty constitutes the core research faculty. During the fall semester of 2015, there were 18 such faculty members. A second group of visiting faculty from the main Georgia Tech campus in Atlanta supplements this core group at any given time.

From the beginning, research was central to the announced mission of the newly established campus. During an interview, the Associate Vice President for International Initiatives for Georgia Tech indicated that the decision to pursue second and third missions reflected GTL planners attempt to mirror its parent institution: “GTL is patterned after Georgia Tech in that education, research, and economic development are closely intertwined.” However, efforts to institutionalize these missions started in 1996 with the agreement on founding of the GTL-CNRS Telecom UMR lab (Telecom Lab) specialized in research in fiber optics and telecommunications. Despite initial success in establishing industrial collaborations, this lab did not result in a prolonged increase in research and innovative output. The lab was discontinued in 2005. Sustained growth in research output and in GTL’s collaborative ties with the region were not achieved until the campus reestablished its collaboration with the CNRS in the form of GT-CNRS UMI (UMI Lab) in 2006. UMI Lab focuses on research in non-linear optics and dynamics; smart materials; and computer science.

From inception regional officials considered GTL a vehicle for economic development and innovation in Lorraine. However, attempts to stimulate commercialization of research in GTL – for example, by bringing Advanced Technology Development Center (ATDC), Georgia Tech’s renowned business incubator, to Metz Technopole (Blau, 1999) – repeatedly failed. Only recently, coincident with changes in the model of intellectual property (IP) management (Cross et al. 2014) and the launch of Lafayette Institute (Institut Lafayette, IL), GTL’s proof-of-concept venue for innovation in optoelectronics, have signs of success in commercialization begun to emerge.

4.3.2 Research in Georgia Tech Lorraine
To trace GTL’s transition into a research mission, we consider the research output of authors affiliated with GTL proper or either or GTL’s research units (i.e. Telecom Lab and UMI Lab). The first article produced by a researcher affiliated with Georgia Tech’s campus in Lorraine was published in 1992, two years after the campus’ opening. We found a total of 368 publications produced by GTL and its research units in the years that followed and up until the first six months of 2016. Figure 1 shows the growth of GTL’s publication productivity over time.

The publication data reveals two distinct phases of research production. The first phase begins in 1992 and lasts until 2005. During this period, GTL’s research output was modest (5.4 publications per year on average) and characterized by low average growth (0.3 articles per year). Indeed, Figure 1 demonstrates that this period is characterized by no clear growth trend and marked by several periods of declining research output. GTL’s first attempt to boost research output through collaboration with CNRS – by creating the Telecom Lab in 1998 – did not

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16 Author’s interview, November 2, 2015
generate sustained research growth. While the advent of the Telecom Lab may have resulted in a short-term increase in research productivity, reaching a peak of 11 publications in 2001, GTL’s research output fell during the subsequent three years.

The second phase of research production begins in 2005 and appears to persist to the present.17 Reversal of the negative trend in publications starts in 2005 and becomes more pronounced in 2006, when the GT-CNRS UMI 2958 laboratory (UMI Lab) was established. In the following years, GTL and its affiliated research units produced 27.4 publications per year on average, increased output at a rate of 2.2 publications per year, and reached a peak of 40 publications in 2015.

Even at its most productive, GTL’s contribution to overall research output in the region is modest. During its 27 years of operation, GTL produced only 3.3% of the WoS-indexed articles published by Metz-based authors, making it a fairly small player in the regional research system. Even at its highest point in 2015, GTL’s research output constituted only 5.7% of the city’s research output. Given that GTL is a small and specialized institution, its contribution is disproportionality high in certain fields. For example, in the field of Optics, a designated research priority both for the Telecom and UMI labs, GTL produced 15.6% of total Optics research output in Metz.

To further investigate the role of GTL in the region, we examine co-authorship patterns amongst the GTL publications. Table 3 presents the top ten institutional affiliations, broken down by publication year, of the co-authors listed on GTL publications. The table reveals a strong relationship between GTL and the main Georgia Tech campus in Atlanta. Indeed, 45% of the publications written by GTL authors had at least one Georgia Tech affiliated co-author. It is interesting to note that before 2005, the intensity of research collaboration between GTL and Georgia Tech was low. The start of productive collaboration between the two campuses coincides with the onset of the second phase of the GTL’s research productivity in 2005 and the establishment of the UMI in 2006.

[Table 3 about here]

CNRS is the second most active GTL collaborator with 38% of GTL publications co-authored with CNRS-affiliated researchers. This reflects the fact that collaborative relationships established by GTL with CNRS in the form of joint labs extend beyond the grounds of the GTL campus to include other CNRS research units. The intensity of CNRS collaborations significantly increased after UMI Lab was established in 2006.

The third most active GTL collaborator is the University of Lorraine (23% of all GTL publications). As noted above, the University of Lorraine was created in 2012 through the merger of four regional universities (one in Metz, three in Nancy), so this category includes publications by authors affiliated with the University of Lorraine proper, and its constituting members before the 2012 merger. In fact, almost all publications in the subset were produced in collaboration with the Metz campus of the University of Lorraine.

The rest of the list is dominated by French higher education institutions, most notably the Metz campus of Supélec (now called CentraleSupelec after the merger with École Centrale Paris in 2015), and several other universities and grandes écoles, who mostly collaborate with GTL.

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17 The publication counts for 2016 are truncated since publication data were only available for the first six months of the year at the time of our search.
through their joint labs with CNRS. With one notable exception, collaborations with these institutions also started only after 2005. Thus the post-2005 increase in collaborations suggests that GTL’s transition into a fully-fledged research mission coincides with an increase in GTL’s embeddedness vis-à-vis local knowledge networks.

The exception to this trend is the collaboration with the University of Franche-Comté (UFC), which began in 1998, the year of establishment of the Telecom Lab. A detailed look at the authorship of the corresponding publications and the content of archived webpages of the Telecom lab reveals the unique character of these collaborations, and also reveals a possible explanation for the failure of the laboratory to sustain its research productivity in the long run.

From the beginning, the Telecom Lab was organized as a close partnership between two sister CNRS labs, one in GTL and the other in UFC in Besançon (also in France), that from 1998 to 2001 shared the same director: UFC’s Jean-Pierre Goedgebuer. The majority of research personnel formally affiliated with the Telecom lab remained physically based at UFC in Besançon, with only one or two GTL faculty members contributing to joint research. As a result, GTL-affiliated publications were mostly produced by researchers affiliated with and physically located at UFC. Dr. Goedgebuer, director of both partnering labs, co-authored almost three quarters of these papers from 1998 to 2004 and these publications were overwhelmingly written in collaboration with authors from UFC. According to Dr. Goedgebuer’s Linkedin profile, he left UFC in 2001 and GTL in 2003. The latter year also marks the departure of several other key UFC-based researchers formally affiliated with GTL-CNRS Telecom. As a result, a steady decline in GTL’s research output (see Figure 1) and in its collaboration with UFC (see Table 3) followed. The Telecom lab struggled to sustain previous levels of output and was discontinued in 2005. Thus, the model initially selected for operating the joint laboratory – the one that was heavily reliant on close collaboration with external organizations at the expense of the development of its own research faculty – proved to be unsuccessful in the long run. In contrast, the UMI Lab was, from inception, launched as part of a broader network of CNRS laboratories with shared research interests with various universities and grandes écoles. The second attempt also increased the number of GTL’s permanent research faculty while building the collaborative network. Based on the significant and sustained growth in GTL research output that followed, it is this model of increasing research capacity that resulted in sustained GTL’s transition to the research mission.

On a country level, GTL most actively collaborated with organizations from the US (54% of total GTL publications), followed by France (41%), China (6.5%), Belgium (5%), and 27 other countries. The prominence of US collaborations is explained by GTL’s close ties with Georgia Tech’s main campus. In France, 63% of collaborative publications were authored by researchers from distinguished partners of the UMI Lab, and 58% by collaborators located within Lorraine, marking once again the embeddedness of the UMI lab within regional knowledge networks. Sixteen percent were produced in collaboration with industrial partners, including French corporations such as Thales, France Telecom / Orange, and PSA Peugeot Citroen. Steady research collaboration with industry began in 2007. However, the total volume of research output of GTL’s industrial R&D collaborations remains low. Patenting behavior, presented in the section that follows, is a better measure of the innovative activities in GTL.

Starting in 2008, data from the Web of Science includes funding acknowledgments, which provides an opportunity to analyze funding sources for research conducted in GTL (Grassano et al., 2016). Out of the total of 368 GTL-related articles, 156 have funding acknowledgments. Of these, 87 (56%) were funded by national-level French funding agencies,
including Agence Nationale de la Recherche (French National Agency for Research) and CNRS. Sixty publications (38%) were funded by US sources, primarily by the National Science Foundation and the Department of Energy, who supported US researchers involved in collaboration with GTL. Forty-six publications (29%) received research funding from local sources, primarily the Regional Council of Lorraine. These data offer another indication of links between the regional government and GTL.

4.3.3 Patenting in Georgia Tech Lorraine
To analyze GTL’s patent output, we use the Derwent Innovation Index (DII) patent database. An initial assignee-based search indicated that only four unique patents had been assigned to GTL or jointly to Georgia Tech and CNRS. However, given the shift in French university-related IP policies discussed in Section 2.3, as well as the evidence from interviews and from Cross et al. (2014) of changes in GTL IP policy in the 2010s, the search strategy was modified to include individual inventors affiliated with GTL. To this end, we created a list of potential GTL-affiliated inventors by analyzing the authors of the 368 GTL-related publications discussed in the previous section. From this list, we identified 36 GTL affiliated individual authors with at least five publications. We then manually searched the DII database for patents for which these individuals were listed as inventors during the time they were affiliated with GTL. This process revealed 19 GTL affiliated patents. For each of these records, the affiliation of all co-inventors was checked. Using the new co-inventors found to have a GTL affiliation, we searched for new GTL affiliated patents. While no new GTL patent records were found this way, this step brought the total number of GTL-affiliated inventors to 22.

Two distinct periods in GTL patenting are observed (Figure 2). The first is associated with the Telecom Lab and is characterized by steady patent output from 1998 to 2004. This flow stops around the time the unit closes. The second phase, which begins in 2005, can be associated with the activities of the UMI Lab and is characterized by less stable patent output.

[Figure 2 about here]

While GTL’s first CNRS research collaboration, the Telecom lab, produced modest and unstable research output, its patenting output was relatively high (11 patents in seven years) and stable. In contrast, the second period saw rapid expansion in research output yet relatively low (8 patents in twelve years) and volatile patenting. Considering the patent assignees and classifications helps to explain this unusual pattern. During the first period, seven out of the eleven unique patents were granted in 1998-2002 and assigned to France Telecom, a French telecommunications corporation. Two of them were co-assigned to Highwave Optical Technologies, another French telecommunications company. These patents fall into technology areas such as fiber optics and light control, telephone and data transmission systems, and optics; areas consistent with the declared research direction of Telecom Lab and the corporate assignees.

The remaining patents were jointly assigned to Photline Technologies, CNRS, or a group of individual faculty members co-affiliated with GTL and the University of Franche Comte (UFC). Photline Technologies was founded in 2003 by former UFC researchers that were listed on four of the GTL affiliated patents.\(^\text{18}\) The company, later acquired by the iXblue group,

\(^{18}\) Profile of Photline Technologies was reconstructed based on news sources in professional publications and press releases, including https://www.ixblue.com/news/photline-technologies-joins-ixblue-group and
became a leading producer of optical modulators for telecommunication, defense and aerospace, sensing, and research instruments. In 2012 it employed 30 people in Besançon. It seems that these GTL/UFC researchers developed a technology using resources from both universities and CNRS, and then quit academia in 2003 to commercialize it through a start-up firm. To date, Photline Technologies is the only known case of successful start-up related to GTL.

Patent analysis reveals a degree of industrial collaboration and applied research and development in Telecom Lab that is not evident in the publications analysis. For example, France Telecom is revealed to be an important funder of the core collective of researchers in the unit. The patents granted during this period were also part of large patent families (i.e., multiple patents granted on the same invention in different patent authorities), which suggests that they had fairly high expected commercial value.

However, despite early commercialization success, the Telecom Lab was not able to survive the exit of its director and some of its core members. Nor was this model of research organization conducive to regional economic development. While the start-up firm that emerged from the UFC/GTL/CNRS collaboration was successful in creating revenue and high-tech jobs, it did it in Besançon in the Franche-Comte region, rather than in Lorraine.

GTL’s patent output during the second period of patenting – 2005 to the present – is sporadic. During this second period, there are no individuals listed as assignees and all patents had more than one organization listed as assignees. The top assignee during this period is CNRS. The second most common assignee is Georgia Tech, suggesting that some, but not all, of the IP created in GTL was produced according to Georgia Tech’s internal IP regulations. Armines, a French public-private partnership focused on industry-oriented contract R&D, was another frequent assignee. Other non-university assignees include car manufacturer PSA Peugeot Citroën, global electronic systems producer Thales, and former telecommunication giant Alcatel – all French-born, multinational corporations with R&D units located in France that participated in research collaborations with GTL.

Patents produced during this period exhibited unusual diversity in terms of technology areas. Surprisingly, given the research specialization of GTL and the official designated foci of UMI lab and Lafayette Institute, there are no patents in Optics or Optoelectronics. Instead, the patents are for sensors for gas exhaust based on semiconductor materials, and for artificial human or animal ligaments. The latter, which is completely outside of GTL’s research focus, is the topic of all three patents with Armines. These patents appear to be the product of a chance, bottom-up collaboration between GTL mechanical engineering faculty members and industry rather than of a planned strategic activity. In contrast, the sensor patents were produced in organized collaboration with the recognized GTL industrial partner. In particular, two sensor patents granted in 2016 were co-produced in collaboration with PSA Peugeot Citroën in the framework of OpenLab – an open innovation network established in 2011 by the corporation. These patents probably represent the first outcome of GTL’s efforts to promote innovation activity by means of serving a boundary-spanning function within the region.

In summary, patent analysis indicates that GTL’s first innovation activity begins in 1998 through a productive R&D collaboration between Telecom Lab and France Telecom. However, this relationship did not endure and failed to produce a regional economic development impact. In 2006, the CNRS collaboration was reorganized as the UMI lab. The years following this

change could be characterized as a *laissez-faire* approach to innovation and IP management, with only occasional patents resulting from a bottom-up external collaborations of GTL faculty members. Then, around 2011, with the founding of PSA Peugeot Citroën OpenLab and changes in GTL’s IP policy, GTL once again adopted a proactive and strategic approach to managing and producing innovation. This new approach sought to place GTL in various boundary-spanning roles within the region with the goal of producing local economic impact.

### 4.3.4. Economic Development Mission

From the perspective of French officials, the rationale for bringing a US university to the region was the one of economic development. A new, technology focused research institution, sought to decrease Lorraine’s reliance on its declining iron ore sector. GTL was envisioned as providing academic and professional education programs to local high-tech firms and conducting industry-oriented research.

Towards this end, GTL was moderately successful: the campus established graduate education tailored to local demand, and briefly, established university-industry research in the form of the GTL-CNRS Telecom lab. However, by the end of the 1990s both sides of the Georgia Tech/Lorraine partnership sought to stimulate economic development through a different approach: the commercialization of GTL’s research. Beginning at least in 1998, several attempts to bring Advanced Technology Development Center (ATDC), Georgia Tech’s renowned business incubator, to Metz Technopole were made (Blau, 1999). However, these efforts failed. Our interviewees attribute this failure to two factors. The first is international differences in faculty attitudes towards risk and norms regarding the commercialization of research. The second is an incomplete innovation ecosystem in terms of the small number of venture capital support organizations, number of entrepreneurial mentors, and companies to serve as early customers in the region. ATDC provides services for founded companies rather than R&D projects at the pre-seed stage, while our interviews indicate that the French academics at GTL preferred to commercialize their research through the establishment of R&D partnerships with large corporations rather than risking their academic positions by starting a company.

Although the mission of promoting local economic development always remained amongst GTL’s stated strategic objectives, it was not until 2011 that this mission was supported by substantial action. First, in 2011 patents began to be assigned to directly Georgia Tech or GTL rather than to individual inventors. This was done to foster greater involvement of both organizations in the commercialization of patentable research.

Second, coordination of GTL’s economic development efforts was assigned to Georgia Tech’s economic development branch: Enterprise Innovation Institute (EI2). EI2 oversees all of Georgia Tech’s major initiatives in stimulating commercialization of research. Assigning economic development responsibilities to a stand-alone organization experienced in commercializing the research from an engineering school added to GTL’s overall commercialization capacity.

Third, GTL established a new industrial partnership. In 2011 OpenLab, a collaborative R&D effort between PSA Peugeot Citroën, UMI lab, Art & Metier Paris Tech *grand ecole*, and Centre Henri Tudor (Luxembourg’s public research institution) was formed. As opposed to the partnership with France Telecom, OpenLab was based on the model of open innovation, implying a more equitable collaboration, in which partners share both risk and rewards. The new

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19 Authors’ interviews, various dates.
partnership also differs from its predecessor in that it involves more linkages to the region of Lorraine and the surrounding region. As opposed to traditional contract-based university-industry research collaboration, these linkages increase the possibility for regional economic impact.

Finally, in 2014 the GTL-Lorraine partnership established the Lafayette Institute (IL): GTL’s proof-of-concept venue for innovation in optoelectronics, photonics, robotics, and advanced materials. The Lafayette Institute emerged from two sources of demand: university and local government. First, IL sought to advance GTL’s goal of improving and expanding its existing laboratory facilities. Second, Lorraine’s authorities sought to stimulate commercialization of technologies developed by the regional research system.

IL was conceptualized in 2005 by two Georgia Tech faculty members with strong professional and personal connections to the region. One of these faculty members, Abdallah Ougazzaden, was based in Metz and had strong local industry and university ties. The other, Bernard Kippelen, was based in Atlanta, but is a French national and also had professional ties to the region. In 2007, Ougazzaden and Kippelen presented the basic model for IL “to elected officials in France” after which the Institute’s formation proceeded “very rapidly.” Multiple interviews suggest that the 2010 France-Atlanta event was a watershed moment in IL’s establishment. During the France-Atlanta event, the first of what would become an annual event in Atlanta organized by the French Consulate General that seeks to promote economic cooperation between the two locations, the General Council of France in Atlanta (Pascal Le Deunff) played an important coordinating function. According to one interview, “the General Council of France in Atlanta invited the right people because you needed to have all the people from all of these government agencies around the table to sign the agreement.” In 2012, IL was approved for development with €30 million in funding provided by the governments of France, the Lorraine region, Metz Metropole, the department of Moselle, and the European Union (EU). The EU funds were provided through the European Regional Development Fund (ERDF). Operating expenses have been funded through a round of seed funding, the provision of services, and R&D grants. The contribution of Georgia Tech to IL has been to supply faculty members that hold leadership positions within the Institute and provide technical assistance associated with the operation of IL facilities.

IL was opened in 2014. It is located adjacent to the GTL campus and is furnished with nanofabrication equipment and a 5,000 square foot clean room. Its principal role is to provide proof-of-concept services and to investigate the commercial potential of the research conducted by its corporate and educational members. In addition, IL in collaboration with EI2 offers technology transfer services, business advice, and has an official objective of promoting

20 Authors’ interviews, November 2, 2015, and December 8, 2016.
22 Authors’ interview, November 2, 2015
23 Authors’ interview, January 21, 2017
24 Authors’ interviews, February 20, 2016 and January 21, 2017
25 Authors’ interview, January 21, 2017
27 Authors’ interview, January 21, 2017
knowledge-based regional economic development. For example, the EI2 has implemented the US National Science Foundation’s Innovation Corps (I-Corps) model of commercialization in IL. I-Corps brings together teams of faculty researchers and student entrepreneurs under the guidance of business mentors to test the market potential of ideas generated through basic research by conducting customer validation and providing market feedback. The I-Corps model, as opposed to the ATDC business incubation model, allows faculty to retain their academic positions while advancing the commercialization of their research in a highly structured manner. By the end of 2016, there were two cohorts of Lorraine-based teams that went through the I-Corps program at IL. It is too early to draw conclusions on their success or failure, although at the time of writing at least one team had begun to generate revenue. Nevertheless, the various actions described above – the changes in GTL IP policy, appointing EI2 in charge of commercialization, and establishing OpenLab and Lafayette Institute – suggest that GTL is attempting to become a significant player in Lorraine’s regional innovation system despite its relatively modest contribution to the net research output of the region.

5. Discussion
Over its 27 years of operation (1990-2016), GTL has undergone a transformation that broadly mirrors that made by the US university or large. At its founding in 1990, GTL was primarily an education-focused institution involved in awarding joint graduate degrees with local grandes écoles. Gradually it took on a research mission, which became fully institutionalized in 2006 with the establishment of UMI Lab. More recently, GTL has begun to assume commercialization and economic development functions.

However, GTL’s transition from education to research to economic development missions did not proceed linearly. Instead, these missions developed in a parallel rather than a serial manner and initial attempts to execute new missions often failed. Neither was the realization of these missions typically the result of strategic planning. Rather sustained expansion into new functional areas was often due to second attempts or opportunism.

A stylized depiction of GTL’s transition into new missions is provided in Figure 3. The striped arrows indicate the emergent state of a mission. This stage is characterized by unstable output resulting from early experimentation into a new mission area. Solid arrows indicate a fully adopted mission. These stages are characterized by sustained growth in corresponding outputs and a portfolio of associated activities. A brief summary of our observations for each GTL mission follows Figure 3.

[Figure 3 about here]

GTL’s initial focus was on the education mission. The campus initially offered a degree in electrical engineering and planned to expand into other engineering disciplines and management. Initial growth, in terms of students and adding new disciplines, was slow and not necessarily the result of early planning. GTL did not expand into other engineering disciplines until 1998 and the planned program in management was never realized. In 1996, the campus’ future was put on hold when a lawsuit from two French-language lobbying groups accused GTL...

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28 Authors’ interviews, December 2016
of using only the English language on its website.\textsuperscript{30} The case, however, was dismissed in 1997. Thus we consider the educational mission of GTL to have become fully developed in 1998 with the addition of undergraduate study abroad program that contributed to the financial sustainability of the campus and the successful expansion into new engineering disciplines.

It is worth noting that the 1996 lawsuit illustrates one facet of what Shams and Huisman (2016) refer to as the challenge of institutional dual embeddedness. The authors contend that IBCs simultaneously face pressure to conform to the institutions of their host countries and maintain the identity of their parent university while operating abroad. In the case of GTL, both of these pressures were evident. While the pressure to conform to the standard of the host is vividly illustrated by the 1996 lawsuit and the resultant press coverage, GTL also faced isomorphic pressure from its parent organization. For example, early in GTL’s operation there was ambiguity amongst the faculty and administration in regards to whether the campus’s faculty would be assessed according to French or American criteria. One interviewee explained that in this instance, the standard of the parent institution took president, stating, “gradually the American way of evaluating performance of faculty entered the French system.”\textsuperscript{31}

The research mission at GTL emerged near the start of the venture, with the first article with a GTL author affiliation published in 1992. Until 1998 research was slow to grow. In 1998 the advent of the Telecom Lab resulted in increased research output, but this lab eventually closed and the resultant research output was never stable. In 2006, with the forming of the UMI Lab, GTL’s research output and research collaborations entered a period of steady growth. Thus, GTL went through two distinct stages in developing its research mission: an initial stage which lasted until 2005 and was characterized by modest and unstable research output and organizational trial and error; and, since 2006, a second stage of sustained research growth and expansion of research collaborations.

In terms of the “third” mission, government officials hoped from the inception of GTL that the initiative would spur economic development and decrease the region’s reliance on legacy industries. However, it was not until the founding of the Telecom Lab in 1998-1999 that economic development language was explicitly used in discussions of the campus’ missions.\textsuperscript{32} During the Telecom Lab’s years of operation (1998-2005), it produced economic impact through industrial collaboration with France Telecom and through successfully spinning out of Photline Technologies. However, none of these activities were directly relevant to Lorraine. Other economic development efforts during this period such as the transfer of ATDC to Lorraine failed outright. It was not until 2010-2011 when a new set of initiatives was launched that GTL began to assume a viable local economic development mission. Among these activities were changes in patenting and IP management strategies, establishment of OpenLab, creation of Lafayette Institute, and the application of the I-Corps program into Lafayette Institute. It remains to be seen how successful these programs will be. However, the degree of involvement of GTL in regional economic development activities including the performance of boundary-spanning functions between the regional government, universities, and industry allows us to conclude that as of 2016, GTL had adopted its economic development mission.


\textsuperscript{31} Author’s interview, February 20, 2016

Based on our analysis of the evolution of Georgia Tech’s campus in Lorraine, in Table 4 we propose a system of key markers pertaining to the development of three key university missions: education, research, and economic development. The accumulation of markers associated with a given mission is meant to indicate first the emergence and then the full adoption of this mission. The application of the proposed system of markers to university activities at home and abroad, including the development of transnational campuses, can be compared with Guimon’s (2016) approach to analyzing university motivations to internationalize across three missions, and Youtie et al.’s (2006) framework for institutionalization of university research ventures. It is worth noting that the mission development process observed in GTL, and that implied in Table 4, represents but one evolutionary trajectory for research ventures operating abroad. Klerkx and Guimón (2017) consider the development of international centers of excellence in Chile and find that the import of applied research organizations from abroad need not begin with an education focus.

[Table 4 about here]

6. Conclusions
This article makes a contribution to the literature on international campuses, much of which focuses on transnational education, by offering an in depth case study of the process by which an international campus added research and economic development missions to its original educational mission. We view GTL as a good exemplar for testing this evolution because of its long history and efforts to integrate into a region pre-populated with educational, research, and economic development organizations and which itself is undergoing economic and educational transformation. If a campus is to evolve anywhere, it is likely to be in a host region that is experiencing changes in its educational, research, and economic ecosystems.

Our findings suggest that the extent to which a transnational education institution is able to adopt research and economic development missions may depend its creation of strong ties to local industry, universities, and government agencies. Our analysis indicates that sustained research output growth coincided with increased intra-regional research collaboration. Similarly, GTL’s attempts to advance the economic development mission unilaterally—through the transfer of the home university’s ATDC commercialization program—never materialized. Instead a partnership between Georgia Tech and multiple representatives of the local government has resulted in the creation of Lafayette Institute, which pairs applied research and commercialization capabilities.

These findings are well situated between the planned architecture and life cycle approaches of Pfotenhauer and colleagues (2016) and the home-host institution tensions (i.e. dual embeddedness) of Shams and Huisman (2011, 2016). The case study indicates the role of the planned approaches in the former as well as the need for attention to host capabilities in the latter. Although this paper represents a case study of a single transnational campus, its 27-year history suggests a life cycle pathway that can be tested in other case studies. The full adoption of the research mission occurred after more than a decade, while the adoption of the economic development mission transpired after more than two decades.

A useful extension would be to replicate the methods used in this case study—historic documents, interviews with home and host managers, and bibliometrics and patent analysis—to examine other transnational educational campuses which have been in operation for more than a decade. The transition markers provided above offer one potential means of facilitating cross-
case comparison. Case studies of longstanding transnational campuses situated in regions with fewer or more resources would be useful to understand the extent to which the findings in this case study hold true in regions with different education, research, and economic development capabilities. Exemplary of such an approach is a recent multi-method impact evaluation of the MIT Portugal Program (Hird and Pfotenhauer, 2017). This study uses a difference-in-difference approach, along with other impact evaluation techniques, to compare the research characteristics of program participants to a control group of non-participant researchers and finds the MIT Portugal Program to be effective in promoting cluster formation and research re-orientation. Additional research of this kind may prove valuable in understanding how transnational campuses evolve their missions under diverse conditions.
References


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Table 1: Socio-economic Profile, Lorraine and France

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Lorraine</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Economy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>64.32 Billion</td>
<td>2.81 Trillion&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>$27,388</td>
<td>$42,627</td>
</tr>
<tr>
<td>Household disposable income per capita</td>
<td>$17,377</td>
<td>$30,259</td>
</tr>
<tr>
<td><strong>Demographic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population (2014)</td>
<td>2.35 Million&lt;sup&gt;b&lt;/sup&gt;</td>
<td>63.9 Million</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>11.6%</td>
<td>9.9%</td>
</tr>
<tr>
<td>Labor Force</td>
<td>1.035 Million</td>
<td>26.23 Million&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Innovation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCT Patent Counts (2010, by inventor)</td>
<td>84</td>
<td>2484</td>
</tr>
<tr>
<td>PCT patents per 10,000 laborers&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.81</td>
<td>0.95</td>
</tr>
<tr>
<td>R&amp;D spending (as fraction of GDP)</td>
<td>1.22%</td>
<td>2.26&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Business enterprise expenditure on R&amp;D</td>
<td>0.56%</td>
<td>1.42%</td>
</tr>
<tr>
<td>Gross domestic expenditure on R&amp;D&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.40%</td>
<td>2.26%</td>
</tr>
<tr>
<td>Employment in Science and Technology</td>
<td>29.90%</td>
<td>32.30%</td>
</tr>
</tbody>
</table>

Note: All dollar figures in 2010 US Dollars, adjusted for PPP. Unless otherwise noted, data are 2013 OECD figures. Source: OECD (2015), "Regional economy", OECD Regional Statistics (database). http://dx.doi.org/10.1787/6b288ab8-en  
<sup>a</sup> World Bank, World Development Indicators, 2013 Figures  
<sup>b</sup> Projection by French Institute for Demographic Studies (INED)  
<sup>c</sup> 2012 figure  
Table 2: Timeline of Georgia Tech Lorraine’s Evolution

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>Lorraine Region and the State of Georgia sign a sistership agreement. Under its framework, the city of Metz is selected as the site for the new European extension of Georgia Institute of Technology (GT).</td>
</tr>
<tr>
<td>1990</td>
<td>Georgia Tech Lorraine (GTL) opens as GT’s first international campus. Jacques Faudon, first deputy mayor of Metz, is its founding President. The campus initially provides only a graduate program in Electrical and Computer Engineering.</td>
</tr>
<tr>
<td>1992</td>
<td>First research article with GTL affiliation is published. a</td>
</tr>
<tr>
<td>1996</td>
<td>Agreement is signed by GT and CNRS to establish a joint research lab at GTL.</td>
</tr>
<tr>
<td>1996</td>
<td>GTL becomes the subject to a much-publicized lawsuit from two French-language lobbying groups accusing GTL of using only the English language on its website. b</td>
</tr>
<tr>
<td>1997</td>
<td>The lawsuit is dismissed. GTL introduces French and German language websites.</td>
</tr>
<tr>
<td>1997</td>
<td>Graduate program in Mechanical Engineering is introduced.</td>
</tr>
<tr>
<td>1998</td>
<td>GTL starts hosting undergraduate study abroad programs of GT.</td>
</tr>
<tr>
<td>1998</td>
<td>Following 1996 agreement, GTL-CNRS Telecom Lab is opened in partnership with CNRS and the University of Franche Comte (UFC) in Besançon. c</td>
</tr>
<tr>
<td>1998</td>
<td>First patent is granted to inventors jointly affiliated with GTL and UFC. d</td>
</tr>
<tr>
<td>1999</td>
<td>Jacques Faudon retires. GTL director Hans “Teddy” Püttgen becomes GTL President. e</td>
</tr>
<tr>
<td>2003</td>
<td>Part of the UFC team leaves GTL-CNRS Telecom Lab. a, d</td>
</tr>
<tr>
<td>2005</td>
<td>GTL-CNRS Telecom Lab is discontinued.</td>
</tr>
<tr>
<td>2005</td>
<td>Computer Science graduate program is introduced.</td>
</tr>
<tr>
<td>2005</td>
<td>GT’s Provost Jean Lou Chameau becomes the 3rd President of GTL.</td>
</tr>
<tr>
<td>2006</td>
<td>Jean Lou Chameau leaves GT/GTL to become the President of Caltech. GTL director Yves Berthelot is appointed as the next President of GTL.</td>
</tr>
<tr>
<td>2006</td>
<td>GTL Strategic Plan is developed.</td>
</tr>
<tr>
<td>2006</td>
<td>GT-CNRS UMI Lab is established in partnership with CNRS and the network of French universities and grandes écoles.</td>
</tr>
<tr>
<td>2009</td>
<td>Branch of GT-CNRS UMI Lab opens in Georgia Tech’s home campus in Atlanta.</td>
</tr>
<tr>
<td>2010</td>
<td>Official agreement to establish the Lafayette Institute, a $30 million facility aiming to commercialize innovation in optoelectronics, is signed by GT, the Regional Council of Lorraine, and the Moselle General Council.</td>
</tr>
<tr>
<td>2011</td>
<td>French car manufacturer PSA Peugeot Citroën establishes OpenLab with GT-CNRS UMI.</td>
</tr>
<tr>
<td>2013</td>
<td>Agreement on establishment of GT-CNRS UMI Lab’s branch in Morocco is signed.</td>
</tr>
<tr>
<td>2014</td>
<td>Lafayette Institute opens.</td>
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<tr>
<td>2015</td>
<td>I-Corps program is launched at Lafayette Institute. f</td>
</tr>
<tr>
<td>2016</td>
<td>First patent assigned directly to GTL (jointly with CNRS and PSA Peugeot Citroën). d</td>
</tr>
</tbody>
</table>


a Authors’ analysis of GTL-affiliated publications in the Web of Science data base.

d Authors’ analysis of GTL-related patents in the Derwent Innovation Index data base.
f Authors’ interview, December 8, 2016.
Figure 1: Georgia Tech Lorraine Publications Indexed by Web of Science by Year, 1992-2016

Source: Authors’ analysis of GTL-affiliated publications in the Web of Science data base, accessed on July 7, 2016. Search query is “(Georgia SAME Lorraine) OR (Georgia SAME UMI SAME France) OR (Georgia SAME CNRS SAME France) OR (GT SAME UMI SAME France)” in the “Address” field. Total number of publications is 368.
**Table 3: GTL Top Co-author Institutions by Publication Year, 1992-2016**

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Source: Authors’ analysis of GTL-affiliated publications in the Web of Science database, accessed on July 7, 2016. Total number of publications analyzed is 368. Numbers for French institutions include publications of their joint UMR research units with CNRS.

\(^a\) Numbers for CNRS include publications produced by in-house research units and joint UMR labs with other institutions, but exclude two joint research units with GTL: GTL-CNRS Telecom and GT-CNRS UMI.

\(^b\) Numbers for the University of Lorraine before 2012, the year of its establishment, include publications of its four constituent regional universities, dominated in this case by the University of Metz.

\(^c\) In 2015, Supélec merged with École Centrale Paris and became CentraleSupélec.

\(^d\) Arts & Métiers ParisTech is the brand name of École nationale supérieure d'arts et métiers (ENSAM), adopted in 2007.
**Figure 2: Basic patent years for GTL-related patent families indexed by DII.**

Source: Authors’ analysis of GTL-related patent records in the Derwent Innovation Index data base, accessed on October 14, 2016. Total number of records is 19.
Figure 3: Timeline of Evolution of GTL’s Education, Research and Economic Development Missions

Source: Authors’ analysis of historical data related to GTL evolution over time.
Table 4: Markers of GTL Transition Across Three University Missions.

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<tr>
<th>Mission Markers</th>
<th>Adoption by GTL</th>
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<td><strong>Educational Mission (E)</strong></td>
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<tr>
<td>E1.1: Degree programs</td>
<td>1990-present</td>
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<tr>
<td>E1.2: Variety of degrees on offer</td>
<td>1998-present</td>
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<tr>
<td>E2: Professional training</td>
<td>1990-present</td>
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<tr>
<td>E3: Student exchanges</td>
<td>Graduate: 1990-present</td>
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<td>Undergraduate: 1998-present</td>
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<tr>
<td>E4: Permanent academic faculty in location</td>
<td>1990-present</td>
</tr>
<tr>
<td>E5: Sustained growth in student population</td>
<td>1998-present</td>
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<tr>
<td><strong>Research Mission (R)</strong></td>
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<tr>
<td>R1.1: Publication activity</td>
<td>1992-present</td>
</tr>
<tr>
<td>R1.2: Sustained research productivity</td>
<td>2006-present</td>
</tr>
<tr>
<td>R2: Research facilities and equipment</td>
<td>1990-present</td>
</tr>
<tr>
<td>R3: Specialized organizational units (labs, research centers)</td>
<td>1998-2005 (GTL-CNRS Telecom)</td>
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<tr>
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<td>2006-present (GT-CNRS UMI)</td>
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<tr>
<td>R4: Significant permanent presence of research personnel in location</td>
<td>2006-present</td>
</tr>
<tr>
<td>R5: External funding sources for research</td>
<td>1990-present</td>
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<tr>
<td><strong>Economic Development Mission (D)</strong></td>
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<tr>
<td>D1.1: Patenting activity</td>
<td>1998-present</td>
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<tr>
<td>D1.2: Pro-active IP management</td>
<td>2011-present</td>
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<td>D1.3: Technology transfer (licensing, joint patenting, etc.)</td>
<td>1998-2002 (France Telecom)</td>
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<td>2016 (PSA)</td>
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<td>D2: Partnerships with firms</td>
<td>1998-2002 (France Telecom)</td>
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<td>2011-present (PSA, Alcatel, Thales)</td>
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<tr>
<td>D3: Start-up and spin-off companies</td>
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<tr>
<td>D4: Infrastructure and support for innovation</td>
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<tr>
<td>D5: Regional boundary-spanning functions (networks, brokerage, liaison, events)</td>
<td>UMI (2006-present)</td>
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<td>OpenLab (2011-present)</td>
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<td>Lafayette Institute (2014-present)</td>
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Source: Authors’ analysis of historical data related to GTL evolution over time, and patents and publications related to GTL.