DELIBERATE INNOVATION, LIFETIME EDUCATION

Final Report • April 2018

COMMISSION ON
CREATING THE NEXT®
IN EDUCATION

#GT 2040

Georgia Tech

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#GT 2040

FOREWORD

In 40 years in academia, I have never experienced a faster pace of change. I am convinced that the future belongs to those institutions that are nimble enough to stay in front of the wave of change and, more importantly, help define what will be next in education.

That feeling led to the creation late in 2015 of the Georgia Institute of Technology Commission on Creating the Next in Education (CNE). In my charge to the CNE, I wrote:

> "...the business of national and international education is rapidly changing. The old models of business, pedagogy, and mission are either being questioned, or are no longer valid, meaning we must continually assess and reassess our own methodologies. Issues of 'flat world' connectivity, technology and accessibility, affordability and return on investment, and a diversifying body of learners drive today's higher education model, all while the old funding model becomes obsolete."

The commission was launched with the mission to take a look at the Institute's current educational principles and methodologies, benchmark best practices in higher education, and make recommendations about how the Georgia Tech of the future will serve new and different generations of learners.

Like most other institutions, Georgia Tech has historically served its students with a traditional, linear, front-loaded educational experience with a defined start and finish. For the Georgia Tech of the future, that pathway must and will change. More than ever, higher education is expected to produce graduates who get jobs and also provide educational opportunities that serve individuals' needs throughout their entire careers. Successful universities will not only meet the educational needs to get that first job after graduation, but also to achieve career changes and advancements over time.

"I got out," is the proud mantra of the more than 157,000 Georgia Tech alumni worldwide. Whether a few years out, or celebrating a 50th class reunion, or perhaps somewhere in their mid-career, each Georgia Tech alumnus is bonded to this institution by stories of tradition, hard work, rigor, and experiences while they were a student. For most of them, the pathway did lead to jobs and success, but "getting out" may not be sufficient for future graduates facing a rapidly changing world where knowledge and information are growing at an exponential rate. So what can Georgia Tech do for these future graduates?

The Commission explores this and more in its final report. Georgia Tech remains committed to our mission as a public, technological research institution, and the traditional, residential experience will remain the core of our mission. But the Georgia Tech for the next generation must be transformed by redefining the fundamental approach to educational delivery. That new approach, called the Georgia Tech Commitment to a Lifetime Education, envisions continual engagement with learners that extends from kindergarten to forever. The Georgia Tech Commitment means integration with primary and secondary schools, flexible learning options, connectivity that enables learning beyond traditional college years, and a network that supports learners all over the world.

Because of the Georgia Tech Commitment, future generations of learners will no longer say "I got out," but instead will happily say "I'm forever in."

The Commission recognized that achieving this vision will require innovation, and Georgia Tech is no stranger to innovation. We know that it takes time, but to become an institution that is responsive and ready to meet the evolving needs of the students, we must begin our transformation today. We are, and will continue to be, the "we can do that" university. In that spirit, I invite the community — students, faculty, staff, alumni, and friends — to join arms and work to implement the ideas found in this document, and lead the way in achieving our vision to "define the technological research university of the 21st century."

Rafael L. Bras

Provost and Executive Vice President for Academic Affairs
K. HARRISON BROWN FAMILY CHAIR
GEORGIA INSTITUTE OF TECHNOLOGY

EXECUTIVE SUMMARY

This moment is ripe for change in higher education. Scores of technology entrepreneurs, foundations, and policymakers are already trying to shape what the future looks like for both learners and institutions. The message for colleges and universities is clear: they can either sit idly by or join in to design their own destiny. As a selective public institution with a history of educational innovation, the Georgia Institute of Technology sits squarely in the middle of the forces shaping higher education. It is uniquely positioned to model what the university of the future might look like.

This report of the **Georgia Tech Commission on Creating the Next in Education (CNE)** is an effort to draw with broad strokes the nature of education that defines the technological research university of the year 2040 and beyond. The Commission was formed because many within the institution are convinced that by the second half of this century Georgia Tech will be different from the university that matured and prospered in the nineteenth and twentieth centuries. Georgia Tech's mission seems to demand that the Institute examine the choices that lie ahead and make plans for a future that, however uncertain is bound to present opportunities and challenges that cannot be understood as incremental changes in the status quo.

DRIVERS OF CHANGE

- CHANGING DEMOGRAPHICS
- SOCIO-ECONOMIC CLIMATE
- WORKFORCE SKILLS
- SCIENCE OF LEARNING

In a prior report titled *Discovering the Drivers of Change in Higher Education* (Georgia Tech 2016), the Commission outlined the forces likely to affect Georgia Tech, including a new and accelerating revolution characterized by technology-driven disruptive change throughout society, shifting public attitudes about the role of public universities, and demographic trends that challenge long-held assumptions about who will benefit from a college education. Upon publication of that report, the Commission engaged in a broad search for ideas about how best to anticipate the kinds of changes that are certainly in store for Georgia Tech and to synthesize a roadmap for the future.

The Georgia Tech **Commitment**

The overarching recommendation of the Commission is an ambitious proposal called the **Georgia Tech Commitment to a Lifetime Education**. It is a concept unlike anything that exists today—a future for college not conceived solely just as a physical place one enters at a particular age and exits when a degree is completed but rather as a platform for an increasingly diverse population of learners.

By the year 2040, Georgia Tech learners will be more ethnically and socioeconomically diverse. Some will be much younger than traditional undergraduates; others will be much older. Neither group will resemble the traditional, residential college student in terms of their expectations or demands. Their numbers may far exceed the current residential enrollment. The Georgia Tech Commitment is a promise to these new learners to provide the rigorous, high-quality experience that has defined a Georgia Tech education for more than 130 years but to do it in a way that is individually personalized and sustainable for a lifetime. This commitment is a promise to invest in the success of all Georgia Tech students.

For the Georgia Tech Commitment to become a reality, the Institute must redefine its fundamental approach to educational delivery with four key actions: eliminate artificial barriers between college and pre-college schooling, invent flexible educational pathways and credentials that recognize continual learning, reinvent the physical presence of a university for a worldwide population of learners, and provide advising and coaching networks that serve the lifetime needs of Georgia Tech learners of all ages.

Innovation is required for each of these steps to be successful. An integral part of delivering on the promise of the Georgia Tech Commitment is a set of initiatives that are aimed at closing knowledge gaps, prototyping new products and services, and building technological infrastructure that enables this broad expansion of Georgia Tech's mission.

These initiatives are conceived as research programs that will be launched upon completion of the Commission's work. They will be planned and managed by an expanded ecosystem for educational innovation.

The Initiatives

The Commission identified five initiatives to better understand the challenges standing in the way of achieving the vision of the Georgia Tech Commitment and to create tools, invent methods, and collect data that will be required to make progress. Included in these initiatives are immediate actions and longer-term projects that will require both invention and sustained research. These initiatives address problems that the Commission believes are on every critical path to the Georgia Tech Commitment and many other conceivable futures as well.

Initiative 1: Whole-Person Education

Georgia Tech graduates have a reputation for strong technical skills and initiative, but, increasingly, other skills are needed for success in the twenty-first century workplace, including cognitive skills, such as problem solving and creativity; interpersonal skills, such as communications and leadership; and intrapersonal skills, such as adaptability and discipline. The Commission found that virtually all employers consider these skills to be a distinguishing characteristic for long-term success. Employers look to leading colleges and universities to provide graduates who have not only deep disciplinary knowledge but also these additional skills.

This initiative consists of four interrelated projects that address important aspects of delivering whole-person education to Georgia Tech learners:

1. Experiential learning that embeds the learning experience in authentic, relevant contexts.

2. Globalization at home to develop a culture in which critical thinking and collaboration can be taught in the context of a multicultural world.

3. Professional development of graduate students that fuses whole-person education with the more research-oriented training typical of graduate education.

4. A new whole-person curriculum that emphasizes interpersonal and intrapersonal dimensions of education in addition to cognitive dimensions.

Initiative 2: New Products and Services

To meet the demands of evolving job markets and the desires of a widely disparate population of future learners, the Georgia Tech Commitment calls for flexible learning experiences and continual learning opportunities. New products will need to be created that afford future learners the ability to customize their educational experiences. Development of these new educational products and services will be enabled by four projects that address both near-term and long-term problems:

1. Microcredentials to create more efficient packages of experience and achievement.

2. A matrix of minimester classes that will allow students to replace monolithic three-credit-hour classes with more granular and flexible modules.

3. A new credit-for-accomplishment unit measured by demonstrated competencies and skills.

4. A new decentralized transcript based on blockchain technology that allows students to combine evidence of learning and achievements into credentials that are relevant to potential employers.

Initiative 3: Advising for a New Era

Advising for a new era is a challenge to the traditional fragmented approaches to advising. The Commission recommends a robust learner data backbone as well as artificial intelligence assistants that integrate prescriptive, intrusive, and developmental advising services to personalize them and provide a new advising experience, at scale, to learners of all types. Three projects are key to launching this initiative:

1. Personalized advising for effective and scalable advising services tailored to the needs and prospects of individuals at all stages of life.

2. Technology-enhanced advising to deliver new ways for supporting personalization at scale.

3. Personal Boards of Directors to create professional networks for Georgia Tech learners.

Initiative 4: Artificial Intelligence (AI) and Personalization

Georgia Tech has led in the development of AI-based personalization systems. The "Jill Watson" experiment used the IBM Watson system as the basis for an artificially intelligent teaching assistant and was widely hailed as a breakthrough in both AI and educational technology. The opportunity now exists to augment "Jill's" skills to handle other tasks that are associated with personalized learning. A multifunction virtual tutor can be deployed to advisors, coaches, and even mentors located at distributed Georgia Tech locations around the world. Three projects are envisioned as part of this initiative:

1. Pilots for mastery-learning and adaptive-learning platforms that can put the kind of technology that will allow customized delivery of material into the hands of learners within two years.

2. Personalized and multifunctional tutors to take advantage of advances in AI to push the envelope in personalized learning.

3. Human-centered AI to support the development of interactive AI agents whose interactions with humans are informed by cognitive models and contexts.

Initiative 5: A Distributed Worldwide Presence

The idea of a physical campus—a designed space for students, teachers, and educational programs—has been a mainstay of the college learning experience for a thousand years. The physical campus is, however, a fragile model. A campus has the advantage of making educational facilities broadly available, but it does not necessarily match services to regional needs.

The Georgia Tech Commitment values the personal presence of instructors and advisors in the educational experience but recognizes that problems of scale and expense will limit the number and kind of such deployments. It is always an option to provide remote or online facilities to connect new students to a central campus, but Georgia Tech's experience with affordable online master's degrees convinced the Commission that there are better ways to create a real presence as part of the Georgia Tech learning experience. The following projects will enable experimentation with new modes of student interaction:

The Georgia Tech atrium™, a concept that recreates in other locations the scalable gathering places and portals to educational services that have become ubiquitous on Georgia Tech's central campus. These spaces can be located near clusters of Georgia Tech learners in co-working spaces, corporate offices, or even retail malls. Each atrium can be programmed to suit the needs of local learners and can provide cost-effective, high-quality educational experiences to Georgia Tech students and others by matching personnel, expertise, and facilities to the needs of the communities served.

A Living Library for Learning (L3) that expands an already successful network of Human Libraries to a broad range of educational contexts. Through an L3 portal, Georgia Tech will be able to provide personal, on-demand access to individuals who have first-hand experiences to relate to classes or individual learners. The Human Library vision of "loaning people, not books" has great appeal for technological universities.

The five initiatives represent radical departures from usual

The Culture of a Deliberately Innovative Organization

ways of delivering rigorous university-level learning experiences. The pace of innovation required to achieve their goals is daunting. Recognizing the often-slow pace of change in higher education, the Commission envisions a long-term process for instilling in the culture of Georgia Tech the ability to innovate in a more predictable and timely way, moving to becoming a more deliberately innovative university.

The Georgia Tech Lifetime Commitment and the initiatives proposed to achieve it are bold, and they need to be supported by an underlying culture of educational innovation that is both robust and agile so that it can adapt to disruptive forces and a rapidly increasing rate of change in technology and society. Georgia Tech's current culture has produced internationally recognized innovations in education that have had great impact, but the Commission feels there are still cultural shifts that would improve the university's capacity for continuing innovations. By making innovation processes the subject of study and applying research-based methodologies, the Commission believes that Georgia Tech can become a more deliberately innovative organization.

A systems approach would allow the examination of innovation processes in interacting groups of people and organizations, and it would support taking deliberate actions to improve desired outcomes over time. The Commission envisions five steps that are necessary to launch the Institute onto this pathway.

Merging Two Successful Cultures

Georgia Tech's capacity for educational innovation has grown dramatically over the past decade, but to a large extent, successful innovation in education is still not systematic. Inventions germinate and successfully change the way education is delivered, but success or failure seems to depend as much on luck or circumstance as on merit or need. The Commission imagines a merger of two existing, successful cultures for innovation: a grassroots culture and an institutional culture. Each culture is individually effective, but aligning the two will create a more agile and sustainable environment for innovation.

A Systems Approach to Becoming Deliberately Innovative

A systems approach to creating a deliberately innovative organization improves on current successful models of innovation. The Commission recommends long-term steps to immerse educational innovation practices in the kinds of cultures that are known to enhance innovation at the enterprise and organizational levels, shifting academic structure and processes when necessary to better align with those known to promote innovation.

Enhancing the Innovation Ecosystem

The Commission examined ways that the current educational innovation ecosystem might evolve into a broader, more coordinated entity, with expanded scope and range. A great advantage enjoyed by Georgia Tech is its vibrant research environment. The Commission recommends fusing the values and mindsets of research and education communities at all levels of university operation and governance.

Bridging Organizational Silos

Organizational silos are policies, procedures, or cultural limits that inhibit people of different groups from free interaction. An example of such limitations are the disciplinary silos common in academic organizations. New organizational and financial models will help to bridge these silos.

Motivating Individuals in the Innovation Process

The Commission recommends policies that acknowledge, reward, and incentivize faculty and department leaders to pursue educational innovation. Everyone at Georgia Tech should be immersed in a culture of educational innovation. Every investment decision should be steeped in it. The Commission endorses total immersion, but it will take time to create conditions that connect the individual goals and aspirations of Georgia Tech's faculty and students with the goals of the Georgia Tech Commitment. It is an opportunity for individuals to grow by leveraging what they know while being honest about what they do not know and by taking risks while thinking through worst-case scenarios.

What's **Next?**

Demographic and economic forecasts gathered during the six-month discovery phase that kicked off the Commission's work paint a clear picture: higher education institutions of all kinds are facing a far different future compared to the world to which they have become accustomed. In many ways, the current challenges facing higher education are similar to the ones that confronted Georgia Tech at its founding. Today's challenges, like those of the mid-nineteenth century, are the consequence of rapidly expanding knowledge, industrial revolution, and immense change in the world economy.

In the previous era, colleges and universities and their leaders approached those changes with great optimism and a feeling that change was an opportunity for growth. The Commission believes that spirit can be rekindled today. A group of universities will need to lead higher education through the changes promised in this next decade and beyond. Georgia Tech is determined to be in this group by expanding its mission to include the Georgia Tech Commitment to a Lifetime Education.

The roadmap presented here is a result of looking up and out to grasp the bigger picture of higher education and its future. We imagine a future where artificial barriers that have existed in education disappear and the role that people and technology play in guiding students in their lifelong educational journeys is better understood. In such a future, new educational products will be needed, and, as simple skill acquisition becomes easier to achieve, the whole-person education needed to prepare individuals for new workplaces will become an essential part of higher education. Finally, the success of all the projects described in this report is predicated on an immersive culture that fosters deliberate innovation.

Access to higher education and scholarly research has long been the lever universities have pulled to promote their prestige. In higher education it is difficult, if not impossible, to stray far from the pack and think differently about how to engage new generations of students and how to provide them with the most immersive educational environment, all while being on the cutting edge of the next discoveries in the world. But the changing needs of both the global economy and higher education demand that universities like Georgia Tech move in a new direction to remain relevant in an increasingly automated and diverse world.

TIMELINE OF ACTIVITIES

Fifty faculty, students, and staff members participated in the process, which included frequent Commission meetings, six formal convenings of the entire membership, informal weekly lunches, meetings of ad hoc subgroups, and many workshops, round tables, seminars, and colloquia. Distinguished speakers, sponsored by the Commission, gave public, campus-wide lectures. In collaboration with the design firm IDEO and the U.S. Department of Education, the Commission sponsored a global design challenge to solicit ideas about the future of universities. A related outreach initiative —#GT2040— was launched in spring 2017 to solicit ideas from the Georgia Tech community about the future of higher education.

In addition to core Commission membership, a larger group of educational innovators followed the work of the Commission and met quarterly to review the Commission's work and provide feedback. Several student initiatives were launched in parallel to the Commission. An external advisory board of senior executives from industry and government helped guide the Commission's work. Transparency was an important factor, so in addition to public venues for soliciting ideas, there were many briefings to committees, faculty, leadership teams, advisory groups, and student organizations.

Facilitated Ideation

Speakers, Visitors, and Consultants

Social Media and Blogs

GT Fire Pilot Projects

Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec

2016

CNE Speaker Series: Chris Hoadley
May 11, 2016

CNE Speaker Series: Rick Staisloff
May 26, 2016

External Advisory Board Meetings
December 2, 2016

CNE Speaker Series: Jim Pellegrino
April 26, 2016

CNE Speaker Series: Michael M. Crow
November 9, 2016

CNE Speaker Series: Caitlin Dooley
June 7, 2016

McGraw-Hill Education Scenario Exercises
October 9, 2016

CNE Speaker Series: David Levin
September 1, 2016

Student Ideation Projects

#GT2040

OpenIDEO Challenge

Symposia and Panels

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2017

External Advisory Board Meetings
February 20, 2017

CNE Speaker Series: Jonathan Cole
May 24, 2017

Internal Leadership Retreat
August 9, 2017

Structured Innovation Exercise via Flashpoint
February 9, 2017

McGraw-Hill Education Scenario Exercises
April 28, 2017

Center For 21st Century Universities 5th Anniversary Celebration
May 12, 2017

INTRODUCTION

This moment is ripe for change in higher education. Scores of technology entrepreneurs, foundations, and policymakers are already trying to shape what the future will look like for both learners and institutions. The message for colleges and universities is clear: they can either sit idly by or join in to design their own destiny.

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In a prior report titled *Discovering the Drivers of Change in Higher Education* (Georgia Tech 2016), the Commission outlined the forces likely to affect Georgia Tech, including a new and accelerating revolution characterized by technology-driven disruptive change throughout society, shifting public attitudes about the role of public universities, and demographic trends that challenge long-held assumptions about who will benefit from a college education. Upon publication of that report, the Commission engaged in a broad search for ideas about how best to anticipate the kinds of changes that are certainly in store for Georgia Tech and to synthesize a roadmap for the future.

This report of the Georgia Tech Commission on Creating the Next in Education (CNE) is an effort to draw with broad strokes the nature of education that defines the technological research university of the year 2040 and beyond.

The Commission was launched in late 2015 to explore ideas, plans, and ecosystems and, above all, to articulate a vision that will position Georgia Tech to respond to these forces and to recommend ways to move toward this vision. The Commission's charter is a declaration of aspirations. It is not intended as a strategic plan, but to inspire a future generation of leaders. It is not without precedent in the 130-year history of Georgia Tech. After all, when the Institute was founded in 1885, it was at the intersection of great nineteenth century movements in American higher education.

Swirling social, political, and economic forces of the post-reconstruction era almost derailed the vision of a new public university that would boost the aspirations of a region in danger of being left behind by the industrial revolution sweeping the rest of the nation. At issue was how to prepare the citizens of a poor, rural state for this new world. Would the new Georgia School of Technology be a narrow institution, designed to enable students to acquire basic skills—catering to public sentiment that favored a workforce armed with practical, technical knowledge—or would it strive to be a polytechnic in the tradition of Europe and the industrialized Northeast? The debate was whether it was better and more economical to train the people who greased the machines of the modern age or to educate the people who created them. As at Williams College decades before, much of this debate centered on whether it was within the capabilities of rough-hewn farmers and laborers to master complex material.

For Isaac Hopkins, the preacher and engineer tapped to be Georgia Tech's first president, the answer was simple. According to Hopkins, the movement toward industrial education was one of those great revolutions of thought and public sentiment, the results of which are not for a day or a generation, but for all time" (McMath et al. 1985, p. 22). Georgia Tech was to be founded on a new idea—the need to understand the complexities facing the modern industrial age rather than the simple tools of a prior generation.

Hopkins declared, "[s]killed labor of today requires thinking." (McMath et al. 1985, p. 22) Georgia Tech rose to prominence as an elite research university on such aspirations; its founders looked out a century and made plans for that future. This attitude toward the future is so important that it has become the central value in the Institute's vision: to define the technological research university of the twenty-first century.

Once again great revolutions are roiling industry and commerce, but this time they are global, with accelerating socioeconomic effects. Despite this, many voices demand that higher education focus on the skills needed for the current workplace. After decades of sustained growth, the number of high school students entering college is in decline. Nationally, students arrive with lower levels of achievement and greater financial need than at any time in memory. The public investment in colleges and universities lags other demands, causing political leaders to search for a more focused and cost-effective means of education.

Georgia Tech was founded as the Georgia School of Technology in 1885 as a public university modeled on the great polytechnical institutes of Europe and the American northeast.

The Georgia Tech of 2018 sits squarely in the middle of these forces. It is, for example, a rare public institution that has become increasingly selective. Not only are entering students better prepared than their peers at other institutions, they are better prepared than previous Georgia Tech students, even as they become less representative of an economically and ethnically diverse population. Georgia Tech students learn skills that are in demand by today's employers, but the price of acquiring these skills has nearly tripled since 2006.

In short, Georgia Tech has not been immune to the disruptive forces facing the rest of higher education, and the changing landscape of a Georgia Tech education is apparent to anyone who looks at the numbers. The Institute can hold fast to a course that was set long ago, or it can anticipate the kind of landscape that is being carved out for all educational institutions. This is a critical juncture in Georgia Tech's history and it is essential to ask, as did President Hopkins, whether the assumptions of past generations will be a solid basis for the future—not for the next decade, but for 2040 and beyond.

A Commitment to the Institute's Values

We do not know with certainty what changes are in store for Georgia Tech in the next twenty years. The mission might evolve. The scope of programs might expand. New learners might arrive at the Atlanta campus or at locations established in places that today seem inconceivable. Some of these individuals might interact in cyberspace with instructors or with fellow students and rarely, if ever, travel to a recognizable physical college campus. They might be older or considerably younger than the typical Georgia Tech student of today. What and where they study might bear little resemblance to today's programs, classrooms, and campuses.

However change may reshape a Georgia Tech education, the Commission reached an early agreement that central to the Institute's purpose are values so essential that they should form a bedrock for the Commission's work. Throughout deliberations, Georgia Tech's key stakeholders expressed to Commission members that holding fast to the following values is necessary to retain the Institute's character during times of change.

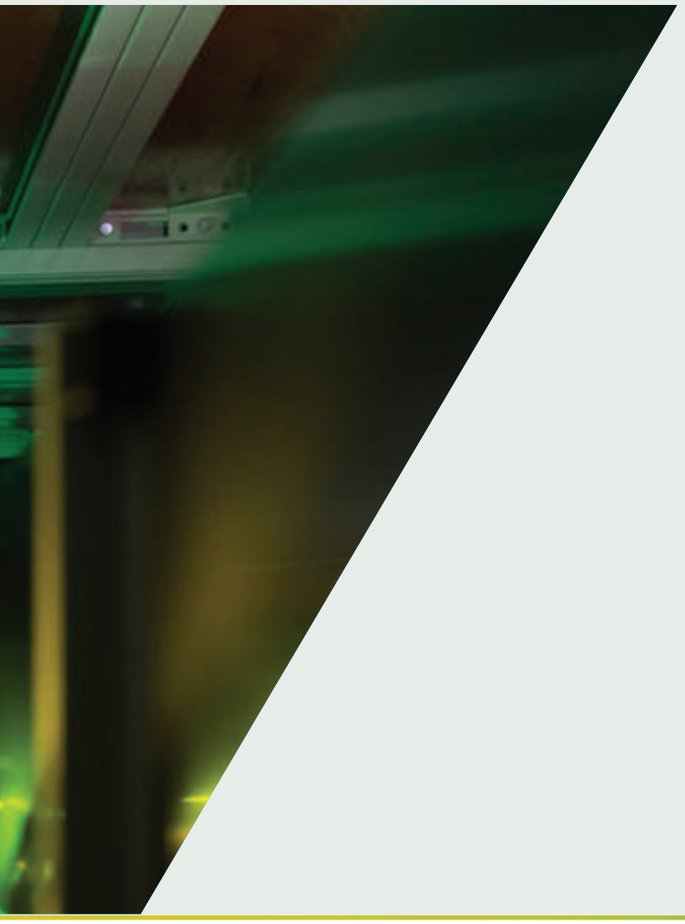
The Bedrock Values of Georgia Tech

Remain a Research University

Georgia Tech will remain a research university with the resources and capabilities to pursue the creation of knowledge at the frontiers of science and technology. This guiding aspiration often sets the Institute apart from other universities and colleges that seek to redefine their educational missions.

Preserve a Public Mission

State and federal funds being shifted away from educational programs have pushed public and land-grant universities toward business models that are less dependent on sustaining funds from states—models more like those of private universities. But Georgia Tech will retain its commitment to public education. The Institute will hold fast to those values that have been successful in helping to build modern society. This includes redefining the social contract that binds the fate of society to its colleges and universities and includes renewing a commitment to *access, affordability*, and *excellence*, the historic calling of public postsecondary education.



Celebrate an Inclusive, Diverse Community and Culture

Like most public institutions, the Institute inherits a commitment to inclusiveness and diversity in academic and non-academic communities. As a technological research university, Georgia Tech recognizes that gender, ethnic, and socioeconomic diversity in the scientific and technical fields is essential and actively promotes a culture of inclusiveness that expands diversity.

Continue to Focus on Science and Technology

The Georgia Tech mission statement commits the Institute to a pathway that values its role in defining a technological research university. The Institute may continue to offer broad courses of study, oftentimes by reinventing educational experiences in fields once thought to be removed from STEM disciplines in both content and culture. Even in those instances, the Institute's focus on science, mathematics, computing, and engineering as lenses for examining critical problems will remain the primary tool for describing and understanding the world.

Promote and Value the Residential Experience

Changes to the Institute's educational mission might involve expansion beyond the typical 18- to 24-year-old undergraduate and the discipline-focused graduate students upon which Georgia Tech's academic reputation was built. None of these changes diminish the Institute's ability to conduct residential educational programs at the highest level. Programs, products, and services studied by the Commission expand upon these traditional educational experiences, even though the numbers of students enrolled in non-residential programs may rise dramatically.

These values anchored much of the Commission's work. The vision for the future described in this report remains centered on Georgia Tech's commitment to the highest caliber of research and education that improve the lives of the people of the state, the nation, and the world. Above all, the findings of the Commission represent an aspirational commitment to Georgia Tech's long-term and personalized investment in the Institute's students and all the citizens of the state of Georgia.

THE COMMISSION CHARGE

The Commission will envision, within the context of Georgia Tech's strengths, mission, and opportunities, the educational enterprise of the technological research university of the twenty-first century and recommend pilots and projects to move Georgia Tech towards that vision.

The Commission's Charge and Work

With this commitment in mind, the Commission was formed in November 2015. The Commission was challenged by Provost Rafael L. Bras to accomplish two things: first, to make the best use of Georgia Tech's capabilities for analysis and innovation to envision—within the context of Georgia Tech's strengths, mission, and opportunities—the educational enterprise of the twenty-first century, and second, to recommend ways to move Georgia Tech toward that vision. The charge was simple and very few restrictions were placed on the Commission's work. The scope was intentionally wide: consider both near-term and long-term ideas and deliver recommendations that influence decisions well beyond any current planning horizon for the university. The Institute expected that collecting and analyzing information, creating and deliberating the merits of ideas, and engaging broadly with the Georgia Tech community would take time, so there was no specific timetable provided for concluding the Commission's work. An artificially imposed deadline would necessarily short-change creative processes, and it would also make it difficult to recruit Commission members who were willing to commit to perhaps two years of service.

The Commission was told to respect the mission, strengths, and opportunities of the 2015 Georgia Tech, but not be bound by them. From an operational standpoint, the Commission aimed to propose and develop plans for implementing ecosystems for educational innovation, recommend a range of experiments and projects, and evaluate the strength and sustainability of the Institute's current model.

At the first meeting, Commission members were reminded that they were writing for the future, for the Georgia Tech that would evolve over the next twenty years. As a result, the year 2040 became a sort of touchstone. Whatever the future holds for Georgia Tech, the Commission was committed to making recommendations that are achievable by the year 2040 and serve as a message to future colleagues and students about what building blocks are necessary to enable the university to continue to succeed.

Fifty faculty, students, and staff members participated in the process, which included frequent Commission meetings, six formal convenings of the entire membership, informal weekly lunches, meetings of ad hoc subgroups, and many workshops, round tables, seminars, and colloquia. Distinguished speakers, sponsored by the Commission, gave public, campus-wide lectures. In collaboration with the design firm IDEO and the U.S. Department of Education, the Commission sponsored a global design challenge to solicit ideas about the future of universities. A related outreach initiative—#GT2040—was launched in spring 2017 to solicit ideas from the Georgia Tech community about the future of higher education.

In addition to core Commission membership, a larger group of educational innovators followed the work of the Commission and met quarterly to review the Commission's work and provide feedback. Several student initiatives were launched in parallel to the Commission. An external advisory board of senior executives from industry and government helped guide the Commission's work. Transparency was an important factor, so in addition to public venues for soliciting ideas, there were many briefings to committees, faculty, leadership teams, advisory groups, and student organizations. A complete list of Commission members and activities appears elsewhere in this report.

The timeline for implementing the recommendations extends well beyond the completion of this report. In fact, the Commission considered three distinct time frames for its findings: *Harvesting, Building Blocks, and Beyond the Horizon.*

The Harvesting horizon comprises the near-term actions and changes that can be accomplished over the next three years. The Commission recommends that the formation of working groups and teams charged with implementing and tracking these efforts begins immediately upon delivery of this report.

The *Building Blocks* horizon anticipates investments in projects and pilots that may take up to ten years to complete. In this time frame, the initiatives that have been generated by the Commission and follow-on teams will have time to mature

and will have transitioned into practical use. During this second horizon, new projects will emerge, knowledge will be captured, and a more complete understanding of the future vision will take shape. Recommendations from the first two horizons are aimed at affecting change over a period that might extend for fifteen to twenty years.

Beyond the Horizon represents the year 2040 and the period beyond any existing planning horizon at the university and about which few details are known but for which the institution must prepare nevertheless. As various subgroups began to synthesize data and generate forecasts, several recurring themes led the Commission to consider even more seriously an Institute twenty years hence, in which the current public educational mission must be molded to serve the needs of new populations of learners and the demands of transformed workplaces.

RECURRING THEMES

- Educating the Whole Person
- Education Outside the Demographic Sweet Spot
- Personalized Education
- A Culture of Deliberate Innovation

In this time frame the entire leadership of the university will certainly have been replaced by a younger generation. A late twenty-first century Georgia Tech will be very different from the Georgia Tech of the nineteenth and twentieth centuries: the students will be different, there will be a different socioeconomic climate for higher education, rapid advances in new markets and industries will require different workers with different skills. To meet these challenges, learning and teaching must be transformed by science, technology, and sustained innovation.

The Commission believes that Georgia Tech must expand its current mission through a new pledge called the **Georgia Tech Commitment to a Lifetime Education**. This is a commitment to long-term and personalized investment in the success of our students, alumni, and learners of all ages. This will prepare Georgia Tech for a future transformed by forces at work today, including demographic shifts, advances in education, and disruptions in work and workplaces. On every possible path to this future, there are common problems that must be analyzed and solved.

The Commission recommends that work begin immediately to develop the organizational capacity to establish, staff, and fund initiatives that will define agendas and assemble project plans for future execution. Because the Institute has no current academic planning model for this horizon, the Commission has leaned heavily on the most successful long-term planning regime currently operational at Georgia Tech: the Campus Master Plan, which guides investment in the physical campus, financial, and workforce development.

One important recommendation of this near-term horizon is the establishment of a parallel Academic Master Plan (AMP) to tie future actions and spending on educational innovation to the other long-range planning cycles for space, university workforce development, and financial sustainability. Integration of the AMP with the Campus Master Plan and the Georgia Tech Strategic Plan will be complete by 2025.

This report is the barest beginning of a roadmap to achieve this vision, as most of what will be necessary for success does not exist today. Some of the critical success factors are known, but most will not be apparent for years to come. The near-term and medium-term recommendations of the Commission have tried to lay the groundwork for this vision.

ACADEMIC MASTER PLAN

The Academic Master Plan ties future actions and spending on educational innovation to the university's other long-range planning cycles.

Investments made today will give Georgia Tech an advantage relative to peers and competitors who will not make similar investments. Georgia Tech is purchasing options that can be exercised by future planners and decision makers. Suggested in this report are the kinds of programs that might be undertaken, but an expansion of knowledge about the future of education at Georgia Tech will unfold over the next decade. Programs that seem important today will likely be replaced by other, more promising ideas.

How to Read the Report

The sheer amount of material generated by the Commission precludes a report that faithfully recites every idea, project, pilot, or initiative. Topical supplements that dive into greater detail have been developed as complements to this report as the various initiatives evolve over the next several years. The Creating the Next in Education (CNE) Report Supplements are accessible online at www.provost.gatech.edu/educational-innovation/reports/lifetime-education/supplements.

The report proper spells out the structure and rationale for the Commission's findings and recommendations and offers a distillation of the ideas that relate most directly to the Georgia Tech Commitment. The public report contains three major parts.

Part One: The Georgia Tech Commitment to a Lifetime Education

One key finding that greatly influenced the Commission is the extent to which demographic shifts will shape higher education over the next twenty years. By the year 2040, a new generation of learners will have entered the Georgia Tech pipeline. They will be ethnically, socially, and economically diverse. Some will be much younger than traditional undergraduates; others will be much older. Neither group will resemble traditional college residential students in terms of their expectations or demands. Their numbers may far exceed the current residential enrollment.

Part One explains why this new population of learners is critical to the future success of Georgia Tech and outlines the programs, experiences, and educational products that will be needed. The Georgia Tech Commitment is a promise to these new learners to provide the rigorous, high-quality experience that has defined a Georgia Tech education for 130 years, but to do it in a way that is individually personalized. This commitment is a promise to invest in the success of Georgia Tech's students throughout their lifetimes.

Part Two: The Initiatives

The Commission recommends five initiatives to develop the knowledge and conduct the research that are the building blocks for the future. Included among these building blocks are projects, pilots, and experiments that address the most likely steps the Institute will be required to take. These initiatives address problems that the Commission believes are on every critical path to the Georgia Tech Commitment and many other conceivable futures as well.

THE INITIATIVES

- Whole Person Education
- New Products and Services
- Advising for a New Era
- AI and Personalization
- A Distributed Worldwide Presence

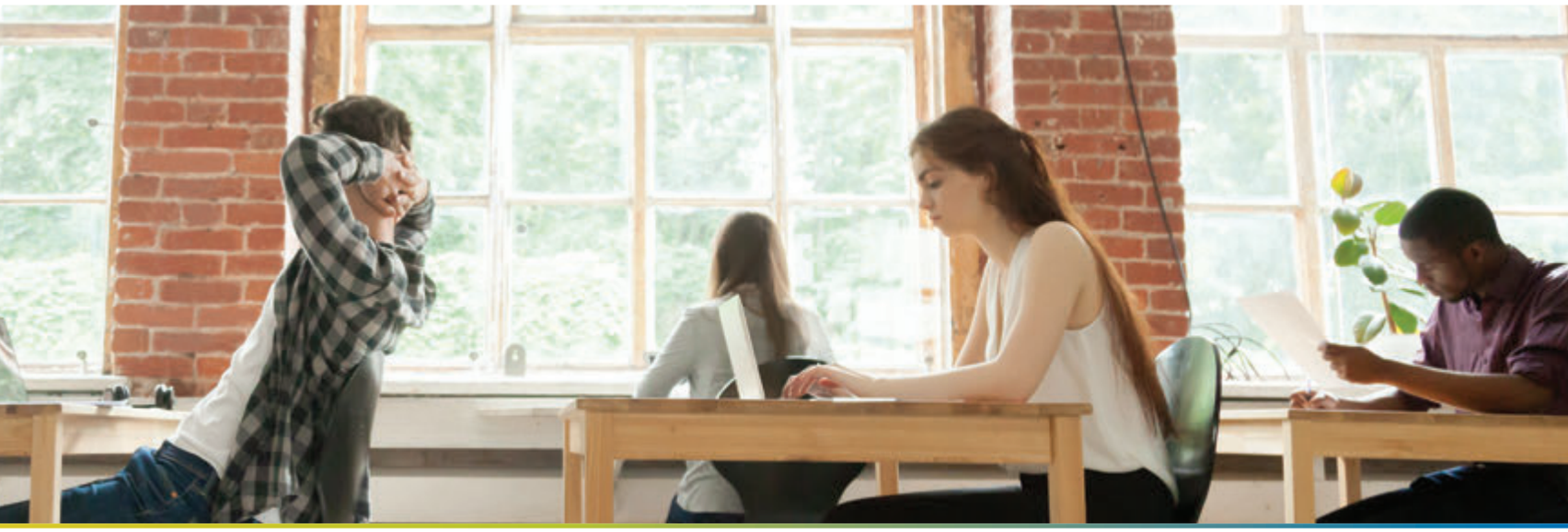
Part Two of this report prioritizes these initiatives into a coherent research program and roadmap for incorporating the results into even more impactful, yet-to-be-defined initiatives that may take ten to twenty years to develop.

Part Three: The Culture—Becoming a Deliberately Innovative Organization

Success in pursuing the initiatives recommended in Part Two would be enhanced by a Georgia Tech culture that encourages educational innovation and provides pathways to pilot such ideas. Georgia Tech's educational ecosystem has produced many impactful and successful innovations. However, repeatable and scalable innovation remains elusive. The time is ripe for an expanded vision. Part Three describes a new approach for taking deliberate, targeted actions at the organizational, team, and individual levels to create a culture of innovation.

One question was whether Georgia Tech's academic culture would be open to this kind of deliberate innovation. To test this, the Commission carried out a demonstration project with a cohort-based program based on a developmental approach to improving institutional capabilities for creating ideas that meet authentic demand and, therefore, are more likely to be adopted. The demonstration was successful, and the implications for a more effective culture of innovation are described in more detail in Part Three.

The current environment at Georgia Tech has produced many impactful and successful educational innovations. But the time is ripe for a new vision: a systems approach for taking deliberate and targeted actions at the organizational, team, and individual levels to create a culture of innovation.



The Future of Education at Georgia Tech

Georgia Tech's mission to define the technological research university of the twenty-first century is not strategic boilerplate; it is a beacon. It is tempting to conclude that future success will follow from continuing the successful strategies of the last 130 years—that the same beacon will attract new generations of scholars and students. That may be true, but it is equally likely that future Georgia Tech students will be different in fundamental ways from students of generations past. The changing landscape in which Georgia Tech is immersed today is as apparent to the Commission as it was to Isaac Hopkins when he founded the university.

Continuing to define the technological research university of the twenty-first century will require new approaches. A traditional Georgia Tech education involves classrooms, lectures, tests, laboratories, and a stable curriculum. Innovation around these components often takes place over many decades, but the forces affecting Georgia Tech are disrupting tried-and-true models. New skill sets that are not easily listed in checklists and inventories will be needed. Existing pathways will be disrupted by an increased demand for flexibility and an educational experience that is both scalable and highly tailored to individual needs.

A renewal of the university's social commitment considering changed regional, national, and global needs may be required. Political and economic forces may place as yet unforeseen demands on institutions like Georgia Tech, fraying old business models and creating new ecosystems. Institutions that ignore these forces often face irresistible competitive and financial pressures. Competitive success in the higher education marketplace will be the reward for those institutions that develop a culture of educational innovation and anticipate changes like the ones described here.

The Commission considered these factors and concluded that, faced with different students, a changing socioeconomic climate, and future workplace demands for future skills, a Georgia Tech in 2040 is likely to be quite different from the Georgia Tech of the nineteenth and twentieth centuries. Although it is a final report of the Commission, the fundamental purpose of this document is to communicate to the next generation of educational innovators, to make the easy changes, to launch the projects whose outcomes will be essential to the challenges of 2040, and to outline the culture of innovation that Georgia Tech will need for the long term.

Faced with different students, a changing socio-economic climate, and future workplace demands for future skills, a Georgia Tech in the year 2040 is likely to be quite different from the Georgia Tech of the nineteenth and twentieth centuries. Georgia Tech remains committed to the idea that what society needs most are skilled individuals who can think and master those complexities.

PART ONE: THE GEORGIA TECH COMMITMENT TO A LIFETIME EDUCATION

In the mid-nineteenth century and in the immediate aftermath of the American Civil War—around the same time as the founding of Georgia Tech—American higher education was in a state of flux, much like the one it finds itself in today. The needs of a growing nation demanded a shift from using the age-old classical European model for educating a small slice of the population to coping with the effects of an industrial revolution. It was a new age of machines that would need factories, businesses, railroads, mechanized farms, and new technologies to support them.

The nineteenth century was a period of experimentation in education. New universities were created to serve students interested in engineering and the sciences. Existing institutions, such as Brown University, experimented with more flexible pathways, including shorter degree programs than the typical four years. The bachelor of science was created at Harvard University during this era to recognize and give currency to learning in the emerging science disciplines. The Morrill Act of 1862 was landmark legislation that created a national network of public universities focused on the practical needs of the country.

The successful universities will be those which invest in the pipeline to help students acquire and renew skills not only through formalized degrees and credentials but with programs, products, and services that are relevant and valuable throughout their lifetimes.

Today there is a new industrial revolution and a new machine age, driven by many of the same forces that were at work at Georgia Tech's founding and requiring the same reimagining of higher education. But America in the twenty-first century is also different in fundamental ways. Global communications, artificially intelligent machines, automation, data in previously unimaginable quantities, and accelerating cycles of innovation, for example, are transforming the nature of work and the workplace.

Workers in the twenty-first century enter workplaces where knowledge churns at an accelerating rate and skills must be renewed to remain relevant. Graduate degrees and credentials signifying mastery of specific skills that would have propelled past generations through careers spanning forty years or more are becoming less important than acquiring skills that grow over decades and allow individuals to master the churn of knowledge.

Moreover, there are fewer 18- to 24-year-old Americans in the college pipeline. Younger and older learners are already challenging the idea of what it means to be a Georgia Tech student. An increasing percentage of Georgia Tech undergraduates enter with two or more semesters of college credit.

College-level education is experienced by high school and middle school students in ever-increasing numbers. These students are ethnically and economically more diverse than previous generations. The demand for citizens who are literate in twenty-first century skills requires engagement with even younger learners, even if they never actually enroll in a formal program of study.

Aspirations are also different. Current students report that their heroes are visionaries who can combine disciplinary skills to address the grand challenges of science and society. When asked what the Georgia Tech Class of 2040 will be studying, today's students are as likely to mention space, robotics, sustainability, and socioeconomic equity as fixed disciplines like computer science, engineering, science, or business. This kind of symphonic thinking is what is increasingly demanded by students and employers alike.

All of this implies that the purpose and structure of higher education will need to shift to keep pace with changes in society and careers. Instead of the industrial model of education, with a prescribed timeline and curricula delivered largely in formal classroom settings, education in the future will need to be more flexible. The successful universities will be those which invest in the pipeline to help students acquire and renew skills not only through formalized degrees and credentials but with programs, products, and services that are relevant and valuable throughout their lifetimes.

The Georgia Tech Commitment to a **Lifetime Education**

The overarching recommendation of the Commission is an ambitious proposal called the ***Georgia Tech Commitment to a Lifetime Education (the Georgia Tech Commitment)***. It is a concept, enabled by the initiatives outlined in Part Two of this report, unlike anything that exists today: a future for college not conceived only as a physical place one enters at a particular age and exits when a degree is completed, but rather as a platform for the increasingly diverse—in age, ethnicity, and socioeconomic status—population of learners that Georgia Tech will serve.

This platform will blend in-person and digital learning experiences. Advising and professional coaching that starts much earlier in high school will provide students multiple pathways through the undergraduate and graduate experience and will be sustained for a lifetime by renewable learning with multiple on- and off-ramps beyond degrees and certificates from Georgia Tech.

This idea takes on special meaning as a new understanding of how, when, and why people learn emerges and as the responsibilities of a public research university to society are redefined in the twenty-first century. It is a concept that remains centered on Georgia Tech's commitment to the highest caliber of research and education that improves the lives of the people of the state, the nation, and the world.

The Need for the Georgia Tech **Commitment**

The demand for a traditional, residential Georgia Tech education is growing, and since there is limited physical capacity for residential students, the Institute has become necessarily more selective. While this has helped Georgia Tech's reputation as an elite research university, selectivity does not address the most important long-term trends in higher education identified in the report *Discovering the Drivers of Change in Higher Education* (Georgia Tech 2016), namely, the decline in the supply of high school graduates applying to college. If Georgia Tech's growth is to continue, it will come in the form of learners who are either much younger or who are older and underserved by research universities.

The needs of these learners—regardless of age—are shifting. Students in grades K-12 who are in the pipeline to college are increasingly arriving on the campus with learning experiences unlike their predecessors. Meanwhile, current undergraduate and graduate students are facing an economy in which industries expand and contract with alarming speed and where the job market will look wholly unfamiliar to them by the time they reach the midpoints of their careers. Mid-career professionals are trying to figure out what skills they need and how to acquire them to keep ahead in their professional fields.

Georgia Tech already sees the beginning of the trend toward a more flexible timeline for education. The Commission agrees with the many experts who believe that Georgia Tech graduates will spend their entire professional lives in workplaces transformed by a modern industrial revolution. As basic job-related knowledge quickly becomes obsolete, so-called "whole-person skills" that emphasize metacognition, communication, synthesis, drive, persistence, and other character values that are predictors of an individual's ability to adapt to rapid change loom large when compared to fixed inventories of competencies.

Knowledge is churning at an ever-faster rate, and as a result, so too is the education needed to stay ahead in school and keep up in almost any job. The rise of artificial intelligence (AI) and its potential to redefine the roles of traditional knowledge workers has implications for success in the global information economy, which will demand that workers have new skills and competencies. Workers are already worried about whether their education is in sync with what is needed for lifetime employment.

A report by the Pew Research Center (2016) found that 87 percent of workers believe it will be essential for them to get training and develop new skills throughout their work life to stay current in the workplace. For these individuals, the need for additional education and training is not determined by an arbitrary date on a calendar. Increasingly, education for these workers is experienced episodically: they seek learning experiences because of life events, not because it is expected of them.

The goal of prior generations might have been success in jobs marked by stability, often with a single employer. By 2040, careers will be marked by experiences and engagements that are highly personalized. What we today think of as a workforce of contractors and freelancers will become commonplace as

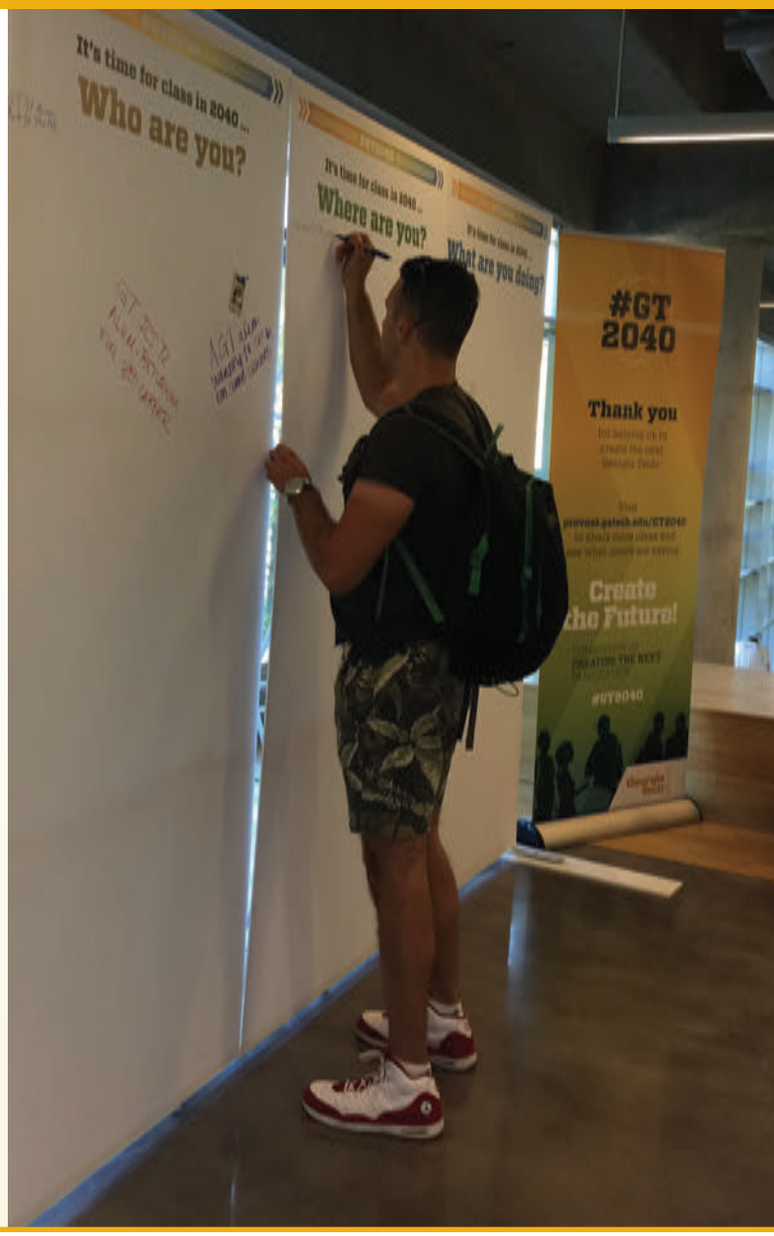
#GT2040

The #GT2040 project was launched with an interactive exhibit entitled "Creating Georgia Tech which invited faculty, staff, students, parents, alumni, and others to imagine themselves on the first day of class in the year 2040 and answer the questions:

Who are you?
Where are you?
What are you doing?

Hundreds of participants shared their ideas, left photographs, uploaded videos, and participated in online polls.

The #GT2040 project told us today's students expect that Georgia Tech will become more diverse, more tied to the urban landscape of Atlanta, and more imaginative in the use of technology used or learning. Participants did not expect to be tied to classrooms, and a surprising number of them thought they would be linking into classes from Mars. Very few mentioned traditional majors. Many identified with studying the challenges facing the world, not academic disciplines.



more white-collar workers are employed in a gig economy in which individuals may change jobs and employers more than a dozen times and may engage in as many as five different careers over the course of their working lives.

It is not a coincidence that WeWork™, the second-largest privately-owned company in the world, has been built to meet the exploding demand for co-working spaces where work-at-home, freelance, and entrepreneurial workers can experience the social benefits of being part of a communal workforce while retaining their flexibility and autonomy.

In early 2017, the Commission launched the #GT2040 project, an effort to engage current Georgia Tech stakeholders in a discussion about the future. The #GT2040 project revealed the extent to which current Georgia Tech students choose visionary role models—people whose accomplishments are not easily captured in a résumé but rather conceive of their skills and experience as contributing to a brand that has unique value.

Today's students see themselves over the next two decades employed in fields such as space exploration, virtual reality, sustainability, AI, and quantum computing, which barely exist as recognizable disciplines now but likely will emerge as drivers of the world's economy by 2040.

It is likely that Georgia Tech students will place new demands on the Institute and the role they expect it to play after graduation. The familiar world of credits, grades, degrees, and transcripts is rapidly being replaced by a flatter, networked world where commoditized information delivery lives alongside personalized services like advising, mentoring, and coaching, experiences that are not so easily commoditized.

The boundaries of Georgia Tech's engagement with its alumni are also being redrawn. Alumni want to know that the Institute will be there for them as their needs change and evolve with the new world of work and play. The Georgia Tech Commitment makes this promise concrete.

What is the Georgia Tech **Commitment to a Lifetime Education?**

THE GEORGIA TECH COMMITMENT TO A LIFETIME EDUCATION

- Prepare for New Kinds of Learners
- Create New Ways to Acquire Knowledge
- Establish Lifelong Ties with Alumni
- Address the Churn of Knowledge
- Provide a Lifetime Educational Platform

Right now, a Georgia Tech education has a beginning and an end. Students apply for admission. They enroll in programs. They receive a well-recognized credential. These students and their experiences are at the core of the Georgia Tech mission. This core student population will not disappear, but given dwindling numbers of students in the college pipeline, increasing costs, and space constraints for scaling the functions that serve these students, it is unlikely to grow much at all.

The Georgia Tech Commitment imagines a future not marked by arbitrary entries on a calendar, but one with numerous entry and exit points where students associate with rather than enroll at Georgia Tech. The idea of an admissions office as the sole gatekeeper to Georgia Tech will make less sense in an environment where learning is always on, so instead students establish and activate learning engagements.

Some learners will arrive to complete a specific learning task or experience and leave once that task is completed. Flexible timelines will allow students to take individual courses or shorter semesters and more easily pursue work and research opportunities, because learning, working, and playing flow naturally from one to the other.

REDEFINING EDUCATIONAL DELIVERY

- Eliminate artificial barriers between conventional schooling and higher education.
- Allow for flexible calendars and pathways through Georgia Tech.
- Award new kinds of credentials that recognize continual learning.
- Allow for learners to personally interact with Georgia Tech experts and services in key locations around the globe.
- Provide an advising and coaching network for life.

These lifetime learning experiences will not be limited to a central physical campus. Georgia Tech students might be learning from anywhere in the world. They will engage with the Institute in new physical spaces that are not like a traditional university campus. These spaces might be embedded in a corporate campus, at a co-working space, or alongside retail storefronts, providing social glue for generations of learners who previously had little access to higher education. Spaces like these might provide face-to-face experiences and networking opportunities.

A worldwide network of guides, advisors, mentors, coaches, and role models—some of them virtual—will help students navigate their journey through learning, no matter their point in life. The collective work of students inside and outside the classroom will result in traditional degrees, but also a new set of credentials will emerge that will measure and communicate learning and can be stacked together over the course of a lifetime.

Much of what seems familiar about the university as a place will be transformed. Work has already begun on Georgia Tech's Library Next initiative, which is replacing the idea of a university library as a physical repository of books with the idea that libraries today are used more for networking, building communities, and creating knowledge or designs than for simple consumption of static information (Bennett et al. 2014).

THE LIBRARY NEXT PROJECT

Creating library services and spaces to match the changing research, teaching, and learning needs of Georgia Tech.

For the Georgia Tech Commitment to become a reality over the next two decades, the Institute must redefine its fundamental approach to educational delivery, discussed in the following subsections.

Eliminate artificial barriers between conventional schooling and higher education

The boundaries between K-12 schools and higher education are an artifact from last century, when the United States experienced a period of unparalleled economic growth, fueled in part by a progressive system of public education. At the heart of that system was the universal high school movement of the early 20th century, which turned the United States into the world's most educated country.

These educated high school graduates powered the prosperity of the twentieth century and the college-for-all movement that followed in the last quarter of the century. The world is clearly a far different place today than it was 100 years ago, with success more dependent on knowledge than ever before. There is no reason that the chasm between the K-12 system and higher education needs to exist.

Integrating college content into secondary schools is the first building block of the Georgia Tech Commitment. It smoothes the transition from high school to college for students and families. It allows students to benefit from Georgia Tech when they are ready—some earlier, and some later, than the typical age of eighteen. It connects motivated high school students with Georgia Tech learning earlier and makes it possible to maintain that connection.

Some of those students will choose to enroll at Georgia Tech, but many others will find other pathways. Some will enter the workforce directly, others will choose another kind of postsecondary learning experience. Still others, in search of advice and help, will consider Georgia Tech a trusted mentor, coach, or partner. Regardless of the pathway, what Georgia Tech offers is an on-ramp to a future that has been enriched by a unique learning experience.

Students who take advantage of early on-ramps to Georgia Tech programs will enter the Institute college with a significant number of transferable credits, enhanced academic experiences, and free elective time in a traditional undergraduate program and will demand more flexible learning options.

Allow for flexible calendars and pathways through Georgia Tech

When the University of Chicago opened in 1890, it pioneered a new idea in the annals of the academic calendar: the quarter system. A handful of institutions (Georgia Tech among them) followed, but for the most part, at most institutions the cadence of the academic calendar—whether two starts or four starts a year—is similar to what it was a century ago.

But now the plethora of choices available to students offers the potential to reshape the traditional academic calendar with a mix of multiple start dates and different-length semesters. With the Georgia Tech Commitment, learners can distribute learning experiences across their lives, as they see fit. Some will continue to front-load the experience as they do now, while others will spread it out and come to education throughout their lives. The Georgia Tech Commitment will provide an easy on-ramp for adults in their current careers or allow them to change careers with a solid academic grounding. This will inject a diversity of generations and work experiences into the campus culture.

This flexible experience is already happening as students are moving through college at different speeds, mixing learning opportunities that include courses from various providers and campuses, and combining learning experiences like co-ops, undergraduate research, and service learning. These experiences do not end even when the student obtains a credential.

Georgia Tech is already witnessing a growing demand for more educational experiences from holders of past credentials. Nearly 25 percent of students in existing distance and online master's degree programs have already earned master's degrees, and 4 percent hold doctoral degrees. Right now, many institutions consider programs that serve individuals who have already earned a degree as continuing education and offer a bounty of degree and certificate programs.

But in this new economy, those programs are often a poor match for real needs, in terms of time and money. Providing a lifetime commitment to learning at the individual course level rather than at the bundled program level or offering lower-cost options, much like Georgia Tech's online Master of Science in Computer Science (OMSCS) and online Master of Science in Analytics degrees, are ways to deal with these problems.

The Georgia Tech Commitment gives students the ability to better match learning to particular episodes of their lives, to start and stop at multiple points throughout their educational journeys, making it much easier to compile learning outcomes into something that has currency in the job market.

Award new kinds of credentials that recognize continual learning

The current array of legacy degrees does not adequately represent shorter-term modules that will be stacked together throughout a lifetime of continual learning. Inventing new credentials will offer the opportunity to create more efficient packages that certify continual learning. The foundation of traditional degrees is time spent in a seat; the depth of learning is equal to time spent learning. Credentials offered through the Georgia Tech Commitment could also break the historic underpinnings of the traditional degree by defining depth of learning through competency (what the learner actually knows) instead of time spent in the classroom.

Georgia Tech must consider other ways to recognize, accept, and reward learning through microcredentials that can be accessed anytime in a career. Microcredentials can help by packaging emerging knowledge with a brief shelf life into short programs that can stand on their own or as add-ons to traditional degrees.

At the rate new knowledge is being created and new skills are being demanded by employers, most workers cannot take two or four years from their working lives to achieve yet another degree as the only credential for learning. Beyond recognition, the churn of knowledge in workplaces will increasingly demand that higher education offer credible renewal of skills and basic knowledge. New educational products will be needed to meet that demand.

Build a Georgia Tech network in key locations around the globe

Even today, when it is easy to connect with anyone anywhere, physical location still matters. Take, for example, students enrolled in the OMSCS at Georgia Tech. The emotional attachment to Georgia Tech is real and can be witnessed at every well-attended networking event or meetup hosted by the Institute in cities around the world. Even students with no prior connection to the university are hungry to interact with their classmates and with Georgia Tech instructors, advisors, and alumni. Students will go out of their way to attend these events in their hometowns.

Others place such value on physical engagement with Georgia Tech that they travel hundreds of miles to attend graduation on campus—arriving in Atlanta from as far as India, Japan, and Ecuador. Much like Apple built retail stores to curate its ecosystem to give consumers a personalized experience, Georgia Tech must create accessible spaces for personal engagement.

We can think of these spaces as a twenty-first century reinvention of the "experiment station," an important outgrowth of the Morrill Act of 1862 that brought industrial and mechanical expertise closer to the citizens who needed it. For most of the twentieth century, Georgia Tech economic outreach in Georgia was accomplished through engineering experiment stations.

The Georgia Tech Commitment would replicate the mission of the experiment stations by providing cost-effective, high-quality educational services and experiences to Georgia Tech students and others by matching personnel, expertise, and facilities to the needs of the communities served. These Georgia Tech presences may be in retail settings, corporate campuses, and community social centers, or they may add educational depth to the social glue that is driving the worldwide growth of co-working communal offices.

In a gig economy when fewer workers are moored to a full-time employer, such spaces will become critical to lifelong learning and career success. Students now graduating from college seek out workplaces where sharing and collaboration can take place. Georgia Tech can meet that need by offering a network of locations with a mixture of shared or networked spaces, problem-solving or enrichment experts, access to special facilities, and opportunities to interact in person or online with individuals who have unique experiences to share but who would not otherwise be accessible.

Provide an advising and coaching network for life

The next generation of students coming into higher education requires Georgia Tech to rethink how it guides students through their college experience. This next generation also offers a unique opportunity for Georgia Tech to build an interconnected advising system that serves Georgia's elementary and secondary schools as well as Georgia Tech alumni.

The first step to reinventing advising at Georgia Tech is to build a network of virtual and in-person resources to provide better college counseling for Georgia's K-12 students. The Institute needs to take a more active role in high school advising for college to reverse the college-going statistics among low-income students and shape how students are being prepared for the rigors of higher education.

To better serve those students once in college, Georgia Tech must construct a comprehensive student advising system that takes advantage of appropriate student-level data. This system will help them negotiate the often confusing and massive course catalogs and direct their learning pathways to graduation.

Advising doesn't necessarily end with graduation. The Georgia Tech Commitment imagines a virtual advising system, a Personal Board of Directors, and electronic portfolios of graduates' work and evidence of learning that students take with them throughout their careers. This advising network would allow graduates access to career resources, one-on-one online coaching sessions, and face-to-face meetups in cities around the world.

A New Model for Higher Education

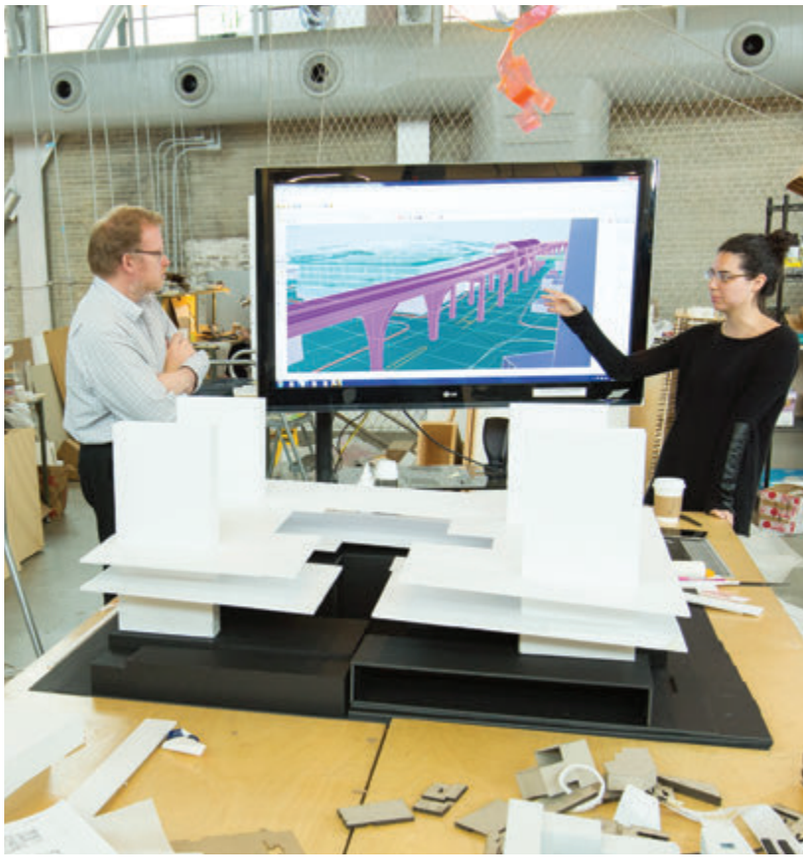
One thing that makes the Georgia Tech Commitment distinctive is the importance of the episodic learner, whose needs vary but begin much earlier in life than is traditional in higher education. Driven by needs that arise unpredictably, episodic learners will arrive at Georgia Tech outside the restrictions of well-established academic calendars and have learning experiences marked by an intensity of the sort needed to master complex material.

The Georgia Tech Commitment relies not on programmatic or classroom experiences so much as collaboration, networking, skills renewal, and expansion of knowledge—all experiences which might imply a vastly different business model. Rather than pay tuition to the Institute for courses or a degree, new learners might pay an annual subscription fee. It is even possible that traditional tuition-paying students would benefit if a portion of their fees were reserved for future-proofing by a kind of insurance program that offered renewal on demand to cope with the churn of knowledge. Georgia Tech learners are being prepared for workplaces where nonrenewable skills quickly become obsolete. In fact, the ideas of agile learners and skill renewal through affordable career sabbaticals are enabled by the Georgia Tech Commitment.

Much like the land-grant universities revolutionized higher education in the aftermath of the Civil War, the Commission believes the Georgia Tech Commitment anticipates the generational changes coming to higher education and the future of the workplace by adding to the Institute's mission; it is a commitment to serve new stakeholders with core programs and new educational products.

In fact, part of the challenge of the Georgia Tech Commitment is that to achieve it, entirely new modes of operation must be invented, new approaches to fundraising must be developed, and a workforce must emerge that is composed of not only traditional tenure-track faculty but also new professionals with new skills. This new workforce must be defined, nurtured, and recruited. No institution, public or private, that we are aware of has undertaken such an ambitious expansion of its mission.

The Commission envisions a pathway to the Georgia Tech Commitment that begins in early 2018 with the formation of working groups and teams. The first goal is the development of the Academic Master Plan (AMP), which will define the concrete steps, investments, and development schedule for the initiatives of the Georgia Tech Commitment that are laid out in Part Two of this report.



By almost every measure, Georgia Tech is significantly stronger today than it has been at any point in history. So, the institution enters a period of profound change in higher education from a position of strength. American colleges and universities face extraordinary challenges and rapid change in the decade ahead. Perhaps the greatest challenge facing higher education is a pressing need to adapt traditional teaching, financial, and research models to the demands of the twenty-first century.

Over the next decade, competition at the top of higher education will intensify. Science, technology, engineering, and math fields will continue to lead in funding and influence. Calls for more practice-based learning will grow louder. Greater partnership building and more unbundling of academic silos will occur. And nearly every academic institution will rush to embrace globalization and technology by securing international influence and digital learning tools.

Given all of these developments, the single best way for Georgia Tech to lead in the twenty-first century will be to become even more adaptable, further fusing premier teaching and cutting-edge research within an intimate and collaborative environment.

THE FIVE INITIATIVES

- Whole Person Education
- New Products and Services
- Advising for a New Era
- AI and Personalization
- A Distributed Worldwide Presence

PART TWO: THE INITIATIVES

To launch a complex and long-lived vision, the Institute must be able to set priorities. Since there are multiple pathways to Georgia Tech of the year 2040, it was not obvious to the Commission how to define these priorities. The scope of the Georgia Tech Commitment makes it clear that members of subsequent teams will make most of the important choices. However, in defining the Georgia Tech Commitment, the Commission paid special attention to the following characteristics and drivers of change that appear to be unavoidable, regardless of how the Georgia Tech Commitment unfolds over the next decade or more.

THE KEY ELEMENTS OF THE INITIATIVES

- Take actions today that prepare for success.
- Tackle problems that will have to be solved in any pathway to the Georgia Tech Commitment.
- Adopt the culture of a deliberately innovative organization to increase the likelihood that the correct problems are being addressed in every time frame.

Renewal The Commission found a near consensus among experts that the workplaces for which Georgia Tech learners are being prepared will have been transformed by technological and economic forces that reward continual renewal of skills and knowledge. These are workplaces where the churn of knowledge quickly makes obsolete those skills that are not renewable.

Early Achievement If it is to maintain its excellent student body, Georgia Tech must be concerned with the strength of its connections to and support of STEM education in the pre-college years. Georgia Tech can play a significant role in promoting early STEM achievement and improvement of STEM teaching and learning within the state and beyond.

Easy On-/Off-Ramps More than ever, future students will associate with rather than enroll in institutions like Georgia Tech. The idea of an admissions office as a gatekeeper makes less sense in such an environment. Instead, what is needed are easier ways for learners to establish and activate learning engagement. These are new on-ramps for which existing recruiting and admissions processes do not seem adequate. On the other hand, student engagement is not a seamless continuum of courses, grades, and degrees. Recognizing accomplishments that fall outside the traditional boundaries of credits and accredited degrees will be necessary as well. These are off-ramps that, even in the absence of an earned degree or certificate, will allow institutions to remain in touch from an educational standpoint.

Modern Conception of Advising Future students will be presented with ever-increasing complexity of choices. The current conception of student advising is not sustainable in that environment, and new tools for guiding students will be needed. As more course content is consumed online and more data are generated by the students who consume it, models that predict the outcomes of educational decisions will become more widely available. Advances in big data and analytics, improved technologies such as AI, virtual/augmented reality, and breakthroughs in cognitive science will be able to make use of this data and will certainly play a role in future advising.

Flexible Learning Experiences Future Georgia Tech learners will be much more heterogeneous. Cookie-cutter templates will be harder to come by as students mix and match course content, credentials, and brand value to prepare themselves for jobs in industries that do not necessarily align well with stable disciplinary boundaries or recognizable curricula. A factory-like, assembly-line model of education will no longer be sufficient. Younger students may lack the depth of understanding or maturity of current college freshmen. Older students do not need the formative mentoring that is typical in undergraduate programs. Some students will benefit from associating with cohorts, while others need space and time alone. For many reasons, the Georgia Tech Commitment will make flexible learning experiences a top priority.

Intense Learning There are many avenues available to learners who want to expand their educational experiences outside the traditional bounds of higher education. TED™ Talks, free massive open online courses (MOOCs), training videos, book clubs, and discussion groups organized around specialized topics are all modern-day incarnations of the early twentieth century Chautauqua, the traveling tent shows that moved across the plains of the American Midwest to bring interesting lectures, performances, and novel cultural experiences to families that otherwise would have had little access to the great ideas of the day. The modern Chautauqua expands educational experiences undertaken for enrichment purposes. In the Georgia Tech Commitment, episodic learning experiences are intentional and marked by standards of achievement. Unlike simple enrichment and most other experiences outside traditional residential instruction, the Georgia Tech Commitment is marked by rigor and intensity of the sort needed to master complex material.

Sustainable Financial Models Current methods of funding higher education are being strained to the breaking point. Tuition as a means of recovering the cost of education faces strong political and societal headwinds. Many institutions with large endowments thrive on increasingly selective admissions criteria that will ultimately affect their ability to address the same market as the Georgia Tech Commitment. The economics of this marketplace are poorly understood, but most analysts agree that transactional pricing (tuition per credit hour) is not a sustainable model. Value-based revenue generation (such as Georgia Tech's online master's degree programs) is innovative, and because it allows the Institute to reach new markets not currently served by higher education, it can be sustained into the foreseeable future. In other ways, however, all business models that rest on admission and enrollment in classes are at risk in a world where episodic education is the common mode of delivering value. New business models must address these realities.

Many experts briefed the Commission about the kinds of challenges that Georgia Tech will face in achieving the educational vision of the Georgia Tech Commitment. However, no two experts agreed on what the state of higher education will be or on the state of the tools that educators will have available to them over that period. An important part of the Commission's charge is to recommend actions that can be taken today that will bear fruit a decade or more down the road. The Commission identified five initiatives to grow our understanding of the problems and to create tools and conduct the experiments that will be required to make progress.

Included in these initiatives are immediate actions that can be undertaken today and longer-term projects that will require both invention and sustained research over several years to yield useful results. Near-term actions will better enable Georgia Tech to incorporate the results of the research that will stimulate innovation in the long term. Both will be needed to achieve the vision spelled out in the Georgia Tech Commitment.

HARVESTING LOW-HANGING FRUIT

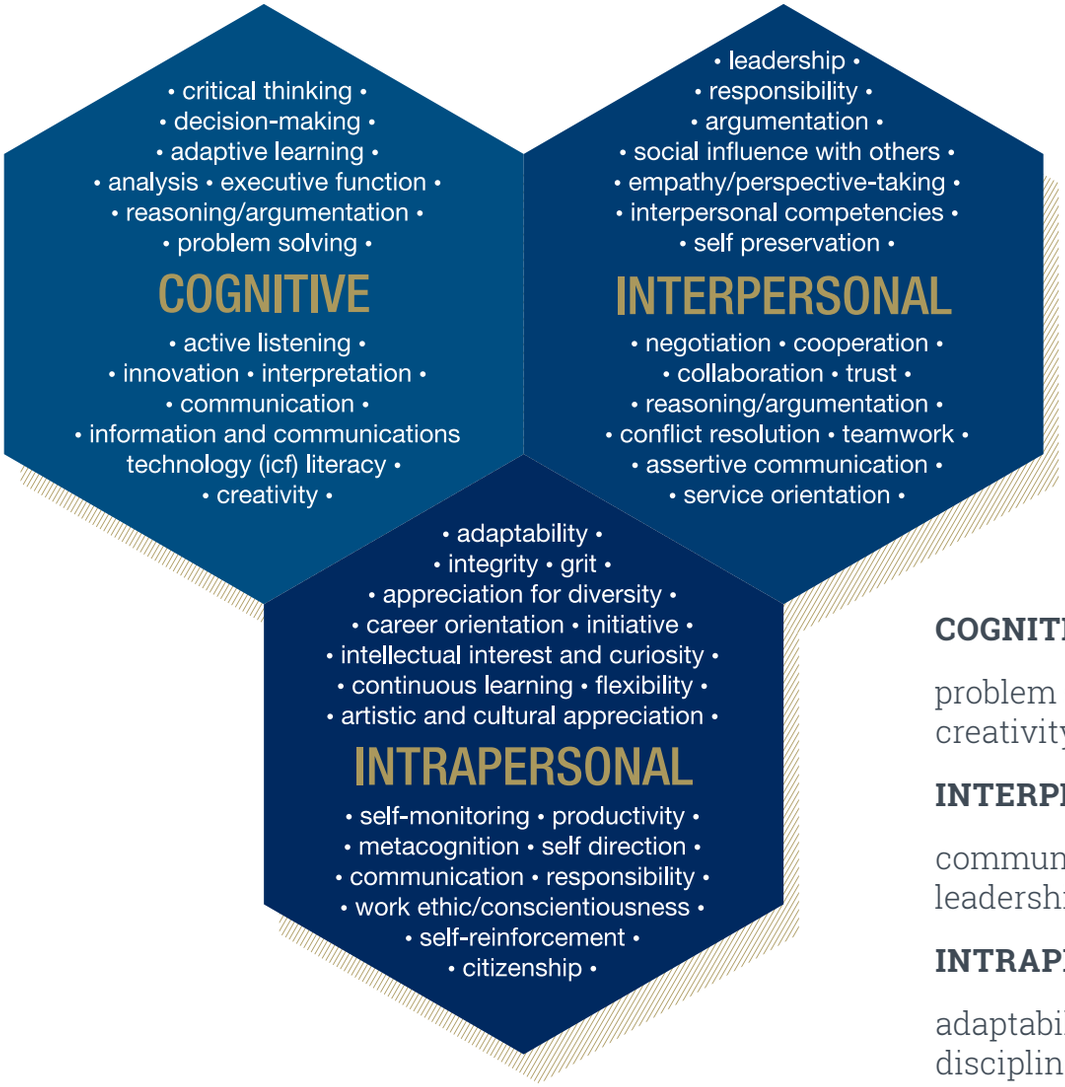
The immediate actions recommended by CNE are:

1. Expand current successful practices
    a. Learning by doing
    b. Globalization of on-campus classes
    c. Professional development for graduate students
2. First steps in longer-term projects and initiatives
    a. Matrix of mini-mester courses
    b. Graduate certificates
    c. Mastery and adaptive learning
3. A culture of becoming innovative
    a. Incentivizing educational excellence and innovation
    b. Faculty development programs

These initiatives are the result of many engagements over the course of the Commission's work. In these engagements, the Commission shared critical path challenges with participants but did not attempt to steer discussions beyond that.

Whole Person Education

Georgia Tech graduates have a reputation for strong technical skills and initiative, but, increasingly, other twenty-first-century skills are needed for success in the workplace. The constantly changing landscape of the current job market requires skills that are developed in college and grow over the course of a professional career. The Commission found that virtually all employers consider skills such as these to be a distinguishing characteristic for long-term success. Employers look to leading colleges and universities to provide graduates who have, in addition to deep disciplinary knowledge, the following three skill types:



COGNITIVE SKILLS

problem solving,
creativity, critical thinking

INTERPERSONAL SKILLS

communications, teamwork,
leadership

INTRAPERSONAL SKILLS

adaptability, initiative,
discipline, ethics, persistence

Source: National Research Council. 2012. Education for Life and Work:
Developing Transferable Knowledge and Skills in the 21st Century. Washington, DC: The National Academies Press)

ENHANCING EXPERIENTIAL LEARNING WITH WHOLE-PERSON SKILLS

Lab courses, studio and design courses, problem-based learning, and flipped classes all have elements that force students to develop skills that are cognitive, interpersonal, or intrapersonal.

Other experiences outside of a traditional classroom or lab broaden the experiences to specific contexts including co-op, research and project teams, Vertically Integrated Projects (VIPs), and entrepreneurial programs such as CREATE-X as well as study abroad.

Overarching themes in the Grand Challenges and Serve-Learn-Sustain programs give ethical and societal contexts for whole-person education.

Often called T-shaped thinkers, graduates who have demonstrated abilities in these dimensions are the ones most in demand. The Commission uses the term whole-person education to describe an educational experience that develops all three skill types.

A report from the Brookings Institution titled "The 'Great Gatsby Curve' for Character Skills and Mobility" (Reeves 2014) reports abundant economic data to support the value of whole-person education, particularly in the United States, where these twenty-first-century skills are predictive of long-term career success and intergenerational wealth. While cognitive skills are important, by far the strongest associations are due to metacognitive skills.

It is striking that among the metacognitive skills, those associated with character traits such as curiosity, drive, optimism, and social intelligence matter most. Because these traits exert such a strong influence on the long-term success of individuals in the workplace, the Commission recommends that the Institute tackle the problem of reducing or removing inequalities in character traits by creating new learning experiences that actively develop metacognitive skills.

It is, for example, not enough to challenge metacognitive abilities by requiring students to work in design teams. Learning how to effectively work in teams would develop those skills. This might be accomplished by underspecifying the scope of a classroom project, forcing students to explore societal or ethical issues prior to making judgments about the scope or duration of the project. The projects recommended by the Commission emphasize deliberate efforts to develop these skills. Expanding

Experiential Learning

Experiential learning embeds learning in authentic and relevant contexts. By doing so, it introduces learners to the challenge of problem seeking, not merely problem solving. A goal of whole-person education is to allow students to develop the skill to not only solve a complex problem but also recognize when a problem is worth solving. The CNE Report Supplement Learning by Doing (Georgia Tech 2018e) discusses experiential learning opportunities that currently exist at Georgia Tech and recommends ways to endow those programs with the contexts needed to develop whole-person skills.

Globalization at Home

A university culture that embraces globalization enhances the whole-person skills of problem solving and critical thinking in diverse situations while encouraging multicultural collaboration and an understanding of global and ethical issues in an ever-changing world. While Georgia Tech's study- and work-abroad programs are highly successful, more accessibility to global education will occur by expanding the presence of global education into standard campus course experiential learning situations. The CNE Report Supplement Whole-Person Development (Georgia Tech 2018h) contains recommendations for incorporating international perspectives into traditional coursework.

Professional Development of Graduate Students

The Commission recommends a sweeping approach to whole-person graduate education through professional development programs in addition to disciplinary and multidisciplinary knowledge. Master's students in particular should develop the following: professional competencies; transferable skills such as communication, leadership, and working in teams; and research. Ph.D. candidates should learn to work in collaborative and multidisciplinary team settings to develop appreciation of the ethics/norms of the scientific enterprise; management, leadership, financial, and entrepreneurial skills; and the capacity to communicate impact of work.

Whole-Person Curriculum

Whole-person development at Georgia Tech occurs in isolated pockets, not as part of a deliberate curriculum. The dominant STEM pedagogy in higher education is instructor-centered lecture, which emphasizes cognitive dimensions with little or no emphasis on the interpersonal and intrapersonal dimensions. The Commission recommends comprehensive teaching training on evidence-based practices, backward course design, effective group work, metacognition and reflection, and deliberate development of interpersonal and intrapersonal skills.

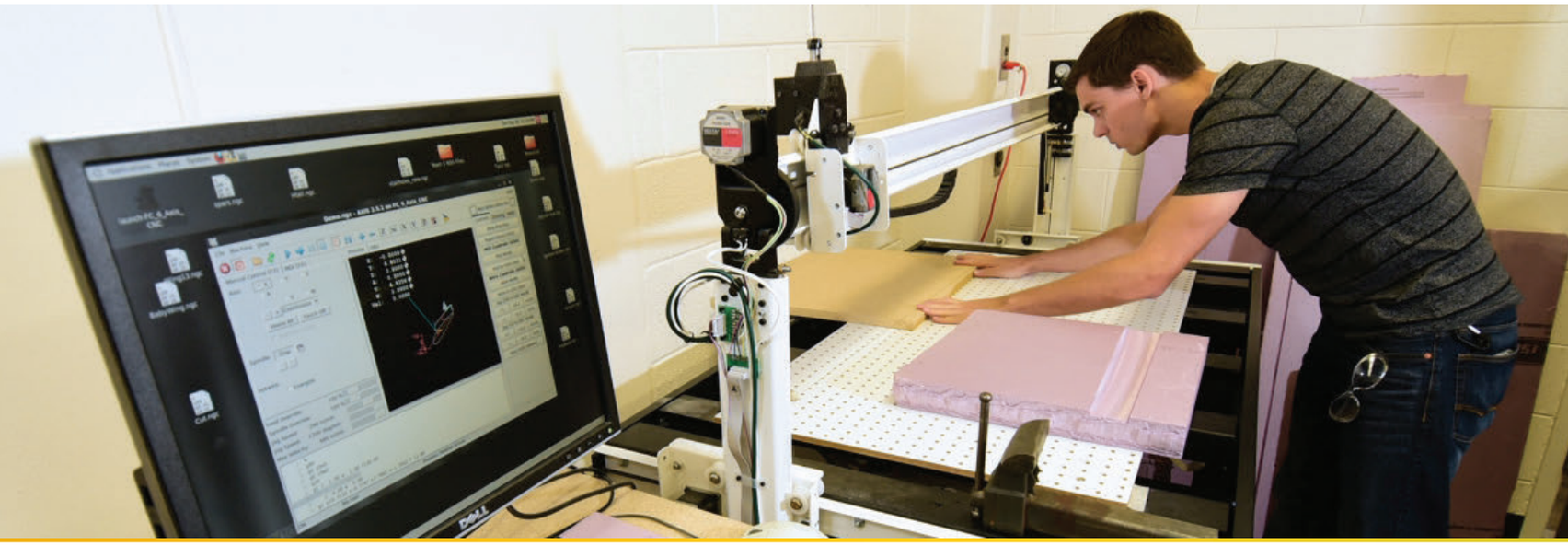
Metacognition embedded throughout the curriculum develops students who can self-monitor their academic progress. However, as is discussed in Part Three, innovation is required to take even these small steps.

The longer-term goal of implementing a curriculum to help students become self-aware and deliberate in their approaches to their educational and career paths should be embraced. Students have views of the world and their places in it that are formed by their life experiences. The Commission recommends the creation of spaces where learners can explore varied ideas with different perspectives.

One such curriculum, modeled on the formative leadership training at Flashpoint, includes development in areas where self-awareness and reflection are important. For example, students in formative leadership training learn how to identify their true interests and the ways they interact with others to critically analyze their own ideas to minimize resistance behaviors. Read more in the CNE Report Supplement *Formative Leadership (Flashpoint): One Georgia Tech-born Approach to Deliberately Innovative Education* (Georgia Tech 2018d).

In this process, students develop listening, observational, and interpersonal skills that reveal the hidden commitments and assumptions about themselves and others that could prevent an authentic idea from moving forward. They learn to listen, reflect, and respond to ideas with sensitivity.

Flashpoint is one of a number of initiatives worldwide that address these problems. Another is "The Science of Everyday Thinking," a course at The University of Queensland (The University of Queensland 2017) which explores the nature of everyday thinking, why people believe the things they believe, how to deal with opinion change, and why expectations and emotions skew judgments. University of Queensland students learn how to evaluate claims, why human beings consistently make the same irrational mistakes, and how to make better decisions.



New Products and Services

To meet the demands of evolving job markets and the desires of a widely disparate population of future learners, the Georgia Tech Commitment calls for flexible learning experiences and continual learning opportunities. Georgia Tech's existing educational products include undergraduate and graduate degrees, minors, certificates, credit-bearing courses, webinars, workshops, MOOCs, short courses, and conferences.

New products will need to be created that allow future learners the ability to customize their educational experiences to achieve the credentials relevant for particular points in time of their career and individual lifetime journeys. For example, services should be expanded to advise learners on how these products can be bundled to form cohesive episodic educational experiences that are recorded in a manner to showcase them to outside organizations who recognize and value them.

Higher education institutions still recognize learning credentials mainly at traditional degree levels—associate, bachelor, master, and Ph.D. Within undergraduate and master degrees, the basic unit of completion is still the Carnegie credit hour. New products would include types of learning credentials that are more granular and more reflective of student achievement than current degrees and reflect new ways to recognize progress toward credentials by unbundling courses and reimagining the credit hour as a unit of learning.

Microcredentials

The Commission recommends the development of microcredentials— including badges, certificates and microdegrees— which offer the opportunity to create more efficient packages that certify learning. Experience with the Georgia Tech OMSCS has shown that there is a demand for working professionals who have existing degrees—master's or even Ph.D. degrees–to come back for another degree if the topic is of interest in the workforce and the price point is right. Microcredentials offer the advantage for learners to earn one or two small-sized credentials in a desired area or to stack together a set of microcredentials to form a typical master's degree.

Georgia Tech is already pursuing the ability to offer graduate certificates, which are ten to twelve credit-hour stand-alone credentials. Such certificates are the fastest growing type of credentials in universities across the United States. Future students can earn multiple certificates over a span of time that is appropriate for their situation, where than can choose to earn the certificates in a cohesive manner so that they can be stacked together to form a more traditional master's degree or they can choose to earn certificates across a broad range of disciplinary topics.

A Matrix of Minimester Classes

A matrix of short courses in a minimester format can overlay on a regular semester calendar. A simple solution would be to offer three concatenated five-week minimester terms with courses meeting for three hours per week. These courses would have the same weekly intensity of a standard three-credit hour course but would not last as long, having less depth of material. This matrix format would allow students to compose a three-credit-hour course from three one-credit-hour courses.

The minimester framework can be used in a variety of ways: for whole-person education, future faculty training, partnerships in education, addressing the Georgia Tech Commitment, and experiments in pedagogy and curricular design as detailed in the CNE Report Supplement New Educational Pathways: Better Granularity and Greater Flexibility (Georgia Tech 2018f). Because of its versatility, this idea has resonated among students, faculty, and administrators, who see it as an opportunity that fits their own needs and wants.

Transcending the Carnegie Unit: Credit for Accomplishment

Recognizing that the Carnegie Unit of time spent in class is not a useful measure of what has been learned, competency-based education (CBE) has become a popular way of keeping track of skills acquired. Continued reliance on the Carnegie Unit raises a number of problems for the Georgia Tech Commitment. For example, much of the novel curriculum resulting from the implementation of Commission recommendations consists of project-based learning and other kinds of active learning not adequately addressed by the Carnegie Unit.

Continuing attempts to translate skills demonstrated in a project to an equivalent thirty-hour lecture/recitation/test is not an efficient way to track student progress. This problem is compounded in the Georgia Tech Commitment since many learners will combine project-based learning, e-portfolios, and certificates of mastery with traditional credit hours based on accredited Carnegie Unit assessments.

One possibility is to abandon the traditional lecture/credit-hour format and adopt skills assessments like those found in CBE. Some peer institutions like Franklin W. Olin College of Engineering have successfully combined project-based instruction with skills assessments to create a true competency-based program. However, in the Commission's estimation, Olin's model is prohibitively expensive.

As reported in its Discovering the Drivers of Change report (Georgia Tech 2016), the Commission found that CBE programs like the ones used at Western Governors University (WGU) and Southern New Hampshire University (SNHU), both of which concentrate on basic skills to the exclusion of more advanced understanding of abstract material, are the most common in the United States. Yet programs like these were found to be a mismatch for Georgia Tech students.

Another approach to incorporating competencies is the one used by the CDIO™ *Initiative*, which, like CBE, establishes an outcomes-driven assessment model based on real-world engineering projects. CDIO affiliate members include many Georgia Tech peer institutions, so there is no doubt that it is possible to construct a challenging, highly regarded curriculum using the CDIO framework.

On the other hand, CDIO does not anticipate the episodic learning trajectories of the Georgia Tech Commitment, so any departure from the Carnegie Unit based on a CDIO framework would inevitably require case-by-case consideration of credentials from other programs for students who transfer into a Georgia Tech degree program, an approach which the Commission believes does not scale well.

Another problem not addressed well by either CBE or CDIO is the churn of knowledge problem in the future workplace. Any fixed listing of skills must confront the speed at which knowledge is changing in key industries. An approach to replacing or supplementing credit hours that requires the concurrence of a third party (like an accrediting agency) or the membership of a consortium (like CDIO) will not be agile enough for the workforce of 2040.

CDIO™ INITIATIVE

The CDIO™ Initiative is an innovative educational framework of Chalmers University of Technology aimed at producing the next generation of engineers. It provides students with an education that stresses engineering fundamentals within the context of conceiving, designing, implementing, and operating (CDIO) real-world systems and products. CDIO Initiative collaborators throughout the world have adopted CDIO as the framework for their educational curricula as well as their outcome-based assessments (CDIO n.d.).

Therefore, the Commission recommends a project aimed at defining a new unit of learning that is tied to achievement but not to a set time in which the achievement must occur. This new unit of learning is intended to be flexible enough to encompass most existing active learning pedagogies but also goes beyond existing active learning in important ways. For example, Georgia Tech will continue to develop novel team learning experiences that are not readily amenable to credit-hour assignment as a unit of achievement but which also differ from project-based learning in fundamental ways.

The same holds true for co-curricular participation, not-for-credit time spent in maker spaces, and creative works that result from design studios. This new unit will be a measure of experiential learning called Dewey Units, in celebration of John Dewey's commitment to learning by doing as described in Experience and Education (Dewey 1938). Research shows that many of the experiences students have outside the traditional classroom, e.g., when they engage directly in research, discovery, and design, help them to develop whole-person skills.

Establishing a unit of learning by itself is not enough. A Dewey Unit is only meaningful if other institutions recognize it as unit of learning and if employers recognize it as knowledge that can be applied to benefit industry. In other words, establishing a unit of experiential learning also requires the establishment of a market for granting and recognizing those units and assigning a value to them. The final project in this initiative proposes the creation of such a market based on new blockchain technology.

The Blockchain Credential Project

By the year 2040, learners will acquire skills in a wide variety of ways and in varying quantities, or units. While degrees, credits, and courses may persist as common units of achievement, it seems likely that Dewey Units and other units of accomplishment will become common as well.

Certificates, seminars, workshops, and self-paced modules may all equip a learner with valuable knowledge, skills, and accomplishments. Utilizing blockchain technology, it is now possible to create decentralized transcripts that allow users to combine such evidence of learning and achievements into credentials that are relevant to potential employers.

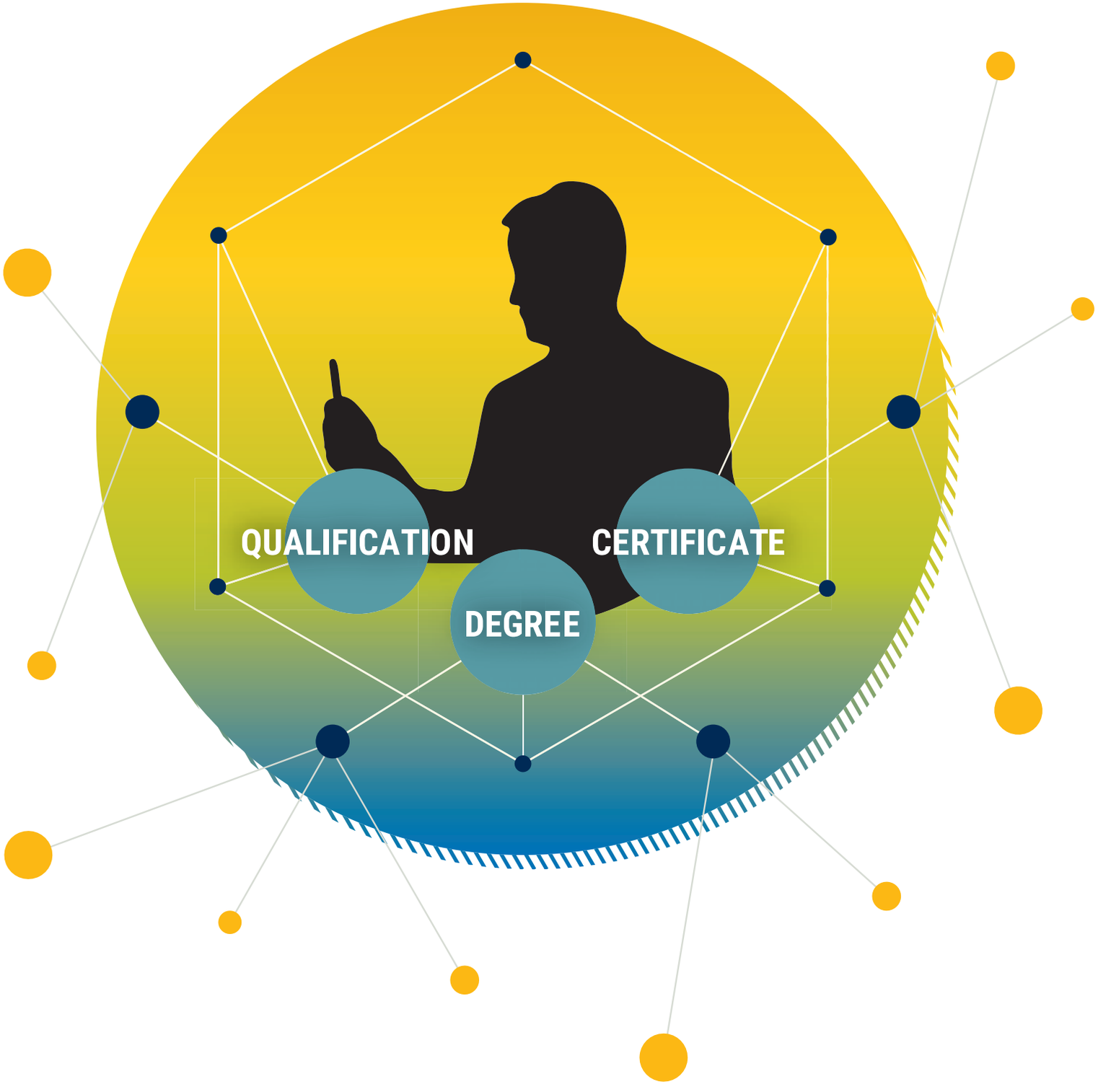
Episodic learners will leave a digital trail of accomplishments scattered among various institutions. However, these institutions may not recognize other units of learning, and employers will be forced to try to make sense of fragmentary data that cannot effectively be used to compare prospective employees. Third parties such as accreditors, ranking organizations, and placement firms are used today to solve some of these problems, but third parties are expensive middlemen and gatekeepers.

The goal of the Blockchain Credential Project is to develop an efficient and secure information infrastructure to manage these digital trails without the need for third parties or central authorities. With blockchain credentials, learners can record digital credentials that document achievement into a global digital transcript where records are consumed by employers, educational institutions, and other stakeholders in the higher education system.

The underlying technology that enables the creation of such a global system is called blockchain, the same technology that enables cryptocurrencies like BitCoin™ to function independently of central authorities. It is complex, and because it relies on the mathematics of cryptography, the details of how a blockchain works may seem intimidating.

However, in the age of the Internet, we have grown accustomed to relying on tools that are not easily understood. Most people, for example, are only dimly aware that the simple act of opening a web browser initiates a stream of coded messages to hundreds of computers that locate remote resources, authenticate users, and route information around the world. Because blockchains allow millions of users who have never met to securely agree on a single, global ledger of transactions, they are now being adapted to record contracts and manage the flow of documents through global supply chains.

Pilots and experiments aimed at exploring these ideas are now underway at a dozen university labs around the world. The Center for 21st Century Universities (C21U) at Georgia Tech is building prototype blockchain infrastructure that facilitates sharing and assigning value to the growing number of nontraditional certificates and credentials.


QUALIFICATION
CERTIFICATE
DEGREE

Advising for a New Era

A key plot element in the Neal Stephenson novel *The Diamond Age: Or, A Young Lady's Illustrated Primer* (1995) revolves around educational technology—a book that is actually a person's lifetime companion in learning. The Primer in this novel is AI. It monitors, suggests, coaxes, guides, reprimands, and teaches what is most valuable in any given circumstance. Merely possessing a personalized copy of The Primer has such a profound effect on the course of an individual's life that it is reserved for the most privileged members of society. The novel describes what happens when a copy accidentally falls into the hands of a child of more humble roots.

While the Commission is fully aware that The Primer is a science-fiction device, members are also struck by how little effort has gone into the notion that lifetime companions in learning that suggest, coax, guide, and teach can change the course of a person's life, a conclusion supported in part by the landmark Brookings Institution study "The Missing 'One-Offs': The Hidden Supply of High-Achieving, Low-Income Students" (Hoxby and Avery 2013).

The "missing one-offs" of their study are those low-income, high achieving students for whom the effect of such coaching would be most profound. Public universities have a special responsibility to ensure that socioeconomic differences among students do not turn into barriers to success. The prospect of a lifetime learning companion is especially compelling for those institutions. Such a companion would, in the words of one of the experts who addressed the Commission, "erase accidents of circumstance" that are often the difference between success or failure.

The Georgia Tech Commitment seems to require a new approach to advising, one that not only serves traditional roles but also addresses the new role that advising will play in guiding both very young students and older learners. It offers a unique opportunity to build an interconnected guidance system that serves Georgia's secondary schools as well as adults pursing lifelong education.

Advising for a New Era is a challenge to the traditional fragmented approaches to advising. The Commission recommends an initiative to integrate planning, advising, and coaching through a robust learner data backbone and AI assistants that will make use of lifetime data to provide personalized advising at scale.

Tasks within immediate reach include course selection and scheduling as well as career placement. Advice on whole-person development will require the development of more human-aware AI. These capabilities will supplement the needs of Georgia Tech learners throughout their lifetimes.

The long-term goal of this initiative, described in more detail in the CNE Report Supplement *Advising for a New Era* (Georgia Tech 2018a), is to bring three distinct aims of advising (prescriptive, intrusive, and developmental) under a single data-driven umbrella.

ADVISING FOR A NEW ERA

Advising for a New Era is a challenge to the traditional fragmented approaches to advising. The Commission recommends an initiative to integrate planning, advising, and coaching through a robust learner data backbone and AI assistants. These capabilities will supplement the needs of Georgia Tech learners throughout their lifetimes.

Prescriptive Advising

Faced with a confusing maze of curricular options, students often naturally play it safe and look to advisors for help. As a result, academic advisors frequently spend much of their time sorting out sequencing problems in a student's schedule instead of mentoring students or assisting them in areas where they are struggling.

Prescriptive advising seeks to correct these issues, using technology that is akin to GPS mapping to provide students with highly structured, coherent degree maps that align with career and further educational goals. This approach simplifies student decision-making and allows colleges to provide frequent feedback so students can complete programs more efficiently.

Intrusive Advising

Intrusive advising strategies are based on individual performance and are designed to identify students who need help the most but typically never seek it. Computer algorithms can pinpoint students most at risk and trigger early alerts on which professional advisors can act. Effective intrusive advising depends more than anything else on accurate and complete data about ongoing student performance.

To achieve this, Georgia Tech must integrate student data into a common database and make it available to predictive analytic models that advise students on which courses to take, ensures classes are offered when students need them, and then, once students are enrolled in classes, generates alerts about performance issues for faculty members and students.

Developmental Advising

Developmental advising helps students understand and articulate their talents, find what engages their passions, and discover what gives purpose to their lives. It leads to selection of majors and other academic offerings, choosing cocurricular and extracurricular activities that promote leadership development, and preparation for careers, including graduate school and entrepreneurship.

As students and parents become more concerned with return on investment, many institutions are witnessing a rise in the importance of developmental advising. In the absence of developmental advising programs and practices, mostly in career services, students end up taking advice from peers or parents and can form misconceptions about professional opportunities available post-graduation.

Prescriptive advising addresses how students will meet well-defined progress goals. Developmental advising, in contrast, is aimed at personal development. It therefore blends forms of advising that are often the responsibility of faculty mentors, academic advisors, and career advisors and counselors.

This initiative proposes three projects that address critical problems that must be solved if this new approach to advising is to be applied to the Georgia Tech Commitment: scaling, cognitive aids for human advisors, and effective, technology-based mechanisms for developmental advising that can be used by older learners as they progress through their careers.

Personalized Advising for a Lifetime

One characteristic of Advising for a New Era is that advice is tailored to the needs and prospects of individuals. Lifelong mentoring entails not only advising for traditional college students but also coaching for K-12 students and mentoring for older learners and alumni. A human mentor might be able to track a student's progress over many years and deliver that kind of personal advice, but the costs of individualized mentoring services are prohibitively large.

By the same token, human mentors are necessarily limited in the scope of their expertise, which means that large numbers of advisors are necessary to provide knowledgeable coverage of areas. Again, the costs of human-delivered personalization are unrealistically large. Therefore, a key problem to be solved in arriving at a new model of advising is how to support personalization at scale.

The information available to personalized advising systems is not static. It not only should consist of information regarding courses, degrees, and careers, but also should consider classroom performance, prior engagements, and measures of progress. For example, effective intrusive advising depends more than anything else on accurate and complete data about ongoing student performance. To achieve this, Georgia Tech must integrate student data into a common data backbone and make it available to predictive analytic models that advise students on which courses to take, ensures classes are offered when students need them, and generates post-enrollment alerts about performance issues throughout the semester.

An important element of the evolving architecture for supporting personal advising at scale could be the use of AI to partially automate the process. Georgia Tech research on AI-based teaching and learning has already demonstrated promising results on question-answering interactions. Projects aimed at scaling for a lifetime will inevitably connect with teaching and learning systems.

Technology-Enhanced Advising

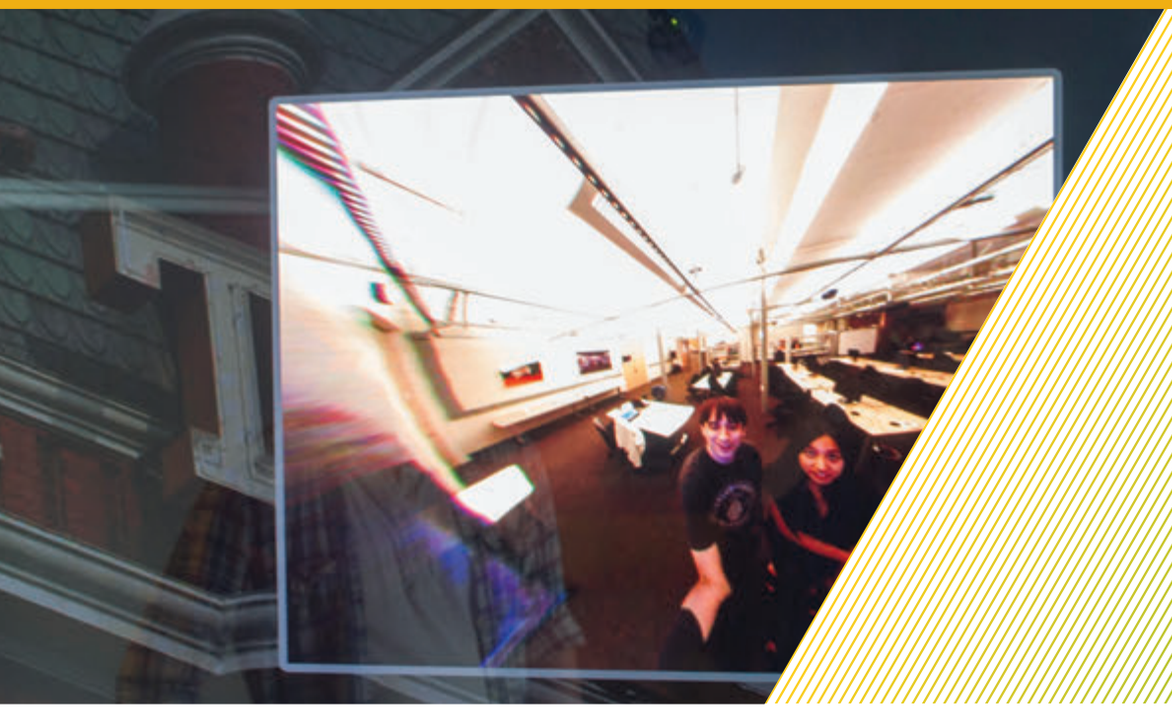
As the Institute moves toward a new model for advising, Georgia Tech will need to find new ways of supporting personalization at scale. This raises the issue of how to scale advising from a few thousand students to hundreds of thousands of people. Advising for whole-person development implies advising not only about course requirements and career placement but also for intrapersonal and interpersonal development.

This reinforces the importance of the personal nature of mentoring. Both scale and personalization are important even for traditional advising of college students. One of the reasons the current system for advising perhaps does not work as well as it should is that the productivity of advisors seems to be immune from the kind of technology enhancements that have enabled scaling in other industries. Lifelong and whole-person advising, which require even higher degrees of personalization, will compound the problem.

An important element of the evolving architecture for supporting personal advising at scale could be the use of AI to partially automate the process. While some elements of advising are personal and clearly require human mentors, other elements are susceptible to productivity-enhancing automation.

Automation can even enhance personalization. For example, an undergraduate student interested in designing a personalized course of study for the economics of climate change may benefit from a system that can access all relevant courses, keeping track of students with similar interests who have found those courses useful. Internet-based social filtering algorithms of the kind used in commercial recommender engines are known to be very good predictors of such preferences.

Preferred courses constitute a first approximation to a preferred program of study that can be successively refined by human counselors and advisors. As advising expands to encompass deeper questions of lifelong learning and whole-person development, social filtering algorithms might become more adept at tasks such as course scheduling, curriculum design, and career placement. In complex environments social filtering algorithms like recommendation engines are used for the personalized discovery of activities or resources that are popular among individuals with similar needs.



A Personal Board of Directors

Advising for life needs a strong human element. There is a rich network of people who share a connection to Georgia Tech. This includes current students, faculty, and staff as well as alumni. One of the best ways that the Institute can add continued value to a Georgia Tech degree is by fostering the growth of a professional network for every learner. An outgrowth of the OpenIDEO Future of Higher Education Challenge (OpenIDEO n.d.), the Personal Board of Directors project uses social networking to establish and grow such a network.

The vision for the Georgia Tech Commitment includes a flexible network of peers, advisors, mentors, and colleagues from which Personal Boards of Directors will be assembled to foster high-value interactions around intellectual and professional goals for both undergraduate and graduate degree holders, adding a distinct value to Georgia Tech offerings.

Enabling students to build professional networks more easily can also help those who may not have an existing community offering advice and expertise about the college experience (e.g., first-generation college students). In this way, a Personal Board of Directors can be a critical part of advancing future career and education choices for those in greatest need of social mobility.

Students can also function as board members for alumni, turning the traditional mentor/mentee relationship upside down. People who have lost a connection to the Georgia Tech community may find a new spark of inspiration from current students. Both students and alumni will find that engaging with Georgia Tech is not just a transaction that yields a static degree but is rather joining a community of scholars and educators who will be able to help them continually navigate through a dynamic professional landscape.

GEORGIA TECH AND IDEO

Georgia Tech and IDEO, an international design and consulting firm, partnered to sponsor and participate in the OpenIDEO Future of Higher Education Challenge. The global initiative was announced November 15, 2016, at the White House by Department of Education Under Secretary Ted Mitchell. Winners were announced in February, 2017.

The Challenge provided faculty, staff, and students with the opportunity to submit ideas on how both Georgia Tech and the global higher education community can innovate and meet the challenges of tomorrow. Other OpenIDEO Challenge sponsors include Arizona State University and Global Silicon Valley (ASU GSV) Summit, Level Education from Northeastern University, USA Funds, and the U.S. Department of Education.

Artificial Intelligence and Personalization

There have been great strides in the science and the technology of education over the last several decades. Scientists now have a deeper scientific understanding of the cognitive, social, and cultural processes of learning. For example, the role of personalization, formative assessment, and metacognition in learning are much better understood today.

On the other hand, computing technologies of the internet and social media are also transforming education—for example, the development of entirely new categories of programs, including the Georgia Tech Online Master of Science in Computer Science (OMSCS) and OMS Analytics degrees. Further, the combination of the new understanding of learning and the availability of online educational materials has led to broad adoption of pedagogies such as flipped classrooms and blended learning.

In the science of education, there will be continued progress in the cognitive and learning sciences, especially cognitive neuroscience. A generation from now, there should be a much deeper understanding of how the human brain processes information and how the human mind learns.

We can also expect rapid progress in technology, especially in artificial intelligence (AI), which is beginning to impact education in a myriad of ways, including intelligent tutoring systems and question-answering agents. It is likely that current movement toward scale and personalization will not only continue but also accelerate, with AI acting as the key accelerator, as detailed in the CNE Report Supplement *Exploiting Artificial Intelligence (AI) for Personalized Learning at Scale* (Georgia Tech 2018c).

The internet has enabled the commoditization of knowledge, with virtually every fact or concept ubiquitously available at the touch of a button. The ability to guide students through complex content domains, arrange experiences that allow them to apply their budding expertise, and provide effective feedback that enables them to refine and improve cognitive models cannot be so easily commoditized. To do this at scale and with a high degree of quality, AI will be necessary.

The "Jill Watson" experiment, which utilized IBM's Watson system as a basis for an artificially intelligent teaching assistant called "Jill", was widely hailed as a breakthrough in both AI and educational technology.

But for all her success, "Jill" is a question-and-answer tutor. The opportunity now exists to augment "Jill's" skills to handle other tasks that are associated with personalized learning, allowing advisors to go beyond scheduling and keeping students on the path of timely completion of degrees to become powerful partners in learning. A multifunction virtual tutor can be deployed to advisors, coaches, and even mentors located in a Georgia Tech atrium™, as described in Initiative #5 below.

Using such facilities, trained specialists can deliver personalized learning services. The platform for these services is an AI-enabled personalized learning system. Such a system must be able to answer questions effectively and with a human touch. The system must also help design formative assessments, be a cognitive tutor, and provide metacognitive tutoring capabilities. The development of such a tutor will require advances in human-centered AI and the ability to apply it to specific domains.

In the near term, AI-based platforms for mastery learning, which have been tested across subject matter and student populations for more than thirty five years, can be married to online and adaptive learning platforms. These platforms, due to their ability to provide flexible learning, remove time as a critical variable to learning. Georgia Tech will explore these effective learning methodologies to raise general levels of achievement to those normally associated with the upper 10 percent of learners.

The Commission recommends pilot projects to test appropriate adaptive learning platforms that can be customized by instructional faculty. Some of these experiments may include interactive books, interactive videos, and AI agents like "Jill Watson" for many Georgia Tech classes, especially large, bottlenecked, remedial, and/or online classes. Some of these adaptive learning platforms can also be transferred to pre-college and post-graduate education.

THE "JILL WATSON" EXPERIMENT

In 2017, Georgia Tech began its third semester using virtual teaching assistants (TAs) in an online course, a year after "Jill Watson" was introduced in the class on Knowledge Based Artificial Intelligence, a core course taught by Professor Ashok Goel as part of the Online Master of Science in Computer Science degree program.

"Jill," originally implemented on IBM's Watson platform, answers frequently asked questions without the help of humans. In spring 2016, the students didn't realize her identity until they were told on the final day of the class.

Recent results show that "Jill" has a personality: she is conscientious, optimistic, and resilient, three traits often associated with effective teaching. These findings also indicate that interactions with "Jill" enhance student engagement that is often strongly co-related with student performance. This is because "Jill" provides more timely answers to student questions.

Virtual teaching assistants as illustrated by "Jill" were recently recognized as one of the most transformative technologies to impact college within the past 50 years by The Chronicle of Higher Education (Myers and Lusk 2016).

To keep ahead of fast-moving innovation elsewhere, the Commission recommends that Georgia Tech develop a multifunctional virtual tutor that can combine cognitive and metacognitive tutoring tasks normally associated with human teachers, such as coaching on open-ended projects and critical thinking development. Such a tutor can be available in the next two to five years. A multifunctional tutor will push the envelope on personalized learning by tailoring the kind of assistance to the needs of individual students, offering formative assessment and metacognitive tutoring based on individual progress, and providing contexts for other functions. For example, a "Jill Watson"–like AI agent operating as part of a virtual multifunctional tutor would be able to answer more complex questions about concepts taught by the cognitive tutors.

In the longer term (up to fifteen years), the development of a multifunctional virtual tutor fully capable of supporting personalized learning at scale would require interactive AI agents whose interactions with humans use cognitive models of humans and contextual knowledge to enhance the quality of the human-AI interactions. Human-centered AI focuses on developing interactive agents that can live, work, play, and learn with humans.

A Distributed Worldwide Presence

The idea of a physical campus—a designed space for students, teachers, and educational programs—has been a mainstay of the college learning experience for a thousand years. There are only a handful of counter-examples. England's Open University evolved from radio and television delivery of university courses to its current online format without the need for a physical campus, and Western Governors University, a collaboration of higher education systems in western and midwestern states, is an online, competency-based undergraduate university that augments traditional distance education programs. For most students, however, enrolling in college classes means traveling to a central location for educational services and access to resources.

The facilities and permanent educational staff of a campus have some advantages for a university with a traditional mission and complex programs to administer. The vertical integration of a central campus permits economies of scale that would be difficult to achieve otherwise. It was the model that authors of the Morrill Act had in mind when federal funds in the form of land grants were provided to enable colonial colleges and universities to expand classical university curricula to agriculture and the “practical arts,” for example. The central campus works because in American higher education, colleges can establish upper limits on enrollments and create economies of scale to deliver services to that number of students.

Georgia Tech Atrium™

The physical campus is, however, a fragile model. This is especially evident in public education, where regional colleges and universities that are essentially copies of much larger land-grant and flagship institutions are established in localities that would otherwise not have access to college-level programs. This has the advantage of making educational facilities broadly available, but it does not necessarily match services to regional needs.

In today's financial climate, one effect of this mismatch is that the high fixed cost of operating a central facility cannot be sustained when there are not enough students interested in the high, fixed-price degrees and programs offered in that facility. Institutions that have tried to open foreign campuses have also seen this effect. The economics of a central campus only make sense either when the portfolio of programs can be sustained by students who are interested in traveling to the campus or when the local economy can subsidize low-enrollment programs and underutilized facilities.

In the digital age, this is known as the long tail effect: economies of scale only justify fixed-cost investments for the most popular products or programs, while less popular programs (in the tail of the distribution) either must be subsidized, thus driving up the costs of the popular programs, or must be offered at higher prices, which further depresses demand.

One consequence of the Georgia Tech Commitment is that more students will avail themselves of programs and services in the long tail. It is always an option to try to provide remote or online facilities to connect those students to the physical campus. However, Georgia Tech's experience with its OMSCS program proves that it is possible to be near the majority of the students with a relatively small footprint.

For example, as many as 80 percent of OMSCS students in the United States live within two hours of one of ten major population centers. The question then arises as to whether there is an alternative to the central campus that can be deployed at a national or global scale.

This is essentially a twenty-first century reinvention of the nineteenth-century idea of the experiment station. Agricultural experiment stations were an important outgrowth of the Morrill Act, and for most of the twentieth century, Georgia Tech economic outreach to the state of Georgia was accomplished through engineering experiment stations that co-located industrial and mechanical expertise closer to the citizens who needed that expertise the most. The Commission recommends a pilot program to test the idea of a scalable distributed presence, called the *Georgia Tech atrium*™, based on this model.

Just like a physical atrium in one of Georgia Tech's new campus buildings, the Georgia Tech atrium™ is a scalable gathering place and a portal to real and virtual services. As the Commission envisions it, the atrium™ is an open space that can be programmed to suit the needs of learners, a venue for performances and events, and a way to provide social glue for learners, professors, and others who want to be associated with Georgia Tech. It is also a market, anchored by two shops—the Library Store and the University Learning Store.

The Library Store enables individuals who do not have physical access to a research university library to learn, create, and research (Bailey 2017). The University Learning Store, Georgia Tech's award-winning shopping experience, provides courses, certificates, and degrees in an online format (Goss 2017). The atrium™ might also contain career service centers, personal counseling and advising studios, and an Invention Studio, as well as space for meetups associated with Georgia Tech's online courses. The Georgia Tech atrium™ would provide cost-effective, high-quality educational experiences and services to Georgia Tech learners and community members by matching personnel, expertise, and facilities to the needs of the communities served.

Although the size and scope of each Georgia Tech atrium™ will be determined by its physical environment, they will all have the following characteristics:

- They will not require classrooms or other forms of educational delivery to support operations.
- They will be a key component of Advising for a New Era and will place an emphasis on mentoring, advising, and collaboration.
- They will employ highly skilled educational professionals with broad subject matter expertise and back them with an extensive, technologically enabled infrastructure that provides on-demand access to more specialized knowledge and resources.
- They will make generic space and services available to anyone with Georgia Tech credentials.
- They will be available on a pay-for-services or subscription basis to non–Georgia Tech students.
- They will incorporate laboratory and maker facilities that can be deployed in a self-contained, self-administered way.

Each of these characteristics requires more extensive study; one of the goals of this program is to investigate the feasibility of the Georgia Tech atrium™ model as a way of implementing a physical presence for the Georgia Tech Commitment. A pilot project to further develop these ideas should begin shortly after the Commission completes its work.

Living Library for Learning

Another way to support distributed presence is through a *Human Library*, a concept initially developed by an international organization in Copenhagen in 2000 (http://humanlibrary.org/). A Human Library allows readers to interact with human books, volunteers with different backgrounds and social experiences. The volunteers are "on loan" to their "readers" for face-to-face conversations during organized events. The Human Library helps its users gain different perspectives on problems and events, oftentimes helping to break down barriers and address implicit bias.

The Commission proposes to apply the Human Library model more broadly to higher education as a Living Library for Learning (L3). Georgia Tech students of any age could obtain a very different learning experience through conversing with a "human book" in addition to reading traditional books. Not only can

students learn perspective, depth, and context of knowledge from such conversations, they can also experience authenticity of content and can build a connection with these human books, thus expanding their social capital. As detailed in the CNE Report Supplement The Living Library for Learning (L3) (Georgia Tech 2018g), the goal of L3 is to establish and curate a collection of human subject matter experts who agree to be called upon when they are needed.

Successful subject matter should be well defined while at the same time having broad appeal. Examples abound in engineering education. For example, students often study structural or system failures, but such events are slow to be analyzed and incorporated into university curricula. Even when they are, students are exposed only to second- or third-hand accounts in case studies, never to the principals (engineers, regulators, decision makers, administrators, environmentalists, or government officials) whose actions were most important at the time of the event. Symposia and conferences are sometimes hosted, but they are very expensive to conduct and not available to a wide audience.

Major problems would have to be solved to make this a reality. This project would necessitate a large enough collection of individuals to permit a classification of topics. There would need to be combinatorial richness in the numbers of individuals, and details such as compensation and legal liability limitations would have to be addressed. However, the Human Library idea is not a new one, and there does not seem to be any reason in principle it could not be applied to higher education in the form of a Living Library for Learning (L3).

PART THREE: THE CULTURE—BECOMING DELIBERATELY INNOVATIVE

The Georgia Tech Commitment and the initiatives proposed to achieve it are bold. They must be supported by an underlying culture of educational innovation that is robust, agile, and adaptive to disruptive forces and a rapidly increasing rate of change in technology and society.

An academic culture, like other organizational cultures, is often composed of unspoken and unwritten rules regarding working together. This culture reflects the shared underlying assumptions, values, beliefs, attitudes, and behaviors of a group of people. The mindset of the members of the community, curricular structure, organizational structure, and administrative processes all work together to sustain an academic culture.

Georgia Tech's current culture of educational innovation has produced internationally recognized innovations. But the Commission also recognizes that the success of the initiatives outlined in this report depends on systematic and deliberate innovation of a kind not common in academic institutions.

Georgia Tech's current culture of educational innovation has produced internationally recognized innovations.

Despite many successes, educational innovation is still not systematic. Inventions germinate and successfully change the way education is delivered, but success or failure seems to depend as much on luck or circumstance as on merit or need. Critical to the vision outlined in this report is a rethinking of Georgia Tech's innovation culture to make it more deliberate. The innovation process needs to become more repeatable, targeted in its actions, and more inclusive of a larger community of people.

The Commission recognizes the importance of new aspirational goals for an improved, sustainable culture of educational innovation. Building upon its successes as a technologically innovative research university, Georgia Tech should promote a culture of intellectual curiosity about education—actively seeking and rewarding individuals who are willing to experiment.

Risk-taking and intellectual agility should be valued and supported. However, good ideas are not enough. Educational innovators must be able to identify a pressing demand and tackle ideas that meet that demand. Innovation of that sort is not haphazard. It results only from a deliberate effort to be developmental—to systematically improve the way that innovation is carried out.

A deliberately innovative organization should make it possible to reflect on the conditions that led to a success so that it can be repeated with new ideas that address new needs. Embracing a developmental culture allows people to deliberately practice the art of innovation and to improve upon their approaches based on their experiences and those of their colleagues.

The Commission recommends a systems approach to becoming developmental and growing Georgia Tech's capacity for educational innovation. A systems approach means three things: first, understanding the parts of the Institute—the organizations, teams, individuals, and processes—that are essential to sustaining innovation; second, determining how to manage the relationships between these parts to get better outcomes; and third, examining innovation processes and taking deliberate actions to improve desired outcomes over time.

Current Successes in Educational Innovation

Georgia Tech's successful educational innovation initiatives have their roots in two cultures, one grassroots and bottom-up and one institutional and top-down. On one hand, support in schools and colleges for experimentation and individual invention gives rise to grassroots projects and pilots that greatly expand the Institute's capacity to be agile in addressing the most pressing problems. On the other hand, institutional leadership that is willing to support and reward risk-taking creates an atmosphere in which the pathway to adoption of novel inventions is much smoother than it is at a university with a less collaborative culture.

A Grassroots Culture

Aligning these two cultures will create a more agile and sustainable environment for innovation. The grassroots successes started with individual faculty members who had the determination to pilot their visions and spread them across campus. Some examples include the Invention Studio, Vertically Integrated Projects (VIP) program, and CREATE-X program, among others,which are described in the CNE Report Supplement Learning By Doing (Georgia Tech 2018e). The conception and launch of Georgia Tech's OMSCS, was also a grassroots effort that was propelled forward by a small group of faculty members, together with the enthusiastic support of the dean within Georgia Tech's College of Computing.

Georgia Tech's Center for 21st Century Universities (C21U), a laboratory for experiments in higher education, started with an individual and later became institutionalized. Some of the most noteworthy experiments that originated in C21U have included the production of more than fifty MOOCs, flipped classroom experiences in courses enrolling hundreds of students, at-home laboratory experiences for online students, AI-assisted education, and Georgia Tech's subsequent launch of MOOC-based courses to nearly two million new learners.

An Institutional Culture

The 2015 establishment of the Education Innovation Ecosystem (EIE) in the Office of the Provost was a substantial step toward defining a campus-wide entity to solicit and incubate new educational ideas as well as to seek new pathways to pilot these ideas. The current EIE offers communities of practice for faculty who wish to incorporate new methods, seed grants for research projects, and support for developing and testing innovative methodologies. The EIE is composed of members from five campus entities:

- *Center for 21st Century Universities (C21U)* is Georgia Tech's living laboratory for fundamental change in higher education. C21U was established in 2011 as a think tank designed to seek and promote innovation in higher education, conduct pilot projects, and build prototypes without the need for cumbersome committee approvals.

- *Center for Education Integrating Science, Mathematics, and Computing (CEISMC)* focuses on STEM readiness and achievement (especially amongst underrepresented student groups) through education advocacy and leadership programs. CEISMC works with early learners—those in pre-K through grade 12—as well as postsecondary learners.

- *Center for Teaching and Learning (CTL)* is a research-based innovation diffusion laboratory. CTL assists educators from a broad cross section of Georgia Tech academic units in using and adapting pedagogical and technological tools that improve learning outcomes.

- *Georgia Tech Professional Education (GTPE)* is a separate unit of the university. GTPE offers courses and programs that enhance professional skills in disciplines closely related to Georgia Tech's STEM mission, including online post-graduate certificates and degrees—programs that are essential to the Georgia Tech Commitment.

- *Office of Information Technology (OIT)* is the Institute's information and computing services organization. OIT has operational responsibility for all educational technology in use at Georgia Tech.

Among the most visible successes of the EIE is a pipeline of affordable online master's degrees modeled on the success of OMSCS, the launch of microcredentials, and the award-winning University Learning Store.

Systems Approach for **Becoming Deliberately Innovative**

The systems approach to create a deliberately innovative organization retains but improves on current successful models by emphasizing cohesive and thoughtful plans and interactions among academic and administrative units. An institutional and deliberate shift in the campus-wide culture would grease the skids for the creation and adoption of new ideas, whether they are bottom-up, top-down, or from a vertically integrated participatory activity.

This seems like a dramatic shift, but the Commission believes that such an approach can be successful if done with deliberate and targeted actions addressing all parts of the system. For example, implementing the Commission recommendation for an Academic Master Plan would tie long-term educational priorities to financial resources needed to support innovation initiatives.

Innovative Organizations

All types of innovative organizations seem to share common characteristics. For example, a shared vision of the importance of innovation is invariably built into the fabric of an innovative organization. An innovative organization encourages open discussion of ideas, has a reward structure for creativity, an embrace of experimentation, provides incentives for risk-taking, and learns from failure.

Innovative organizations also have infrastructure that eases the development of new ideas, even when that means overcoming organizational barriers. For example, agility is important for innovation and is enhanced when individuals can self-organize into effective teams to pursue special initiatives, even though those teams may cross organizational boundaries. Creating this kind of infrastructure is often a challenge for research universities.

Because research opportunities are often unpredictable, successful universities tend to have an agile research infrastructure. Academic operations, however, are more encumbered by slow-moving processes. Even simple changes like modifying curricula or updating textbooks can involve buy-in and approval from multiple, often redundant, committees and are therefore often difficult.

Not only is there a natural resistance to change, as there would be in any culture, but shared governance of academic matters means that the prevailing academic culture at most universities favors slow and consensus-driven change as a safeguard of the integrity of academic standards. Yet structuring the academic enterprise to behave more like the research enterprise would create a more agile environment for educational innovation. The goal should be to agree on an innovation infrastructure for the academic enterprise that does not detract from the integrity of the academic mission.

An important first step is to have a vision that is shared among academic leadership and distributed across academic units and the many committees that make up shared academic governance. Leaders of academic units may act locally, believing that is the best pathway to improving a unit's reputation or resources. Academic and curriculum committees may put the brakes on change, believing that limiting the amount of risk that is inevitable in educational innovation is the best pathway to preserving academic quality.

A shared vision for innovation among these leaders would require the alignment of their beliefs with the long-term goals of educational innovation. Unit heads report directly to the provost, who controls incentives that can reward actions that increase alignment with the desired vision. On the other hand, there is no corresponding direct line of authority for committee chairs. Change in their behavior is indirect and is the result of influence.

A key governing principle might be that academic committee chairs meet jointly at the beginning of each academic year to discuss the campus vision, examine their committee charters, and receive instruction on ways to run their meetings effectively, including ways to accommodate change without sacrificing the integrity of the academic processes. The Commission believes that such measures can be systematically introduced to create a culture of educational innovation in which alignment with a shared vision is deeply ingrained in the academic enterprise.

Building on the work of Kegan and Lahey at Harvard Business School in "An Everyone Culture: Becoming a Deliberately Developmental Organization," the Commission recommends that Georgia Tech create an infrastructure to develop innovation skills by committing to become a deliberately innovative organization, that is, an organization in which the innovation processes are explicit and can be deeply aligned with the motives of individuals to solve problems. A consequence of this deep alignment is that ongoing innovation is "woven into the daily fabric of working life, visible in the [university's] regular operations, day-to-day routines and conversations" (Kegan and Lahey 2016)."

As a step to becoming deliberately innovative, the Commission recommends establishing an immersive cohort-based training program. This program would also provide a facilitated mechanism in which individuals within the cohort could help each other create, evaluate, evolve, and pilot their educational innovations.

To find out whether this would be feasible, the Commission conducted a year-long experiment with such a program to determine its potential for more widespread use at Georgia Tech. Beginning in early 2017, a cohort of ten Commission members established a project to develop and pilot such a program using methodologies that were developed to help business entrepreneurs become more reliably and deliberately innovative. The results of the pilot program are described in the CNE Report Supplement *Formative Leadership (Flashpoint): One Georgia Tech-born Approach to Deliberately Innovative Education* (Georgia Tech 2018d).

The Commission further recommends that additional organizational transformation and change management strategies be used to help adopt or spread educational innovation. These strategies are plans and programs that are directed at easing the changes for the stakeholders and improving the chances of success for an innovation. As an example, the innovative methods could be piloted in alternative pathways that are optional for both students and faculty. Faculty members who are interested in changing are freer to explore innovative solutions. Students can choose either pathway. If the innovation is well conceived and executed, then the demand for the piloted program will outpace that of the existing programs.

> "A consequence of this deep alignment is that ongoing innovation is woven into the daily fabric of working life, visible in the [university's] regular operations, day-to-day routines and conversations."
>
> Kegan and Lahey 2016

Evolving the Educational Innovation Ecosystem

The Commission recommends that the current ecosystem evolve into a broader, more coordinated ecosystem whose scope would range from coming up with ideas to institutionalizing them. The EIE should continue to serve as a "sandbox"—a space to run educational experiments with new courses, course formats, and educational products—but increase its collaborative interactions with other academic units and offices through new or stronger mechanisms and incentives. Such collaboration will help support the new initiatives of the EIE, provide feedback on needs and growth areas, and help spread successful pilots across campus. The new EIE should continue and even expand it efforts in outreach and development for foundation, industry, and research funding as well as seed funding for new ideas. The EIE should establish a structure that supports and encourages partnerships with existing and new stakeholders (students, faculty, alumni, industry, K-12 collaborators, etc.) for creating innovative ideas. The research mindset should be extended to educational innovation by encouraging curiosity and intellectual pursuits in education among a large and diverse community of scholars through programming, networking, and building an infrastructure. The overall support for the community of researchers and innovators that is currently provided by C21U, CEISMC, CTL, GTPE, and OIT organizations should be expanded and made more cohesive so that it forms a widespread and continuous spectrum of support that is transparent to the user regarding where to go for what support. This indicates that the current EIE should be made more collaborative and coherent.

Enhanced Teaming by Bridging Organizational Silos

Teams made up of people from diverse backgrounds and perspectives can be a fruitful platform for forming new ideas, but policies, procedures, and even cultural differences can be barriers that inhibit free interaction. These barriers are responsible for the organizational silos that stifle innovation.

Academic disciplines, for example, are the most common organizational silos in a university. Such silos make interdisciplinary programs hard to create and even harder to maintain. Bureaucratic restrictions on course registration, long chains of prerequisite course requirements, and complex accounting rules for allocating a professor's time make it hard for students to take courses outside their major field of study.

To provide an academic culture where both students and faculty can interoperate across disciplinary lines, educational units need to operate more along the lines of interdisciplinary research units. The Commission recommends that new organizational and financial models be examined that would help break down disciplinary silos.

Breaking down stakeholder silos by encouraging partnerships in education is another way of promoting a more integrative culture for academic innovation. Currently, the stakeholders in education generally have distinct roles: faculty teach, students learn, and companies hire. This segmented view seems to run contrary to the significance that is placed by educational institutions and the workforce on teamwork and collaboration.

Partnerships in education forged between these different stakeholders, as well as alumni, can improve the overall educational experience while possibly decreasing the burden on faculty to implement educational innovations on their own. Current examples of successful partnerships at Georgia Tech include education-themed VIP teams, maker spaces, advisor-supervised peer-to-peer mentoring, and student-designed course resources for either pay or credit.

Motivating Individuals **in the Innovation Process**

Institutional goals for educational innovation must be matched with appropriate levels of individual motivation for faculty members and unit leaders to adopt, create, and promote innovative educational methodologies. To achieve that motivation, the Commission recommends a two-pronged approach: increase the value of the initiatives to individuals through incentives, and increase the ability of individuals to undertake the initiatives through development programs. A summary of this approach is described below, with a more detailed description available in the CNE Report *Supplement Building a Culture to be Deliberately Innovative in Education* (Georgia Tech 2018b).

The Commission recommends initiatives that acknowledge, reward, and incentivize faculty and department leaders to pursue educational innovation. For example, there should be an Institute-level award for the scholarship of teaching and learning and another for educational innovations within a department. School chairs and deans can incentivize a culture of educational innovation through awards, evaluation and reporting, hiring, and flexible faculty workload models.

For example, annual faculty evaluations that have categories such as “Report on the Use of Evidence-Based Instruction” add weight to the topic. Deans can incentivize school chairs, making them responsible for educational excellence and innovation in their schools’ annual reports by asking for details on topics such as improving the quality of instruction, to the use of evidence-based teaching, and how experimentation in education is encouraged.

The promotion and tenure (P&T) process is often cited as the main tool to incentivize faculty members to engage in innovational educational activities. While educational activities are important factors in the evaluation criteria, the implementation of the P&T process varies by school and college, especially the scopes and roles of the educational activities.

The Commission recommends that the P&T process be used to identify and share best practices for evaluating educational contributions. Possible examples include piloting alternative metrics for assessing teaching excellence and developing methods for assessing candidates who would like to use the scholarship of teaching and learning (SOTL) in their creative contributions.

An outgrowth of the P&T process might also be the creation of faculty development programs to foster innovative work in education. This might include expanding existing programs to cover a wider range of topics, such as the Flashpoint program as a teachable model of educational innovation, organizational transformation, and change management. Motivation for faculty to participate in these development programs will be enhanced because the basic methods learned will not be limited to educational innovation and can be applied to other areas such as research, technology, science, and policy.

Becoming
Deliberately Innovative

The predicate for the Commission's recommendations is that the educational world of 2040 is rushing at us, and it does not look very much like the world that has guided Georgia Tech since its founding in 1885. The Georgia Tech Commitment is an expression of the Institute's seriousness in preparing for the future, but the recommendations by themselves do not illuminate the specific steps that should be taken. That is because there is no algorithm or formula that leads inevitably to success.

The complex pathway to the Georgia Tech Commitment will be a series of inspirations, experiments, and projects that either take the Institute a step closer to the vision of lifetime education or demonstrate that the current approach will not lead to success and should be discarded so that work can begin on a new approach. In the twenty-year time frame of the Commission's charter, there is room for learning how to improve this basic process of innovation.

Development practices, shared frameworks, and a common way of identifying gaps that must be filled should be explicit. Based in science and tested many times, the innovation process recommended by the Commission is a repeatable way of focusing resources on important problems and addressing barriers like resistance to change. There should be a clear explanation of how innovation aligns deeply with everyone associated with Georgia Tech. The rules of innovation should be part of the fabric of education. That requires an approach to innovation that is deliberate.

In the longer term, the innovation culture should be immersive, and every important aspect of education should be steeped in it. Hypotheses should be tested, and academic governance should weigh the results carefully. Becoming deliberately innovative is an opportunity for community members to grow by leveraging what they know while being honest about what they do not know and thinking through worst-case scenarios.

The Commission recognizes that getting buy-in from a substantial fraction of the Georgia Tech community for this kind of deliberately innovative activity requires constant exposure and reinforcement. No training program or boot camp will be sufficient, but a slow building of innovative capacity might enable the kind of changes outlined above.

Incentives for taking educational risks, equivalent rewards for both pedagogical innovation and research, as well as supportive home organizations, are attainable steps if Georgia Tech's leadership drives these changes. Big goals, like the Georgia Tech Commitment, require the Institute to rethink how the work of the university gets done. This is the first step in becoming a deliberately innovative organization.

CONCLUSION

During its nearly two years of preparation, deliberation, and synthesis, the Georgia Tech Commission on Creating the Next in Education devoted a surprisingly small amount of time to debating the most likely future of higher education. Despite some initial misgivings about the wisdom of making predictions, demographic and economic forecasts gathered during the six-month Discovery Phase that kicked off the Commission's work painted a clear picture: higher education institutions of all kinds are facing a far different future from that to which they have grown accustomed.

The higher education landscape that was forged by the massive growth of colleges and universities since the 1960s is being reshaped by a generation of global students with changing needs and demands, advances in artificial intelligence and learning sciences, a profound shift in the financial underpinning of institutions, and, for public universities, the changing economics of the states that have largely supported them.

As noted in the introduction of this report, in many ways this current period is like the time in higher education when Georgia Tech was founded—an era of immense change in the world economy. But then, unlike now, the leaders of colleges and universities approached change with optimism and a growth mentality. The future was a great opportunity.

A similar approach is needed now, but it seemed to the Commission, throughout 24 months of work, that for some in higher education this is a time of risk, worry, and even retrenchment. It seemed time for Georgia Tech, by contrast, to create a vision of what a great technological research university might become.

A group of universities will need to lead higher education into this next decade and beyond. Georgia Tech should be among these leaders. By almost every measure, the Institute is significantly stronger today than it has been at any point in its history. The level of undergraduate research at Georgia Tech is unparalleled. Georgia Tech's research expenditures exceeded $800 million during FY17 alone. Georgia Tech's graduate programs include some of the strongest in the world, with many ranked among the top ten in the nation. The Institute's culture has sparked technological innovations including the development of truly useful AI agents and the well-publicized OMSCS degree that reshaped the discussion of college affordability.

So, Georgia Tech enters a period of enormous change in higher education from a position of strength. Given the complex demands and pressures facing institutions today, most have focused their strategies and planning on the near horizon. The Commission has attempted in this report to look up and out to grasp five major elements of the bigger picture of higher education.

First, the Institute needs to imagine a future in which the artificial barriers found throughout higher education disappear. Traditional conventions such as courses, semesters, and credits, even the academic calendar itself, will be reimagined. Unlike today, students will come to Georgia Tech through multiple pathways, sometimes starting earlier in life.

These students will experience undergraduate education in vastly different ways—through a mix of experiential and project-based learning, online and hybrid classes, and interactions with Georgia Tech graduates taking professional sabbaticals or serving on Personal Boards of Directors. Many of them will never become "alumni" in the traditional sense, as they may return throughout their life for additional education wherever they are in the world as part of the Georgia Tech Commitment to a Lifetime Education.

Second, this expansive way of thinking about Georgia Tech's educational mission will require the Institute to rethink advising as a service. The current model happens in small bursts and is not always consistent. The new model will necessarily provide a set of tools that can continually guide students and alumni throughout their lifelong educational journeys. This will require investments both in virtual resources, such as new undergraduate advising systems driven by AI, and in predictive analytics, as well as face-to-face interactions made possible by a Personal Board of Directors and a Living Library for Learning (L3).

The challenge of how to engage personally and in-person with Georgia Tech's widely distributed learners requires innovation. No longer tied to a centrally located, vertically integrated campus, economically self-sustaining Georgia Tech atriums, strategically placed to be within easy reach of learners, will become the personal touch points for experts, tutors, mentors, and an array of services yet to be invented.

Third, new educational products will be needed. Expanded age groups and those with evolving careers, as well as learners who are either not ready for traditional credentials or are no longer seeking new degrees, will demand new services and recognition for educational goals they have achieved. A new generation of stackable credentials—with yet-to-be invented platforms to create a global marketplace for the credentials—along with personalized services and communities that continue to add value to a Georgia Tech educational experience will be needed.

Fourth, whole-person education that prepares individuals for twenty-first-century workplaces will become a priority for Georgia Tech. This preparation includes so-called character traits that are highly predictive of long-term success but cannot be achieved with additional courses or minor curriculum changes. Character traits must be deliberately developed in immersive experiences.

Georgia Tech's bedrock commitment to research provides many of the essential ingredients of such an environment. The experience of conducting research immerses students in cultures that practice and value traits like initiative, determination, ethical behavior, judgement, and effective communication. The deliberate intention to fuse research and educational cultures throughout Georgia Tech's programs is an important step toward the development of the twenty-first-century skills discussed in this report.

Finally, all the ideas imagined in this report are predicated on a culture change at Georgia Tech. This change will require deliberate efforts to innovate and create an immersive environment for continuous individual educational innovation. The Commission has mapped out a systemic plan for developing this culture, beginning with strengthening and expanding the existing Educational Innovation Ecosystem and borrowing from the research culture of innovation.

The creation of an Academic Master Plan ties long-range Institute planning to academic goals and ensures that university governance is aligned with the needs of educational innovation. Finally, there are techniques for promoting innovation at the level of the individual faculty member, including the use of new ways of thinking about educational change, to provide a useful framework for identifying high-impact projects and initiatives.

Access to higher education and scholarly research has long been the lever universities have pulled to promote prestige. In higher education, it is difficult, if not impossible, to stray far from the pack and think differently about how to recruit and enroll students and how to provide them with an immersive educational environment, all while remaining on the cutting edge of the next great research discoveries.

However, like the Georgia Tech of 1885, the forces reshaping the increasingly automated and diverse world of the current industrial revolution require bold thinking by the Georgia Tech of today. As Isaac Hopkins foresaw, the complex world needs skilled individuals who can think. Georgia Tech's commitment is to apply its innovative capacity to educate those individuals for a lifetime.

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Commission Speaker Series:

November 9, 2016 - "Wave 5: The University of the Future" Michael M. Crow, President, Arizona State University

September 1, 2016 - "The Future of Higher Education – Harnessing Software to Enhance Learning Outcomes and Support Teaching" David Levin, President and CEO, McGraw-Hill Education (2014-2017)

June 7, 2016 - "Ready to Learn, Ready to Live, Ready to Lead" Caitlin Dooley, Deputy Superintendent, Georgia Department of Education

May 26, 2016 - "Creating Innovation in Higher Education Budget Models" Rick Staisloff, founder and principal of rpkGroup, a higher education consulting group.

May 11, 2016 - "Cyberlearning and educational technology: Current R&D, future trends, and how educational institutions will need to change" Chris Hoadley, associate professor in the Educational Communication and Technology Program, the Program in Digital Media Design for Learning, and the Program on Games for Learning at NYU - Steinhardt.

April 26, 2016 - "The Integration of Teaching, Learning and Assessment: A Design-Based Approach" Jim Pellegrino, co-director of Learning Sciences Research Institute, Liberal Arts and Sciences Distinguished Professor, and Distinguished Professor of Education at the University of Illinois at Chicago

May 24, 2017 - “How We Ought to Change our Great Research Universities,” Jonathan Cole, Former Provost, Columbia University

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Organizations

U.S. Department of Education
USA Funds
OpenIDEO
McGraw-Hill Education
Lumina Foundation
International Futures Forum
MIT Office of Digital Learning
Steel Case Corporation

We are also indebted to the following individuals who generously helped with the Commission’s work:

Jean-Lou Chameau
Graham Leicester
David Levin
Tom Moore
Bill Sharpe

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