

**Case Studies for the
Research Triangle Foundation's
Global Convergence Center**

Prepared for: Anna Penner, Research Triangle Foundation

Prepared by: Tyseer Khaled
Master of Public Policy Candidate
The Sanford School of Public Policy
Duke University

Faculty Advisor: Professor Pope McCorkle

April 18, 2014

Executive Summary

As the Research Triangle Foundation proceeds to implement its 2011 Master Plan for the Research Triangle Park (RTP), the Global Convergence Center will likely play an important role as a centerpiece and symbol for the park. The Foundation envisions the Convergence Center as a campus for cutting-edge, collaborative research that serves as a common ground where Triangle university researchers can work together. In addition to building RTP's reputation as a premier research hub in both the United States and the world, the Convergence Center could contribute to local economic development by leading to entrepreneurial spin-offs from the research conducted at the center.

This paper seeks to help answer what the Research Triangle Foundation can do to develop a center that is cutting-edge, collaborative, and draws on local talent. We explore three case studies: the MIT Media Lab, multi-university teams, and RTI International. The MIT Media Lab serves as an example of cutting-edge research. The study of multi-university teams provides insight on effective collaboration, and RTI International serves as an example of how an organization attracted local talent. These case studies point to some best practices that may guide the Foundation's design of the Convergence Center.

Best Practices:

1. Select a leader for the Convergence Center that has deep relationships with the Triangle universities and has worked across academia and industry.
2. Develop a unifying vision for research that the Convergence Center will host.
3. Ensure researchers and administrators have ample opportunity to develop relationships with industry.
4. Reduce faculty concern about working with industry by creating processes that match faculty interests with market or industry needs.
5. Reduce and eliminate the organizational boundaries that researchers must work across.
6. Recruit diverse teams from uncommonly grouped areas of research.
7. Recruit prestigious researchers and leverage their reputation to attract more talent and research dollars.
8. Ensure that the Global Convergence Center offers a unique research opportunity that cannot be found at local universities.

Table of Contents

Introduction	4
Methods.....	6
Case Study 1—MIT Media Lab.....	7
Case Study 2—Multi-university Teams.....	16
Case Study 3—RTI International.....	22
Best Practices.....	27
Conclusion.....	29
Appendix—A: Media Lab Research Groups.....	30
Appendix—B: Wiesner Building/Media Lab Research Group.....	32
Appendix—C: Works Cited.....	33

Introduction

As the Research Triangle Foundation implements its long-term strategic plan for the Research Triangle Park (RTP), the proposed Global Convergence Center will undoubtedly play an important role as a centerpiece and symbol for the future of the park. In partnership with the Research Triangle Foundation, The Triangle Universities Center for Advanced Studies Inc. (TUCASI), has driven the vision for the Global Convergence Center. TUCASI envisions the center as a campus that would create opportunities for “interaction, discovery, and a collision between world-class thinkers and doers,” and offer spaces for labs, start-ups, and venture capitalists.¹ At the center, multi-disciplinary, multi-institutional teams could work on large problems like clean tech, food and water challenges, and the management of big data. Smedes York, chair of the TUCASI Board of Trustees, emphasizes that the convergence center will be complementary to TUCASI organizations.² In the words of the TUCASI white paper on the center:

It will cement the historic and vital role of the universities as the Park’s true value proposition and serve as a powerful magnet to attract new companies, leading innovators, and engaged scholars to the state.³

Beyond creating new avenues for research collaboration, the Global Convergence Center can also serve as a physical symbol of RTP and an asset that makes the Triangle universities more competitive for federal funding. Bob Geolas, CEO of the Research Triangle Foundation, board member of TUCASI and key supporter of Project Archie, hopes for a powerful symbol. He imagines a center that is “a mix between a Guggenheim, a World’s Fair and the Epcot Center. You’ll have something unlike anything anyone is doing in the world today.”⁴ He imagines a place where researchers work alongside scientists from RTP companies to address far reaching problems like solar energy.⁵

¹ TUCASI, Inc. “Project Archie.” White paper. [No date available].

² Ohnesorge, Lauren. “Convergence center in middle of RTP’s extreme makeover.” Triangle Business Journal. September 27, 2013.

³ TUCASI, Inc. “Project Archie.” White paper.

⁴ Ohnesorge, Lauren. “Convergence center.”

⁵ Ibid.

By combining research strengths of local universities and companies, Geolas believes the convergence center can create a symbiotic relationship for the universities. Geolas points out that UNC does not have an engineering program, but NCSU does. On the other hand, NCSU does not have a medical department but UNC does. The ability to leverage each institution's strengths to fill gaps like these makes the center even more important.⁶ Moreover, the ability to cite multiple universities and third parties like RTP companies on federal grant applications will make will increase Triangle applicants' chances of winning government dollars. Joseph DeSimone, director of UNC's Kenan Institute, board member of the Foundation, and preeminent university scientist, reinforces this message: "we have got to make it easier for our faculty to come together, to team, so that we can be competitive in Washington for federal research dollars."⁷

Today, the challenge for RTF is to identify how to get there—which brings us to this paper's policy question. What can the Research Triangle Foundation do to develop a research center that is cutting-edge, collaborative, and draws on local talent? The Methods section will discuss how we chose to answer that question. The Case Studies section will explore the MIT Media Lab, the literature on multi-university research teams, and the birth of RTI International. The Best Practices section will highlight lessons learned from these case studies. The Conclusion will discuss next steps and remaining questions.

⁶ Ibid.

⁷ Ibid.

Methods

To answer this policy question, we chose to focus on comparable organizations for examples of cutting edge-research, collaboration, and leveraging local talent. The literature on co-located multi-university collaborative research centers is scarce. It's challenging to find information on what these centers should look like or how their success should be measured. If we add to our search through the literature an additional filter—that we would like studies on physical multi-university collaborative centers that aim at entrepreneurial spin-offs, innovative research, and maintains an identity similar to RTP—then the literature is even scarcer. Therefore, we thought it best to approach this challenging question through a broader lens of understanding the stories of other organizations that mimic the center's intended traits (i.e. cutting-edge, collaborative, and local) and then to draw out insights. These insights, grouped as Best Practices, are simply lessons that we found useful, but don't necessarily conclude all the insights from these studies.

The three case studies are on the MIT Media Lab, the literature on multi-university research teams, and the birth of RTI International. The MIT Media Lab represents a great example of a center that conducts cutting-edge and multi-disciplinary research. The literature on multi-university research teams provides a good view of the challenges teams face when collaborating across organizational boundaries. Finally, the birth of RTI International is an important story to explore because like the Convergence Center it relied on relationships with local universities to grow and expand.

Case Study 1—MIT Media Lab

In this first case study, we will explore the birth of MIT’s storied Media Lab. Founded in 1985, the MIT Media Lab is dedicated to creating disruptive technologies by “actively promoting a unique, antidisciplinary culture...[that] goes beyond known boundaries and disciplines, encouraging the most unconventional mixing and matching of seemingly disparate research areas.”⁸ The Media Lab has an annual operating budget of about \$45 million, has 28 associated principal investigators and faculty, 146 associated graduate students (66 PhD, 80 Master’s), and offers a graduate concentration in Media Arts and Sciences.⁹ In the spirit of anti-disciplinary learning, graduate students must take a mix of classes like epistemology, holography, signal processing, filmmaking, experimental psychology, and computer science.¹⁰ The lab tries to ask questions that haven’t been thought of but that could greatly improve how “people live, learn, express themselves, work, and play.”¹¹ Today, the lab works on more than 350 projects under 25 research groups.¹² Directors lead research groups, which have names like Design Fictions, High-Low Tech, Civic Media, and Opera of the Future.¹³ The Media Lab has also successfully produced many spin-offs, some of which are well-known like BuzzFeed and Elance.¹⁴

The MIT Media Lab represents an example of a leader in unique, cutting-edge research. We’ll examine the beginnings of the MIT Media Lab to understand what it took to get it off the ground. The Media Lab provides lessons in the importance of leadership, vision, industry relationships, and faculty culture.

The leader behind MIT’s Media Lab: Nicholas Negroponte

The Media Lab’s 24 year pursuit of a unique brand of innovation began in 1985, with its founder Nicholas Negroponte. Growing up in New York as the son of a Greek shipping magnate,

⁸ MIT Media Lab, “About,” <<http://www.media.mit.edu/about>>.

⁹ Ibid.

¹⁰ Stewart Brand, The Media Lab: inventing the future at MIT, p.11

¹¹ MIT Media Lab, “About.”

¹² Ibid.

¹³ MIT Media Lab, “Group Projects,” <<http://www.media.mit.edu/research/groups-projects>>, see Appendix A for full listing of research groups.

¹⁴ MIT Media Lab, “Spin-offs,” <<http://www.media.mit.edu/sponsorship/spin-offs>>.

Negroponete was exposed to business leadership at an early age. He is also just one person in a family of very accomplished persons. His brother, John Negroponete is a former US Deputy Secretary of State, and his other brother, Michael Negroponete, is an Emmy-award winning film maker.¹⁵ Nicholas Negroponete obtained his undergraduate and master's degrees in architecture from MIT,¹⁶ and in 1966, MIT accepted him to a faculty position. The following year, he began MIT's Architecture Machine Group.¹⁷ The Media Lab grew out of the Architecture Machine Group and today, still remains under MIT's School of Architecture and Planning.¹⁸

In 1980 Nicholas Negroponete and Jerome Wiesner, former Science Advisor to President Kennedy and former President of MIT (1971-1980), developed the original idea for the lab.¹⁹ When the Media Lab opened its doors at the Wiesner Building in 1985,²⁰ Negroponete became the director of the Lab. In Stewart Brand's 1988 book, The Media Lab: Inventing the Future of MIT, Brand describes Negroponete as breaking the mold for a faculty director. Brand narrates how Negroponete was equally comfortable in both academic and business worlds. Negroponete was an "amphibian" giving "value to both worlds, taking an amphibian's advantage in both worlds."²¹ He could hobnob with CEOs, chairmen of large corporations, and executives from government research offices.²² He was a road warrior who, along with Jerome Wiesner, spent months out of the year demoing and selling the concept of the Media Lab to potential sponsors.²³ Negroponete had a unique branding in the two worlds. In a university setting, he had the polish of a jet-setting executive and the drive of a hard-charging businessman.²⁴ In business settings, he was the esteemed scholar, representing the intellectual perspective of the

¹⁵ Wikipedia, "Nicholas Negroponete," <http://en.wikipedia.org/wiki/Nicholas_Negroponete>.

¹⁶ Ibid.

¹⁷ Ibid.

¹⁸ MIT Media Lab, "MIT Media Lab," Facebook, <<https://www.facebook.com/mitmedialab/info>>.

¹⁹ MIT Media Lab, "MIT Media Lab," Facebook, and Wikipedia, "Jerome Wiesner," <http://en.wikipedia.org/wiki/Jerome_Wiesner>.

²⁰ See Wiesner Building in Appendix-B

²¹ Brand, p.6-7

²² Ibid.

²³ Brand, p.6-7,11

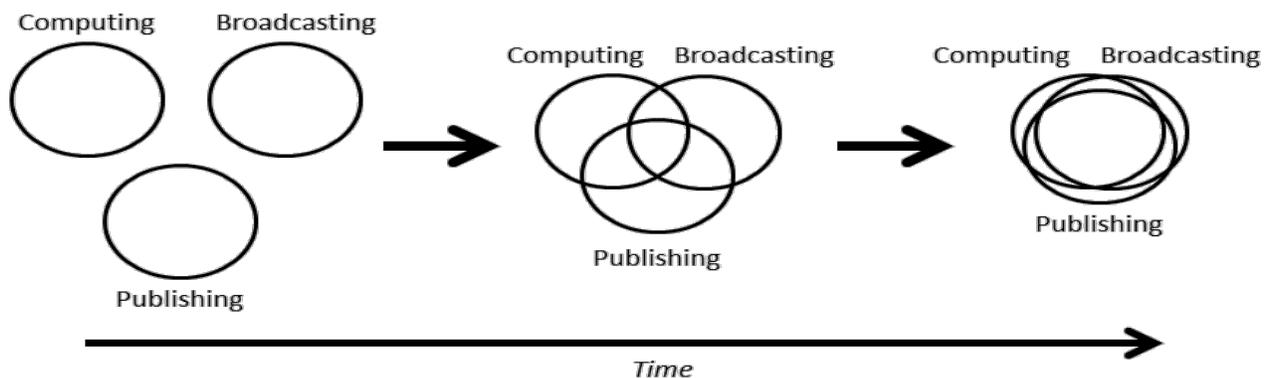
²⁴ Brand, p.6-7

prestigious engineering university.²⁵ Through years of road shows, Negroponte and Wiesner were finally able to generate funds needed to establish the lab.²⁶

The convergence model and the lab's initial projects

By 1987, the Media Lab took on more structure and comprised 11 groups. In this first generation of Media Lab initiatives, the Lab's groups and projects strongly reflected its vision. Brand describes Negroponte's vision as a model of *convergence*.²⁷ Negroponte used the model as a marketing symbol. It consisted of 3 circles, with the circles titled, computers, broadcasting, and publishing.²⁸ Looking into the future, Negroponte said:

We foresaw the coming together of these three industries, which previously were completely distinct...We saw the richest and most promising areas of research and development at their intersections. One of the goals of the Media Lab was to deal deliberately with the middle intersection, where you couldn't find much that was successful yet.²⁹



Negroponte demo'ed the convergence model in his roadshow before the inception of the Media Lab, and he viewed this intersection as fertile for research—predicting that the circles would converge over time.³⁰ Ideally, the Lab would jump ahead of others in finding the intersections.

²⁵ Ibid.

²⁶ Brand, p.11

²⁷ Brand, p.10

²⁸ Ibid.

²⁹ Brand, p.10-11

³⁰ Hugh Dubberly, "Extending Negroponte's Model of Convergence," *Interactions*, p.74-75

Another important dimension of the vision and culture of the Lab was its “demo or die” spirit.³¹ In academia, the mantra of a budding researcher is “publish or perish.” Obtaining a tenured position in a university is based on prolific or high visibility in publishing research. At the Media Lab, researchers certainly write books and papers, yet the litmus test of success is not publication. The researcher or team must demonstrate their idea through a real performance or else risk losing resources to other researchers.³² The Lab is more about application and invention and less about pure scholarship.³³ The Lab finds that visiting representatives from industry are more attracted to the type of technology that they can see, feel, and be dazzled by. Thus, in addition to its anti-disciplinary culture, the Media Lab’s “demo or die” trial-by-fire is another way it creatively reframes how institutions address the interaction between research and the real world.³⁴

In the chart below, we outline the project groups that Brand identified.³⁵ Although the projects represent a wide variety of topics, they are thematically unified by Negroponte’s media convergence model. The period of sponsorship also varied from extending over a year to others that could be more than five years.

	Project	Sponsorship	Example
1	Electronic publishing	\$1M IBM	electronic books
2	Speech	\$500K DARPA, Nippon Telephone and Telegraph	phones that recognize callers
3	Advanced Television Research Program	\$1M ABC, NBC, PBS, 3M etc.	TVs with computer intelligence
4	Movies of the Future	\$1M Warner Bros, Columbia, Paramount	digitization of movies

³¹ Brand, p.4

³² Ibid.

³³ Ibid.

³⁴ Brand, p.15

³⁵ Brand, p.12-13

5	Visible Language Workshop	\$250K Polaroid, IBM, others	cure the ugliness of computer graphics and design
6	Spatial Imaging	\$500K GM, DARPA	holography
7	Computers and Entertainment	\$300K	artificial intelligence
8	Animation and Computer Graphics	\$300K NHK and Bandai	real-time computer animation
9	Computer Music	\$150K System Development Foundation	music cognition
10	School of the Future	\$1M IBM, LEGO, Apple, MacArthur, NSF	computers in grade school
11	Human-machine Interface	\$200K DARPA, NSF, Hughes	machines that read lips and eyes

This project list demonstrates the great extent to which industry was involved with supporting the work of the Media Lab. Due in no small part to Negroponte, the Lab was able to foster deep relationships with companies across major industries. Companies bought into the pay-for-research proposition because Negroponte’s salesmanship convinced them of the business value in the Lab’s anti-disciplinary research.

MIT builds industry relationships

Negroponte and Wiesner were the stalwarts behind the Lab’s industry sponsorships. As long-time faculty and administrators, they were experienced in how the larger university built relationships with industry. In University-Industry Partnerships in MIT, Cambridge, and Tokyo: Storytelling across boundaries, Sachi Hatakenaka describes MIT’s deep relationships with government and industry. The university—not just the Media Lab—encourage its professors to

spend up to 20% of their time toward external consulting or other lucrative endeavors.³⁶ This policy allows faculty to build a broader set of touch points with industry, laying the groundwork for future collaboration and sponsorship. The faculty's industry connections would lead them to roles like serving on the board of directors for companies and accepting full-time opportunities to work in industry research.³⁷ In essence, faculty who crossed the university-industry boundary helped create deep relationships with private sector research. These relationships led to new collaborative opportunities like partnerships, consortia, and strategic alliances, which further enhanced boundary-crossing by introducing other faculty to industry.³⁸

At the same time, MIT administrators play a critical role in building relationships with industry. According to Hatakenaka, professional administrators play the role of creating a "template" for industry relationships—meaning structures like strategic alliances or consortia that can be replicated and repeated.³⁹ Oftentimes the best type of professional administrator is one who also has background as a researcher. MIT's professional administrators frequently begin as researchers and then transition to administrative leadership.⁴⁰ Having lived research, they speak the language of researchers and understand their environment, making them capably disposed to connecting administration with faculty. Administrators at MIT tend to play 3 specific roles in developing relationships: they managed external boundaries; they replicated lessons learned from one situation to another; and they focused on scaling up projects.⁴¹ One example of a success was an administrator who was recruited to MIT in the early 1990s as a corporate relations officer.⁴² He had around 20 years of research and development experience at a technology company and was an active alumnus from MIT.⁴³ The administrator, who is not named, became a hero in terms of developing corporate relations because of his background

³⁶ Sachi Hatakenaka, University-industry partnerships in MIT, Cambridge, and Tokyo: storytelling across boundaries, p.6

³⁷ Hatakenaka, p.108

³⁸ Ibid.

³⁹ Hatakenaka, p.110

⁴⁰ Ibid.

⁴¹ Hatakenaka, p.109

⁴² Hatakenaka, p.99

⁴³ Ibid.

with his technology company, his personal connection to MIT, and his larger familiarity with the culture and organization of MIT.⁴⁴

Indeed, the 1990s was a testament to his and other administrators' work in developing relationships. The chart below illustrates how MIT was able to enter into collaborations over 6 years that would lead to over \$250 million of industry funding.⁴⁵

Year	Company	Amount (millions)	Period (years)	Benefits
1994	Amgen	\$30	10	Brain and cognitive science research
1997	Merck	\$15	5	Brain and cognitive science
1997	Ford	\$20	5	All MIT
1998	NTT	\$18	5	Artificial Intelligence Lab, Computer Science Lab
1999	Merrill Lynch	\$20	5	Sloan Business School, engineering
2000	DuPont	\$35	5	Chemical and biomedical engineering, biology,
1999	Microsoft	\$25	5	All MIT
2000	Nanovation	\$90	5	Microphotonic Center
2000	Hewlett-Packard	\$25	5	All MIT
	Total	\$278		

With so much collaboration between industry and university, it was also important to match university and industry research cultures as well as earn support from executive leadership. Although the data above demonstrate the successful results of collaborative ventures, not every effort ended in success. Hatakenaka notes that many examples of collaborations were

⁴⁴ Ibid.

⁴⁵ Ibid.

negotiated between university and industry but later dissolved.⁴⁶ In some cases, a strategic alliance dissolved because the industry sponsor lacked a research culture.⁴⁷ In other cases, a match between the corporate research activities and faculty research interests was too difficult to find.⁴⁸ Yet in other cases, despite executive endorsement of the strategic alliance, there wasn't enough endorsement from the research and development arm of the corporation.⁴⁹ Thus lack of alignment between corporate and academic leadership and research groups often threatened failure.

Getting faculty onboard

Faculty in academic institutions tend to be critical of collaborations with industry, fearing undue corporate influence.⁵⁰ To assuage these concerns, MIT administrators had to develop a mechanism that would suitably match faculty interest with industry interest—thereby reducing faculty fears of losing autonomy.⁵¹ MIT's solution was to rely on a proposal-based system, where no researcher would be forced to march down a specific route.⁵² Individual researchers would submit proposals to a committee consisting of corporate and MIT representatives, which would then assess its potential. Faculty also worried what would happen if a corporate sponsor unpredictably withdrew out of a collaboration.⁵³ MIT addressed this concern by writing contingency clauses into agreements that protected researchers from unexpected corporate exits.⁵⁴

Co-location also turned out to be important to faculty. One MIT researcher commented on his experience in working with an external counterpart. He says:

It's definitely best to have a visiting scientist here (with whom) we can be collaborating on a day-to-day basis. It's so much easier when you can walk down

⁴⁶ Hatakenaka, p.101

⁴⁷ Ibid.

⁴⁸ Ibid.

⁴⁹ Ibid.

⁵⁰ Hatakenaka, p.100

⁵¹ Ibid.

⁵² Ibid.

⁵³ Ibid.

⁵⁴ Ibid.

the hall, and not only that, it's so much better when you're working on a joint project.⁵⁵

By prioritizing buy-in, MIT saw faculty culture change over time and respond more positively to sponsored collaborations. Below are some quotes that highlight the experience of researchers.

- (i) One former academic recalls the suspicion originally present among faculty.

Almost all my research has been supported by industry—but I was an exception not the rule. Most of the faculty have had and still do have their money coming from the federal government. So, there was a suspicion of industry.⁵⁶

- (ii) Then as collaboration increased and faculty concerns were addressed, administrators observed a cultural shift:

Another change is that a larger and larger fraction of them [faculty] are getting interested in working with industry and are realizing that you don't have to sell your soul to do so. And that interaction with industry can be very beneficial to the academic process if managed right. A lot of them used to think that it was inherently contaminating.⁵⁷

- (iii) Finally, some researchers' experience of collaboration acted as an accelerator for exposing them to new possibilities.

It was the most intellectually interesting interaction I had in that period of time...because I didn't have company connections, and there was a whole industry side of the (the field). And, if I hadn't had that exposure, I would have been excluded from that interaction, because I'm not on the board of any small companies...this was my access to it. And, I think, without it I would not have been able to keep abreast of what was really happening in the field.⁵⁸

⁵⁵ Hatakenaka, p.108

⁵⁶ Hatakenaka, p.104

⁵⁷ Ibid.

⁵⁸ Hatakenaka, p.101-102

Case Study 2—Multi-university Teams

Team structure and innovation

An important part of the vision for the Foundation’s convergence center focuses on creating a symbiotic relationship between the Triangle universities that will foster multi-disciplinary and multi-institutional teams. Although a great case study on how one institution does research differently, the MIT Media Lab does not represent a case study in multi-institutional collaboration. At best, the Media Lab is multi-institutional in that it is between one university and many corporations.

However, the Global Convergence Center as envisioned by TUCASI hinges on collaboration between several non-profit *universities*. The literature is slim on case studies of specific multi-university collaborations. However, one can certainly find literature that studies challenges facing multi-university collaborations.

In their 2010 article, “The Mechanisms of Collaboration in Inventive Teams: Composition, Social Networks, and Geography,” Janet Bercovitz and Maryann Feldman analyze the purpose and ideal parameters for productive collaborative teams. They begin by identifying the goal of collaborative, commercially-oriented research teams: creating “an invention that is novel, valuable, and non-obvious.”⁵⁹ In pursuit of this goal, institutions have shifted from individuals to research teams as a major source of creativity and innovation. According to Bercowitz and Feldman:

Innovation is increasingly becoming a team sport. And like all team sports, success is a function of the expertise of the individual players, a solid roster enabling coverage of the key positions with the potential of a few stellar combinations.⁶⁰

This analogy of innovation as a team sport asks the question what are traits of successful research teams. Bercovitz and Feldman highlight a few lessons. For instance, creativity

⁵⁹ Janet Bercovitz, “The mechanisms of collaboration in inventive teams: composition, social networks, and geography,” p.1

⁶⁰ Bercovitz, p.12

becomes an important element in breaking the silos that inevitably result as scientists become more specialized in niche fields.⁶¹ New product development relies on inventive effort and creativity as integral enablers. Team size plays an important role as well. As the complexity of research grows, scientists cannot go it alone. More and more, scientists—especially those in the life sciences—rarely engage in research by themselves.⁶² Based on the number of inventors listed on US patents, research team size in America has grown at approximately 17% per decade.⁶³

With team size comes also the potential for team diversity. Diversity in skills and experience has aided successful research and development. The discovery of the Krebs Cycle is one great example. The Krebs Cycle is a key step in the biochemical process of cell respiration, which was once a confounding scientific problem. The two discoverers of this important step in respiration were Frederic Lawrence Holmes and Hans Krebs.⁶⁴ Holmes was a chemist by training and Krebs was a doctor with training in biology.⁶⁵ According to Holmes, Krebs brought fresh perspective to their research because Krebs lacked training in organic chemistry and therefore, was unconstrained by its conventions.⁶⁶ He lacked the biases that limited the types of questions biochemists would ask when attempting to understand cell respiration. The diversity of skills and experience gave their team an advantage in combining their abilities in a unique way to produce more successful research.⁶⁷ Understandably, Bercovitz and Feldman find that teams with diversity of knowledge have a higher chance producing a patentable or licensable invention.⁶⁸

Team composition can be divided into three broad categories:

1. Minimal diversity: team members are from a single knowledge area.

⁶¹ Bercovitz, p.1

⁶² Bercovitz, p.11

⁶³ Bercovitz, p.1

⁶⁴ Bercovitz, p.2

⁶⁵ Ibid.

⁶⁶ Ibid.

⁶⁷ Ibid.

⁶⁸ Bercovitz, p.11

2. Moderate diversity: team members may be from various knowledge areas, but they are from knowledge areas that are commonly coupled together.
3. Maximum diversity: team members come from many knowledge areas that have rarely been grouped together.⁶⁹

Whether there is a sweet spot for the degree of diversity in a team is unclear. However, these categories of team composition provide an approach for determining how out-of-the-box a team is willing to be in pursuit of creativity and innovation. The MIT Media Lab is the quintessence of the third, most diverse category.

Collaboration and government

In their 2007 article, “Coordination Costs and Project Outcomes in Multi-university Collaborations,” Jonathon Cummings and Sara Kiesler discuss university collaboration. They describe the goals of research collaboration as achieving “outcomes that include producing new knowledge, creating new research tools, training and educating students, and forming partnerships with institutions in the larger society, such as government agencies, museums, or schools.”⁷⁰

The United States government incentivizes university collaboration. The National Science Foundation, for example, funds projects in interdisciplinary research through initiatives like the Information Technology Research (ITR) Program.⁷¹ The ITR was a 5-year program that supported interdisciplinary information technology research and education projects.⁷² The program was a large investment from the government, increasing investment from \$90 million in the year 2000, to \$295 million four years later. The National Institutes of Health has incentivized collaborative research through major initiatives like the Human Genome Project, which spanned across many research groups.⁷³ The US National Academy of Sciences also

⁶⁹ Bercovitz, p.2

⁷⁰ Cummings, “Coordination costs and project outcomes in multi-university collaborations,” p.1621.

⁷¹ Cumming, p.1620-21

⁷² Cummings, p.1623

⁷³ Cummings, p.1620-21

promotes collaboration by citing major discoveries in neuroscience, nanotechnology, and bioinformatics as outcomes of collaborative research.⁷⁴

The big coordination challenge

With the advent of increased collaboration has come the challenge of coordination. One problem is that more and more projects are conducted by teams that are geographically spread apart. Scientific labs can be spread across continents, and open source collaborations (e.g. software development) can have contributors from all over the world. Scientists and innovators collaborate across geographic, organizational, and technological boundaries because they can mutually achieve synergies and cost savings. This began after World War II, when researchers began to take on more complex scientific inquiries and needed to share the cost of expensive equipment and specialists.⁷⁵

The Bercovitz and Cummings papers both emphasize the challenge of increased coordination requirements. Bercovitz states that as a research team spans more organizational boundaries, coordination becomes harder to pull off, and the probability of innovation diminishes.⁷⁶ In his study of 491 research collaborations, half of which included more than one university, Cummings stated that coordination costs are a significant obstacle to successful outcomes.⁷⁷ However, Cummings goes a step further. He argues that multi-university collaborations impose much higher coordination costs than individual university projects, despite the advantages of shared resources, experts, and funding incentives.⁷⁸ Cummings' research found that multi-university collaborations were significantly less successful than single university projects in the short-run.⁷⁹ The data show that the decline in productivity, with respect to knowledge, tools, and outcomes, began to show even with collaborations between two universities.

⁷⁴ Cummings, p.1621

⁷⁵ Cummings, p.1620

⁷⁶ Bercovitz, p.11

⁷⁷ Cummings, p.1621

⁷⁸ Ibid.

⁷⁹ Cummings, p.1632

A theory called “the knowledge-based view” sheds light on why multi-university collaborations aren’t inherently better than single university collaborations. The knowledge-based view developed out of the private sector from analyses of the classic “grow versus buy” question. Companies, when faced with an absent but needed capability, have the choice of growing the capability in-house or purchasing it.⁸⁰ According to the theory, research teams better at integrating the diversity will produce more successful outcomes.⁸¹ Thus if multi-institutional teams don’t effectively address the high coordination costs they are predisposed to encountering, then they are more likely to fail than their single institution colleagues, with lower coordination costs.

Cummings provides examples of the types of challenges multi-institutional teams face. For instance, universities often have different pay scales for graduate students and faculty, different requirements for joint appointments, and different cultural norms.⁸² University researchers may disagree where to publish because their respective universities may categorize top tier journals and conferences differently. Additionally, university collaborations are often separated by geography, which can slow down debate, consensus-building, and delay catching problems.⁸³ Cummings provides a litany of research that illustrates the variety of communication problems observed in collaborative endeavors.

When multiple universities are involved in a project, complexity increases and the difficulty of coordination activities increases (Hagstrom 1964; Hobday, 2000). Distance reduces opportunities for spontaneous, informal talk in a shared social setting (Kiesler and Cummings, 2002). Compared with single university projects, projects with investigators at different universities are likely to have more difficulty fostering a collegial social environment (Kraut et al., 2002; Nardi and Whittaker, 2002), building common ground (Clark and Brennan, 1991), maintaining awareness of what others are doing (Weisband, 2002), and making rapid adjustments to surprises (Olson and Olson, 2000). Allen’s (1977) rule of thumb is that co-workers should be no more than 30m apart, beyond which collaboration effectiveness declines precipitously (see Kraut et al., 1990).⁸⁴

⁸⁰ Cummings, p.1621

⁸¹ Cummings, p.1622

⁸² Cummings, p.1621

⁸³ Ibid.

⁸⁴ Cummings, p.1622

Due to these high coordination costs, the knowledge-based view finds that developing expertise in-house at one university is the best option when that expertise will be used often and is unlikely to be copied by other universities. On the other hand, research alliances and collaboration is the best option when it won't be used often, won't be copied by others, and won't be inexpensive to develop.⁸⁵

Another solution to mitigating high coordination costs is increasing socialization between team members. Data suggest that reinforcing socialization across the team through repeated interactions, communication activities, and alignment on processes reduces coordination costs.⁸⁶ Additionally, co-location could be another solution. Cummings cites a plethora of literature that state alternatives to co-location aren't valid substitutes. He writes:

For purposes of coordination, technology is an imperfect substitute for collocation. In studies of business and research projects with dispersed members, researchers have discovered project delays (Espinosa and Carmel, 2004; Herbsleb et al., 2000), misunderstandings (Cramton, 2001), institutional rivalries (Armstrong and Cole, 2002), free riding (Weisband, 2002), distractions from local institutional priorities (Mark et al., 1999), inconsistent procedures across institutions (Curtis et al., 1988), and failures to share information and communicate effectively (Hinds and Mortensen, 2005; Hoegland Proserpio, 2004).⁸⁷

⁸⁵ Cummings, p.1621

⁸⁶ Bercowitz, p.11, Cummings, p.1625

⁸⁷ Cummings, p.1622

Case Study 3—RTI International

The story of how RTI International began provides insight on how a local player, with RTP roots, successfully developed itself as a cutting-edge research institution. By understanding how RTI began, the Research Triangle Foundation can have a better understanding of how the Global Convergence Center may get off the ground.

Over fifty years, RTI has built an impressive reputation. With its mission for improving the human condition, it sits on a campus of 180 acres. It has conducted over 10,000 projects for hundreds of private and public sector clients all over the world. RTI has around 3,700 employees working on over 1,000 projects in over 75 countries.⁸⁸ RTI's research areas cover a wide set of subjects like agriculture, economics, education, medicine, public policy, energy, technology, the environment, and transportation.⁸⁹

RTI has evolved over the decades. When it won its first contract, statistics was RTI's only area of expertise. However, over the last 50 years, RTI has grown and expanded. Through the 1960s, building off of President Lyndon Johnson's "War on Poverty," RTI spread into social sciences work. By the 1980s, during President Reagan's era of budget cuts on quality-of-life initiatives and greater defense spending, RTI moved into health care, space, technology, and cultural dimensions of the military. Then in the 1990s, RTI further advanced its work on the environment with research on water and air pollution. As of the 2000s, RTI's international work has been its fastest growing segment of contracts.⁹⁰ As of recent, RTI's largest area of study is health research, where it has a wide breadth of sub-specialties.⁹¹

With its wide variety of research capabilities, RTI's success is partly due to its multi-disciplinary approach to client problems.⁹² This approach helps to create more imaginative and thoroughly

⁸⁸ Banham, *Impact on a changing world; RTI International at 50*, p.12, and RTI International, "About RTI," <http://www.rti.org/page.cfm/About_RTI>.

⁸⁹ Banham, p.14

⁹⁰ Banham, p.12

⁹¹ Banham, p.14

⁹² Ibid.

examined solutions. For instance, one team of researchers used data mining and analytics to develop software that helped law enforcement increase public safety and get more out of limited resources.⁹³ Another example is of a team that brokered a public-private partnership to shepherd a new tuberculosis drug, PA-824, to clinical trials.⁹⁴

When RTI was founded in 1958, the physical area that RTI now comprises consisted only of open fields and pine trees. Local business, political, non-profit leaders decided to improve the local economy by stemming the “brain drain” of educated professionals who had been trained in the Triangle universities. These pioneers proposed creating a business park (RTP), with a research institute at its center.⁹⁵ The goal was to improve economic development by creating jobs through research and innovation.⁹⁶ Thus the Research Triangle Park and the Research Triangle Institute came into being.

RTI’s first president: George Herbert

George Herbert became the first president and employee of RTI in 1958. After earning an electrical engineering degree from the US Naval Academy in 1945, Herbert, on a chance encounter, met the executive director of the nascent Stanford Research Institute (today, SRI International), Jesse Hobson. Hobson invited him to work as an administrative assistant, and Herbert accepted.⁹⁷ Over several years, Herbert steadily rose through the ranks to eventually become executive associate director, the second person in charge at the institute.⁹⁸ After a short stint as treasurer of the American and Foreign Power Company located in New York, he was invited by George Watts Hill, the chairman of the Research Triangle Committee, to head RTI.⁹⁹ When Herbert took the reins at RTI, the only assets in RTI’s hands was the promise of a 157-acre site and a \$500,000 grant from Archie Davis.¹⁰⁰

⁹³ Ibid.

⁹⁴ Ibid.

⁹⁵ Banham, p.12

⁹⁶ Ibid.

⁹⁷ Banham, p.30

⁹⁸ Banham, p.30

⁹⁹ Ibid.

¹⁰⁰ Ibid.

The role of renowned researchers in winning RTI's first contracts

Two major events helped RTI get on its feet. The first was RTI's initial contract and the second was a grant to support basic research in polymers. In 1959, 3 staff members from UNC's Institute of Statistics transferred to RTI. They came to support RTI in fulfilling a contract with the state of Tennessee to analyze morbidity data from the city of Nashville.¹⁰¹ The contract was worth \$4,500.¹⁰² A month after the 3 staff members joined RTI, Gertrude Cox, the founder of UNC's Institute of Statistics, joined the team on a part-time basis.¹⁰³ Cox's association with RTI was crucial in developing the young institute's research reputation. Cox was the first woman full professor at North Carolina State University, and later the first person to lead a university department of statistics.¹⁰⁴ Cox's reputation could create a regular flow of contract research. In fact, of RTI's first twenty research contracts, 18 of them were statistics projects.¹⁰⁵

The second major event was the Camille and Henry Dreyfus Foundation's \$2.5 million grant to RTI. The Dreyfus funded the institute to support a 10-year study in polymer chemistry and physics.¹⁰⁶ This became the second major area of expertise for RTI. RTI's polymer lab became the first in the US dedicated solely to its research.¹⁰⁷ However the Dreyfus Foundation's grant was contingent on RTI hiring an internationally renowned polymer scientist to head the lab.¹⁰⁸ It took a year and a half, and more than 18 candidates, before Herbert settled on the European Anton Peterlin.¹⁰⁹ Peterlin was a theoretical physicist and mathematician who was Yugoslav and jailed by the Nazis during World War II.¹¹⁰ Peterlin not only accepted the invitation to lead

¹⁰¹ Ibid.

¹⁰² Ibid.

¹⁰³ Ibid.

¹⁰⁴ Banham, p.32

¹⁰⁵ Ibid.

¹⁰⁶ Ibid.

¹⁰⁷ Ibid.

¹⁰⁸ Banham, p.33

¹⁰⁹ Ibid.

¹¹⁰ Ibid.

the polymer lab, but played a critical role in drawing other renowned European polymer scientists to join his team.¹¹¹

The Tennessee contract and the Dreyfus grant got RTI off its feet. RTI learned important lessons in recruiting renowned scientists and leveraging their reputation to win contracts. In the case of RTI's famous Natural Products Laboratory, RTI snapped up the renowned scientist Monroe Wall when the opportunity arose. In the early 1960s, Wall was a Ph.D. scientist at the US Department of Agriculture (USDA), where he was in charge of the plant steroid research section.¹¹² Although he had recently found some fascinating cancer-fighting plant samples, the USDA declined to fund further research. The National Institutes of Health offered to fund his research on a contractual basis if he could assemble a team and find a lab elsewhere.¹¹³ Wall found that lab and team at RTI, where Wall led the Natural Products Laboratory and went on to discover camptothecin and taxol—two early treatments in the history of anti-cancer therapies.¹¹⁴

RTI continued to benefit from its relationships with Triangle university researchers. Arthur Menius, the dean of the physics department at North Carolina State University, was familiar with the Atomic Energy Commission and therefore knew that it wanted to fund the development of research centers focusing on radioisotope applications.¹¹⁵ In Menius' proposal to the commission, he argued that RTI would be the best location for funds because it could capitalize on Triangle universities' synergies. He said the Triangle universities could "offer what one institution finds most difficult—the engineering and industrial knowledge supported by research and advanced concepts nurtured in an academic atmosphere...tempered by close

¹¹¹ Ibid.

¹¹² Banham, p.37

¹¹³ Ibid.

¹¹⁴ Banham, p.38

¹¹⁵ Banham, p.35

cooperation in a small geographic area.”¹¹⁶ In 1959, the commission awarded RTI a \$160,000 grant to fund a radioisotope lab at the institute.¹¹⁷

George Herbert’s strategy to hire famous scientists and attract business was key to growing RTI. According to Herbert, “We built RTI from the top down, first hiring key people who could assemble top-notch staffs and establish high-quality research programs in their respective fields.”¹¹⁸ As a Triangle institution, RTI benefitted from the interest that researchers from the Triangle universities had in working at the young organization. For them, RTI offered an opportunity to work in an environment different from their university settings.

¹¹⁶ Ibid.

¹¹⁷ Ibid.

¹¹⁸ Banham, p.37

Best Practices

We offer the best practices below based on the three case studies we examine in this paper. The case study we drew the practice from is cited in parentheses.

- 1. Select a leader for the Convergence Center that has deep relationships with the Triangle universities and has worked across academia and industry. (MIT Media Lab)**

Reasoning: Negroponte's alumnus connection and his ability to function comfortably in both academic settings and corporate boardrooms enabled him to speak convincingly to the Media Lab's multiple stakeholders.

- 2. Develop a unifying vision for research that the Convergence Center will host. (MIT Media Lab)**

Reasoning: Negroponte's convergence model maintained thematic alignment between the Media Lab's diverse projects and promoted cutting-edge, anti-disciplinary research.

- 3. Ensure researchers and administrators have ample opportunity to develop relationships with industry (MIT Media Lab)**

Reasoning: The opportunity to interact with industry represents new work experience for many researchers and the resulting relationships lay the groundwork for future collaboration.

- 4. Reduce faculty concern about working with industry by creating processes that match faculty interests with market or industry needs. (MIT Media Lab)**

Reasoning: Since losing autonomy to corporate partners can be a major faculty concern, finding a match between faculty and industry interest creates alignment and reduces barriers to collaboration.

- 5. Reduce and eliminate the organizational boundaries that researchers must work across. (multi-university teams)**

Reasoning: The more boundaries (e.g. geographic, resource, employer) a research team must work across, the smaller its chance of producing innovative results.

- 6. Recruit diverse teams from uncommonly grouped areas of research. (multi-university teams)**

Reasoning: As innovation becomes a team sport, greater member diversity and novel groupings of members increase the probability of creative production.

- 7. Recruit prestigious researchers and leverage their reputation to attract more talent and research dollars. (RTI)**

Reasoning: This was Herbert's strategy when he joined RTI and it proved successful in building an extremely talented staff and winning contracts and grants.

- 8. Ensure that the Global Convergence Center offers a unique research opportunity that cannot be found at local universities (RTI)**

Reasoning: Local researchers came to RTI and funneled work toward it because RTI offered work opportunities that were different from their respective institutions.

Conclusion

An examination of the literature on cutting-edge research, collaboration, and the leveraging of RTP talent can produce useful insights to guide how the Research Triangle Foundation moves forward with the Global Convergence Center. However, this study brings up further issues that the Foundation will need to carefully analyze. First, who will be the Global Convergence Center's Nicholas Negroponte? The right type of leadership will be a linchpin in the center's successful growth. Second, how will the Foundation recruit experts from outside the Triangle? The Convergence Center may serve to unite the research strengths of the Triangle universities, but neglecting external talent may be a lost opportunity for the center. Third, when researchers from different universities come together, what will be the organizational boundaries? For example, will a team represent Duke, UNC, and NCSU (thereby, increasing organizational boundaries), or will the team assume a new, common identity independent of the members' original institutions? Finally, what will the role of industry look like at the center?

The Foundation can investigate these questions by networking closely with administrators and researchers at the Triangle universities. Getting their input will further sharpen the vision for the center. Speaking with the local venture capital community would also help the Foundation understand how to increase the business viability of the research conducted at the center. Finally, the Foundation should continue studying comparable organizations to gain more insights. In addition to the organizations here, the Foundation can explore the story of the Georgia Research Alliance and the Stevenage Bioscience Catalyst Open Innovation Campus in the United Kingdom.

The Global Convergence Center represents a great opportunity to grow the economic and reputational footprint of the Research Triangle Park. We hope that our research will play a part in the one-day historic story of the Convergence Center.

Appendix – A

MIT Media Lab Research Groups¹¹⁹

	Director	Research Topic	Description
1	Rosalind Picard	Affective computing	How new technologies can help people better communicate, understand, and respond to affective information
2	Hugh Herr	Biomechatronics	How technology can be used to enhance human physical capability
3	Ramesh Raskar	Camera culture	How to create new ways to capture and share visual information
4	Kent Larson	Changing places	How new strategies for architectural design, mobility systems, and networked intelligence can make possible dynamic, evolving places that respond to the complexities of life
5	Ethan Zuckerman	Civic media	How to design, create, deploy, and assess tools and processes that foster civic participation and the flow of information between and within communities
6	Deb Roy	Cognitive machines	How to build machines that learn to use language in human-like ways, and develop tools and models to better understand how children learn to communicate and how adults behave
7	Hiroshi Ozaki	Design fictions	How to provoke discussion about the social, cultural, and ethical implications of new technologies
8	Pattie Maes	Fluid interfaces	How to integrate the world of information and services more naturally into our daily physical lives, enabling insight, inspiration, and interpersonal connections
9	Leah Buechley	High-low tech	How to engage diverse audiences in creating their own technology by situating computation in new contexts and building tools to democratize engineering
10	Alex Pentland	Human dynamics	How social networks can influence our lives in business, health, and governance, as well as technology adoption and diffusion
11	Henry Holtzman	Information ecology	How to create seamless and pervasive connections between our physical environments and information resources
12	Mitchel Resnick	Lifelong kindergarten	How to engage people in creative learning experiences
13	Cesar Hidalgo	Macro connections	How to transform data into knowledge
14	Neri Oxman	Mediated matter	How digital and fabrication technologies mediate between matter and environment to radically transform the design and construction of objects, buildings, and systems
15	Joseph Jacobson	Molecular machines	How to engineer at the limits of complexity with molecular-scale parts
16	V. Michael Bove	Object-based media	How sensing, understanding, and new interface technologies can change everyday life, the ways in which we communicate with one another, storytelling, and entertainment
17	Tod Machover	Opera of the future	How musical composition, performance, and instrumentation can lead to innovative forms of expression, learning, and health

¹¹⁹ MIT Media Lab, “Group Projects.”

18	Cyntha Breazeal	Personal robots	How to build socially engaging robots and interactive technologies that provide people with long-term social and emotional support to help people live healthier lives, connect with others, and learn better
19	Kevin Slavin	Playful systems	How to design systems that become experiences by transacting mere utility and usability
20	Joseph Paradiso	Responsive environments	How sensor networks augment and mediate human experience, interaction, and perception
21	Sepandar Kamvar	Social computing	How to design large-scale social systems
22	Henry Lieberman	Software agents	How software can act as an assistant to the user rather than a tool, by learning from interaction and by proactively anticipating the user's needs
23	Chris Schmandt	Speech + mobility	How speech technologies and portable devices can enhance communication
24	Edward Boyden	Synthetic neurobiology	How to engineer intelligent neurotechnologies to repair pathology, augment cognition, and reveal insights into the human condition
25	Hiroshi Ishii	Tangible media	How to design seamless interfaces between humans, digital information and the physical environment
26	Andrew Lippman	Viral spaces	How to make scalable systems that enhance how we learn from and experience real spaces

Appendix—B
Wiesner Building, MIT Media Lab



Appendix—C

Works Cited

Banham, Russ. Impact on a changing world; RTI International at 50. Old Saybrook, Connecticut: Greenwich Publishing Group, Inc., 2008.

Bercovitz, Janet and Maryann Feldman. "The mechanisms of collaboration in inventive teams: composition, social networks, and geography." *Research Policy*. RESPOL-2495. 2010, p.1-13.

Brand, Stewart. The Media Lab: inventing the future at MIT. New York: Penguin Books, 1988.

Cummings, Jonathon and Sara Kiesler. "Coordination costs and project outcomes in multi-university collaborations." *Research Policy*. 36. 2007, p.1620-1634.

Dubberly, Hugh. "Extending Negroponte's Model of Convergence." *Interactions*. Volume 18, Issue 5. September/October 2011, p.74-79.

Hatakenaka, Sachi. University-industry partnerships in MIT, Cambridge, and Tokyo: storytelling across boundaries. New York: RoutledgeFalmer, 2004.

MIT Media Lab. "MIT Media Lab." Facebook. Accessed March 3, 2014. <<https://www.facebook.com/mitmedialab/info>>.

MIT Media Lab. "MIT Media Lab." MIT School of Architecture + Planning. Accessed March 3, 2014. <<http://www.media.mit.edu/>>.

Ohnesorge, Lauren. "Convergence center in middle of RTP's extreme makeover." *Triangle Business Journal*. September 27, 2013.

RTI International. "About RTI." Accessed March 3, 2014. <http://www.rti.org/page.cfm/About_RTI>.

Triangle Universities Center for Advanced Studies Inc. (TUCASI). "Project Archie." Whitepaper. [no date available].

Wikipedia. "Nicholas Negroponte." Accessed March 3, 2014. <http://en.wikipedia.org/wiki/Nicholas_Negroponte>.

Wikipedia. "Jerome Wiesner." Accessed March 3, 2014. <http://en.wikipedia.org/wiki/Jerome_Wiesner>.