PUTTING IMPORTANT IDEAS TO USE FOR THE PUBLIC GOOD

2010 Strategic Roadmap to Accelerate Innovation at the University of North Carolina at Chapel Hill

2016 Progress Report

CATALYZE

PREPARE

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TRANSLATE

ALIGN

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

INNOVATE CAROLINA

top left: James Ellsmoor, recently named to Forbes "30 Under 30," founded Solar Head of State as a student to raise awareness of solar power by installing free solar systems on government buildings and the homes of world leaders.

top right: David Baron founded Nugget Comfort as a student when he realized the large amount of dorm futons that ended up in the trash because they did not last.

center: A customer enjoys the Nugget Comfort couch.

bottom left: Student-led venture Seal the Seasons was founded by Patrick Mateer to make healthy food available year round and increase profits for small and mid-size farmers.

bottom right: the Seasons employee George Odom adds prepared strawberries to the conveyor-fed freezing system at the Piedmont Food and Agricultural Processing Center in Hillsborough, North Carolina.

Chuck Perou, Distinguished Professor of Molecular Oncology (left) talks with lab manager Jerry Usary. Perou received the 2013 Hyman L. Battle Distinguished Cancer Research Award in recognition of his accomplishments in cancer research.

Alice Ammerman (far left), Professor of Nutrition and Director of UNC's Center for Health Promotion and Disease Prevention, co-leads the campus theme "Food for All," which focuses on food access, food systems innovation, health promotion and disease prevention, and the documentation of food cultures and history.

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THE CHANCELLOR'S INNOVATION CIRCLE 2010

■ *Charter Members*

The Strategic Roadmap to Accelerate Innovation (Innovate Carolina Roadmap) was developed by three groups that shared a passion for Carolina's future: the Chancellor's Innovation Circle, the Faculty Steering Committee and the Chancellor's Student Innovation Team.

TITLES AS OF 2010

LOWRY CAUDILL
Chair, Innovation Circle,
Co-founder, Magellan
Laboratories Inc.
Durham, North Carolina

RYE BARCOTT
Founder, Carolina For Kibera
Charlotte, North Carolina

HARRIS BARTON
Managing Director,
Capital Dynamics
Palo Alto, California

VAUGHN BRYSON
President, CEO, Eli Lilly & Co.
(Retired), President, Clinical
Products Ltd. Vero Beach, Florida

BEN CAMERON
Program Director for the
Arts, Doris Duke Charitable
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CFO, Dominion (Retired)
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ALFRED CHILDERS
Co-founder, Magellan
Laboratories Inc.
Cary, North Carolina

PHILLIP L. CLAY
Chancellor, Massachusetts
Institute of Technology
Cambridge, Massachusetts

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Austin, Texas

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Partner, Kleiner, Perkins,
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Kenan, Jr. Charitable Trust
Chapel Hill, North Carolina

MYLA LAI-GOLDMAN
CEO, CancerGuide
Diagnostics Inc.
Chapel Hill, North Carolina

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President and Executive
Director, Creative
Capital Foundation
New York, New York

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Affiliated Partners, Kleiner,
Perkins, Caufield & Byers
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Executive Chairman,
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Chapel Hill, North Carolina

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Wakefield Group
Chapel Hill, North Carolina

TODD POPE
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TransEnterix Inc.
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THOMAS RIZK
Chairman, CEO, TractManager
Saddle Brook, New Jersey

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Executive Summary for the 2016 Innovate Carolina Roadmap Progress Report

This report is a comprehensive review of the creation and implementation of the Strategic Roadmap to Accelerate Innovation (Innovate Carolina Roadmap) at the University of North Carolina at Chapel Hill, from 2010-2016. It starts with messages from Chancellor Carol Folt, Board of Trustee Chair Dwight Stone, past Board Chair and Chair of the Innovation Circle Lowry Caudill and Vice Chancellor for Innovation, Entrepreneurship and Economic Development Judith Cone. They explain why this work became, and continues to be, a critical part of the strategic direction for the University as it seeks to have even greater impact.

ACCOMPLISHMENTS TO DATE

Organize and Mobilize for Impact: In 2010 UNC-Chapel Hill declared that it wanted to systematically help solve some of the biggest issues facing North Carolina, the nation and the world. The University had to build a culture, infrastructure and a robust ecosystem of innovation to have any hope of taking on grand challenges. Programs, or even a center, would be insufficient—this effort would require a centralized/decentralized approach so that each unit and program would include innovation as core to its work whenever possible. Leaders would be needed throughout the University, as well as in central administration.

This report is the story of how the Board of Trustees, chancellor, administration, deans, chairs, faculty, staff, students, alumni, parents and other donors came together to ensure that this University is well positioned to make people's lives healthier, happier and more prosperous. In the process of creating the Innovate Carolina Roadmap, the University took a hard look at itself and designed a path to become a place that thoroughly supports people who want to work with others to understand needs, and design and successfully implement solutions. The Roadmap outlined key steps that would make innovation and entrepreneurship (I&E) widely shared working priorities at Carolina.

The vision and mission paint the picture of this work:

> **Vision**—With a special focus on the world's most pressing problems, innovators and innovations launched at Carolina consistently put important ideas to use for the public good.

> **Mission**—Be a place where innovators thrive.

Defining innovation was an important part of the earliest discussions and focused on three equally important parts:

> An innovation is a **successfully implemented, unique** and **valuable** idea.

The full report shares the details of the strategies, goals, actions, lessons learned and next steps for the five key strategic areas described in the Roadmap:

- **Prepare** faculty, graduate and undergraduate students, staff and the broader Carolina community with the knowledge, skills and connections necessary to translate ideas into innovations.
- **Collaborate** with diverse groups internally and externally to explore issues, options and creative approaches that may lead to innovations.
- **Translate** important new ideas more expediently and at an increased volume into innovations that improve society.
- **Align** people, incentives, resources and processes to strengthen an intentional culture of innovation at Carolina.
- **Catalyze** innovation at Carolina by facilitating the work of faculty, staff and students as they put important ideas to use for the public good.

In 2010 then Chancellor Holden Thorp commissioned a special assistant for innovation and entrepreneurship to lead the creation of the Roadmap and implementation of the centralized/decentralized model described in that document. The Innovation Circle, made up of alumni, parents and donors, was instrumental in challenging the University with different viewpoints and offering support. Faculty and student working groups helped create the Roadmap. Thorp, along with University Entrepreneur-in-Residence Buck Goldstein, released *Engines of Innovation*, a book written to encourage the reshaping of higher education institutions to better support innovation. And finally, the UNC-Chapel Hill Board of Trustees made a commitment to support innovation by devoting one of its four committees to focus on innovation and entrepreneurship, which continues today.

In 2014, the UNC-Chapel Hill Board of Trustees and Chancellor Carol Folt made innovation, entrepreneurship and economic development a top priority of their administrations. In 2015, Chancellor Folt created the new Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development to strengthen the overall ecosystem and to offer direct programs and services. This would include creating a campus-wide integrated approach, to be continued under the Innovate Carolina label that was introduced in 2010. The Chancellor set a specific goal for commercialization, commonly referred to as technology transfer: Be among the top performing offices relative to Carolina's peers. At the time, UNC's Tech Transfer Office was one of the most underfunded, understaffed and underperforming such offices.

Achieving such a goal depends on: 1) the amount and nature of the research, 2) alignment of reward systems, 3) encouragement from deans and chairs to translate research, 4) deans, chairs, faculty, students and staff developing an innovation mindset and skillset, 5) the expectations and desires of faculty to be translational when possible, 6) efficient processes for sponsored research and the management of conflicts of interest, 7) leadership talent and funding for de-risking ideas and for faculty startups, 8) availability and funding of essential spaces and programs, especially for life-science faculty startups, 9) relationships with industry and other external partners, and 10) funding for the ecosystem from donors and the University. It is essential that an adequate budget be allocated to protect intellectual property, operate the office and hire the appropriate number of people with the required type of commercialization expertise.

At the start, some deans were already engaged in innovation and direct service to individuals and communities. Areas such as medicine, public health, social work, dentistry and government, along with the Campus Y and Center for Public Service, have service missions to North Carolina that are integral to their very purpose.

Today, across the campus, a growing number of academic units have designated faculty serving as their Innovation and Entrepreneurship (I&E) liaisons, and many have external entrepreneurs-in-residence (EIRs) who help to watch for promising ideas and mentor potential faculty or student entrepreneurs. The Innovate Carolina Student Leadership Team, formed to channel student input and to promote and assist student-led activities, is actively working with students and informing the overall agenda.

Networks and linkages of innovation leaders are growing both within the University and with external partners. In 2010 there were a few people involved in I&E. Today the Innovate Carolina Network has more than 200 people on campus who meet regularly to learn from each other, work together and help move the I&E strategy and programs forward.

Communication of I&E news has accelerated; a master web portal for information (innovate.unc.edu) is in service and all efforts are branded under *Innovate Carolina*.

Embrace Multidisciplinary, Convergence and Diversity of Thought: The Roadmap described the need for interdisciplinary, diverse communities to understand and help solve the world's most complex problems. It specified the need for hybrid disciplines, such as applied physical sciences and biomedical engineering.

- The chancellor, provost and dean of the College of Arts and Sciences created the first new department in 40 years in the sciences—applied physical sciences.
- UNC-Chapel Hill and NC State University Chancellors Folt and Woodson and Provosts Dean and Arden committed to strengthening the joint department of biomedical engineering.
- The Roadmap also called for makerspaces, graduating students data literate, strengthening computer science, building app development services and promoting serious games as important tools of innovation.

Partner with Donors and Industry: Donors such as Dennis Gillings, Tom Marciso, Fred Eshelman and many others made significant investments in translational work and continue to be involved on a strategic level as well. The Roadmap called for an increased emphasis on industry partnerships.

- The GlaxoSmithKline project with UNC-Chapel Hill for the HIV/AIDS cure was a first-of-its-kind public-private partnership. This is just the beginning of such meaningful relationships. In order to better realize these complex deals, there is now a cross-university team dedicated to developing additional deep relationships with industry.
- The chemistry department partnered with Eastman Chemical Company for joint research.
- The School of Medicine began its work with IBM Watson Health and with SAS and Siemens.
- Plans for the future call for commercialization spaces to house such activities. Most peer institutions have dedicated innovation spaces including wet labs for faculty startups and proximity for/to industry.
- The Office of Industry Contracting was formed to consolidate and improve the support of industry-sponsored research at UNC. The Office of Sponsored Research is undergoing a complete redesign.

Embed Innovation in Research and Teaching: The teaching of innovation and entrepreneurship, both for credit and in extracurricular workshops and coaching, grew from a few courses in the business school and a new minor in entrepreneurship in Arts and Sciences, to numerous programs in schools and institutes. Today the following is underway:

- Applied Physical Sciences is hiring new faculty and will be part of the proposed new convergence science building.
- Carolina's BeAM (Be a Maker) movement now operates three state-of-the-art makerspaces where students and faculty can prototype and build physical objects. This is essential for developing ideas that could lead to advanced manufacturing and new products in the arts and other fields.
- The Center for Entrepreneurial Studies in the Kenan-Flagler Business School already offered courses in 2010 and was running Carolina Challenge, a business venture competition. Today those efforts have expanded. The center, in collaboration with the Vice Chancellor's Office for Innovation, Entrepreneurship and Economic Development, has taken on responsibility for Launch Chapel Hill and 1789 Venture Labs. The new Adams Apprenticeship is their latest program.
- In 2010 the undergraduate Entrepreneurship Minor had just started and served 100 students in two tracks: social and commercial. Today, the minor enrolls 125 students per year and offers Econ 125 Introduction to Entrepreneurship, enrolling up to 400. It has hubs in Silicon Valley, New York and Beijing (recently moved to Shanghai) and continues to reach more students through nine tracks.
- The School of Media and Journalism developed numerous classes that teach design, advertising and marketing-all part of an entrepreneurial skillset. The School's Reese News Lab generates student-led solutions to current issues in the media industry.

Support Startups and Innovators: Pre-Roadmap, the University had no physical facilities dedicated to nurturing startup ventures. Now there are several with related support services and programs, and more are

being planned through the Master Planning process. Launch Chapel Hill and 1789 Venture Lab were co-founded by University leaders and alumni, the Town of Chapel Hill, the Downtown Partnership, and Orange County Economic Development. The Becker Family generously donated funding to the University for Launch Chapel Hill, Jim Kitchen provided original funding for 1789, and various other donors contributed. The Vice Chancellor's Office provides a portion of the annual funding for Launch Chapel Hill and 1789, and the Center for Entrepreneurial Studies at the Kenan-Flagler Business School provides programming and staff. These spaces are important to nurturing startups, yet they are already too small to meet the demand. Additionally, donors are needed to maintain operations and expand the offerings. Faculty startups based on University-IP in the life sciences require access to wet labs, offices and meeting rooms. Since Chapel Hill has no wet lab space for startups, companies are forced to go elsewhere, which is inconvenient for the faculty and an economic loss for Chapel Hill/Orange County. The fundraising campaign for Innovate Carolina includes these items.

Once the Vice Chancellor position was established in 2015, several programs were absorbed into the new office. NC TraCS' KickStart Venture Services and the Kenan Institute's Patent and Landscape program as well as other initiatives became part of the comprehensive approach to commercialization, while leaving many programs operating at the unit level. Not only do startups need spaces, they need de-risking/proof-of-concept funding as well as startup funds. Grant programs for these purposes are provided through the Eshelman Institute for Innovation, the NC TraCS program, the School of Medicine, UNC Health Care and the Office of the Vice Chancellor for IEED. The Vice Chancellor's Office worked with the Board of Trustees and the Office of the Vice Chancellor for Finance and Administration to establish the Carolina Research Ventures Fund. Sallie Shuping Russell was instrumental in making this a reality and serves as the chair of the board. The Carolina Angel Network is the latest program designed to help close the early-stage funding gap.

- ■ **Launch Chapel Hill Accelerator:** 63 companies since 2013 > raised $15M > 250 jobs in Orange County > 1,000 jobs beyond Orange County > 3 companies acquired.

   Launch Chapel Hill is an international award-winning startup accelerator located in downtown Chapel Hill. Initiated by UNC-Chapel Hill, this public-private partnership brings together the Town of Chapel Hill, Orange County, the University and a private donor. Twice a year, it accepts applications from entrepreneurs who are committed to building their early-stage businesses into self-sustaining enterprises. Its goal is to provide the tools and knowledge needed to decrease risks, reduce go-to-market time and accelerate the growth of startups.

The Genome Sciences Building brings faculty and researchers together, fostering collaboration among multiple units across campus. From left are, Hemant Kelkar, Center for Bioinformatics, Department of Genetics at the School of Medicine; Greg Copenhaver, Biology, Carolina Center for Genome Sciences, Lineberger Comprehensive Cancer Center; Joe Keiber, Biology; Yuchang Tsai, Biology; Daniela Munoz, Genetics and Molecular Biology at the School of Medicine discuss a project in one of the labs in the new building.
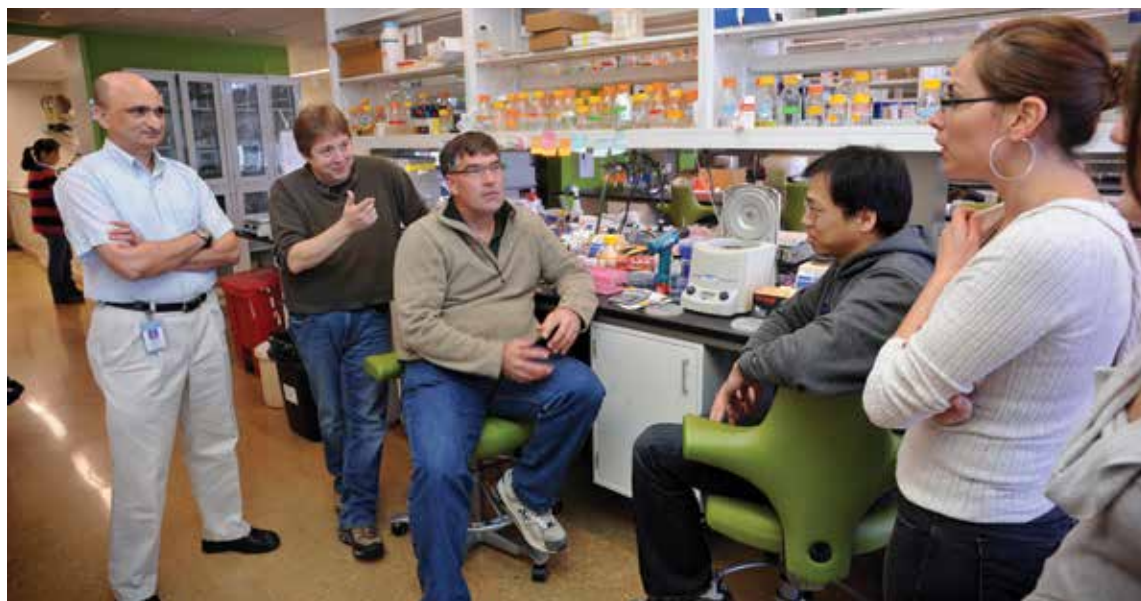
- **KickStart Venture Services:** Provided $1.8M in awards to 56 IP-based faculty startups since 2009 > $20M in SBIR/STTR grants > $137M in total funding.

  KickStart Venture Services, part of the Vice Chancellor's Office for IEED, supports the formation of IP-based companies at UNC-Chapel Hill. Services include business development through coaching and mentoring, early-stage funding, connection with key service providers, management, investors and space. KickStart Labs is the wet lab startup incubator located on campus in the heart of research and innovation. KickStart Labs has incubated 20 startup companies, offering proximity to the University founders, access to specialized equipment and a location for a faculty startup business.

- **Carolina Research Ventures Fund LLC:** Started in 2015 > $10M fund > Hired Hatteras Venture Partners to manage > 3 investments to date in startups that have raised more than $115M.

  Many of the UNC-Chapel Hill faculty startups based on intellectual property are working on breakthrough ideas and solutions that could greatly benefit the public. However, private investment capital is not broadly available at this earliest stage, preventing many potentially-valuable innovations from evolving into commercial products. The Carolina Research Ventures Fund helps unlock these young companies' potential and get their products into the hands of businesses and consumers by providing early capital and leveraging the University's relationships with the national venture capital community. This is an affiliated entity, run by an experienced board that oversees a venture capital firm managing the fund.

- **Carolina Angel Network:** Started in November 2016 > has 90 members, exceeding expectations by three-fold > has a $2M side-car fund designed to return revenue to the University.
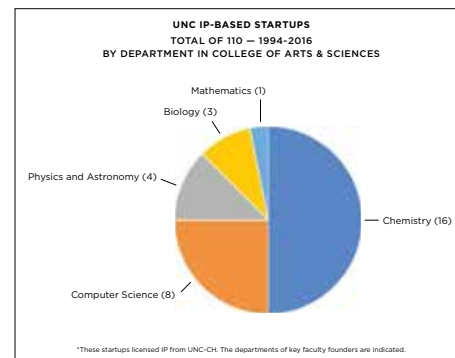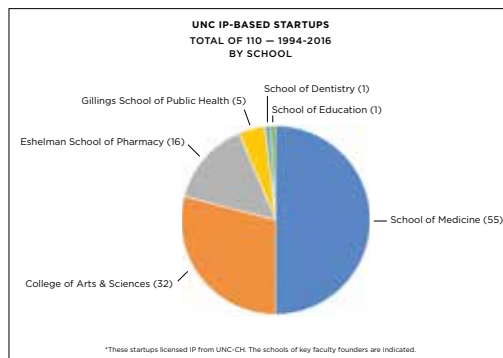
  CAN is part of a four-university consortium made up of Duke, NC Central, NC State and UNC-Chapel Hill. These four universities first started working together when they formed the Blackstone Entrepreneurs Network. The Blackstone program provides growth-oriented entrepreneurs the opportunity to be mentored by a group of the area's top repeat entrepreneurs called entrepreneurs-in-residence (EIRs). Angel investors are often the first significant people to believe in a startup, thus they play an important role in the early stages of building a company. And since the Blackstone EIRs' goal is to get entrepreneurial teams investment ready and funded, these two programs are complementary.

- **Office of Commercialization and Economic Development (OCED):** Includes technology transfer, strategic partnerships, startup services, and outreach to faculty to drive the pipeline and build faculty innovation capacity.

  The Roadmap outlined in detail the types of actions needed to improve the translational outcomes of the University. The University's goal is to maximize the societal value of its intellectual property and other ideas, plus return revenue to the University. As part of the newly formed Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development, the OCED was formed to commercialize University intellectual property, as well as to help move forward important ideas of all kinds. Significant changes were made to the tech transfer office, and the aforementioned additional units were added. For more information, please visit oced.unc.edu. This office reports the official data on technology transfer to the Association of University Technology Managers (AUTM). These are but a few examples of the hundreds that are described in the full report. Collectively they reflect the comprehensive ecosystem and culture of innovation at Carolina.

  Because it takes a long time to realize the investment in life science technologies, the following statistics from tech transfer activities are reported as annual averages over a five-year period.

	Annual Avg. FY07–11	Annual Avg. FY12–16	Cumulative 1994–2016	% Increase / % Decrease
Disclosures	127.8	157.2	2762	23%
Patent Applications	116	169.4	2551	46%
Issued US Patents	25.4	37.4	705	47%
Licenses	58.2	52.8	1183	–9%
Startups	4.2	9.8	110	133%
Revenue	$2.4 M	$4.16 M	$57.10 M	73%

UNC IP-BASED STARTUPS
TOTAL OF 110 — 1994-2016
BY SCHOOL

- School of Dentistry (1)
- Gillings School of Public Health (5)
- School of Education (1)
- Eshelman School of Pharmacy (16)
- School of Medicine (55)
- College of Arts & Sciences (32)

*These startups licensed IP from UNC-CH. The schools of key faculty founders are indicated.

UNC IP-BASED STARTUPS
TOTAL OF 110 — 1994-2016
BY DEPARTMENT IN COLLEGE OF ARTS & SCIENCES

- Mathematics (1)
- Biology (3)
- Physics and Astronomy (4)
- Chemistry (16)
- Computer Science (8)

*These startups licensed IP from UNC-CH. The departments of key faculty founders are indicated.

WHAT LIES AHEAD

As this report shows, many significant initiatives are now well under way with efforts in other areas at the planning or early stages. Some key areas going forward are:

- Innovation and entrepreneurship are central to UNC's strategic priorities and the plans of many of the schools. In fact, within The Blueprint for Next, the University's strategic framework, one of the two core strategies described is called "Innovation made fundamental."

- A comprehensive space plan is in progress and will become part of the 10-year master plan to develop more and better spaces for Innovate Carolina Network programs.

- A number of University policies and procedures need updating to facilitate, rather than hinder, innovation. These include conflict of interest resolution, tenure and promotion guidelines to include I&E activities by faculty, and reducing barriers to collaboration across boundaries. These are being addressed with an ultimate goal of building a nimble, responsive organization.

- Better measurement and evaluation of I&E impact are needed, both to document Carolina's contributions to society and to inform future work. This is challenging, as positive impact takes many forms beyond more easily measured economic gains.

- Further fundraising and appropriate budgeting for Innovate Carolina programs is critical.

- Pan-university dialogues on social innovation and economic development will guide the work in these areas.

In general: The work begun under the 2010 Innovate Carolina Roadmap is itself a massive exercise in innovation. It amounts to a sweeping re-invention of the University across many fronts to better serve a fast-changing society. New ideas have been piloted and proven, which now need to be scaled and/or widely emulated.

UNC-CHAPEL HILL'S SANCAR WINS NOBEL PRIZE IN CHEMISTRY

Aziz Sancar, MD, a researcher in the School of Medicine, was honored with the 2015 Nobel Prize in Chemistry for his research on the natural mechanisms of DNA repair. DNA in living cells can be damaged by many factors, and health may depend on the body's ability to restore the affected parts. Sancar's early work identified a mode of repair which, if defective, can allow UV damage to lead to skin cancer. His Sancar Lab at Carolina has now "mapped" the various DNA repair mechanisms for the entire human genome—information that could help in finding new ways to deal with cancers, aging and other conditions

Born in the historic town of Savur in Turkey, Sancar began his career as a medical doctor, then came to the U.S. for his doctoral studies and research. A member of the UNC-Chapel Hill faculty since 1982, he is the Sarah Graham Kenan Professor of Biochemistry and Biophysics. Sancar shared the Nobel in Chemistry with Paul Modrich of Duke and Tomas Lindahl of Cancer Research UK, whose research has shed light on other aspects of DNA repair.

top: Aziz Sancar, MD celebrates his Nobel Prize with Chancellor Carol Folt.
bottom left: UNC-Chapel Hill's two laureates the late Oliver Smithies, MD and Aziz Sancar, MD view their respective prize medals.
bottom right: Aziz Sancar, MD with UNC System President Margaret Spellings and Louis Bissette, Jr., Chair of the UNC Board of Governors.

top: Kelly Hogan, Director of Instructional Innovation for the College of Arts and Sciences and Senior STEM Lecturer in the biology department, delivers the commencement address during the 2015 Winter Commencement.

bottom: The State Historical marker for the University of North Carolina at Chapel Hill on McCorkle Place.

The Report

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top: Jeff Dangl (left), Vladmir Jojic (center) and Surge Biswas (right) collaborate on plant genomics research in UNC-Chapel Hill's Genome Sciences building.

bottom: Helen Huang (left), Francis Legler (center right) and Nancy Allbritton (right) discuss data from a sensor-covered cap worn by a research assistant in UNC-Chapel Hill's Biomedical Engineering Lab.

INTRODUCTION

■ *Chancellor Carol Folt*

Lasting Positive Impact

Dear Colleagues,

As a scientist, one of the reasons I was excited to come to Carolina and serve as chancellor is because of the University's international reputation as a research powerhouse and the University's commitment to become a leading innovation and entrepreneurship center. Over the past three years, through focused work and institution-wide dedication, Carolina's success in this area has blasted off to new heights.

This report shares compelling stories about how Carolina embraces the translational aspects of its work and makes innovation and entrepreneurship part of our core missions of research, teaching and service. The following pages document work already under way and describe the logical next steps that must be taken to build upon recent successes. The stories speak of Carolina's demonstrated commitment to helping people increase their capacity to convert knowledge into practical benefit for the public good that delivers lasting positive impact in our state and beyond.

Under the guidance and support of University-facilitated programs, students, faculty and staff are working together like never before to create powerful results to tackle North Carolina's and the world's most challenging problems. This perfectly aligns with our pan-university commitment to ensuring our graduates are ready to face a certain-uncertain future as part of the Innovation Generation.

Carolina is already well on its way to being a global leader in innovation and entrepreneurship. Equally as important and essential, we have built a foundation to expand our work in the future, creating opportunities for new ventures, areas of exploration and ultimately successes in the years ahead.

Our success wasn't created by happenstance, and achieving our goals takes many people collaborating across a diverse range of activities, coupled with support from an integrated network of resources.

University innovators who wish to bring discoveries or inventions to market need early-stage support. In this critical area we took deliberative action on multiple fronts. In February 2015, I created a new position reporting directly to me, Vice Chancellor for Innovation, Entrepreneurship and Economic Development. The mandate of this office includes aggressively seeking out marketable ideas and creating needed partnerships among inventors, investors, industry partners, mentors and the University community. Another major new initiative to fuel our social and economic value to North Carolina is the creation of the Carolina Research Ventures Fund for investments into faculty-founded, IP-based startups.

In the formal teaching of entrepreneurship, we are building on the successes of the Kenan-Flagler Business School's Center for Entrepreneurial Studies, the Frank Hawkins Kenan Institute of Private Enterprise and the Entrepreneurship Minor in the College of Arts and

Sciences. Additionally, the excellent work of other schools—Media and Journalism, Public Health, Social Work, Medicine, Pharmacy, Law—and many units are contributing to student success.

For students, we are dedicated to delivering uncompromising quality in education, in terms of both what and how they learn. We want Carolina graduates to have proficiency in their disciplines, amplified with an entrepreneurial mindset and skillset that includes design, leadership, planning and execution.

Supporting all of these efforts—and our innovators—is a dedicated team of faculty and staff whose work underpins the programs, spaces and initiatives critical to Carolina's innovation strategy. Their efforts are, in part, a reflection of the leadership of the UNC-Chapel Hill Board of Trustees and senior administrators.

In this critical area, I want to recognize and thank four leaders for their tireless support and personal commitment: Dwight Stone, chair of the UNC-Chapel Hill Board of Trustees; Lowry Caudill, trustee and former board chair, for his leadership as chair of the Innovation Circle; Julia Grumbles, trustee and chair of the Board Committee on Commercialization and Economic Development; and Judith Cone, vice chancellor for innovation, entrepreneurship and economic development, who keeps our innovation agenda focused on supporting those who are transforming lives for the better. Critical leadership has also been provided by the provost and deans. And, very importantly, our initiatives could not have moved forward without the people who recognize the value of innovation and entrepreneurship and provide the financial resources needed to advance these critical activities.

Our overarching goal is to make Carolina synonymous with excellence in innovation and entrepreneurship. This is our personal and institutional commitment to our students, faculty and staff, our state and to those who provide lifeblood financial resources needed to advance our programs. Thanks to their continuing support, we are developing and inspiring the next generation of innovators and entrepreneurs who will create new jobs and fields of endeavor that capture imaginations, create new opportunities and help change our state, nation and world.

Carol L. Folt
Chancellor, the University of North Carolina at Chapel Hill

■ *Dwight Stone*

Strategic Support

Since its founding in 1789 as the nation's first public university, Carolina has continuously met the changing needs of the state, nation and the world. Our students, faculty and staff see a challenge, mobilize their knowledge and resources and do what it takes to get results.

Today, the challenges confronting universities and academic institutions across the country and world are huge. We must face those head on and meet them with courageous, transformational solutions. As chair of the University of North Carolina at Chapel Hill's Board of Trustees, I feel honored to be able to work with the administration to advance the University to meet new demands while remaining true to its core values.

Many board members were part of the creation in 2010 of the Innovate Carolina Roadmap. Alston Gardner, Steve Lerner, Barbara Hyde and Sallie Shuping Russell spent nearly a year working with faculty, students, donors, parents and friends of the University to better understand the need and opportunity for Carolina to become a leader in innovation and to create the Roadmap. Later, Innovation Circle members Lowry Caudill, Phil Clay and Julia Sprunt Grumbles would join the UNC-Chapel Hill Board of Trustees. Each successive board since that time has placed innovation as one of the top priorities. A UNC-Chapel Hill Board of Trustee subcommittee on innovation has worked with the administration to continue to advance the University's capacity to deliver the much-needed results to communities of need, and to contribute to the economy broadly.

The Board of Trustees is committed to providing the leadership and support for making UNC-Chapel Hill a place where people come to explore and create, and where Carolina-born innovations and innovators start in North Carolina and change the world.

Dwight Stone
Chair, UNC-Chapel Hill Board of Trustees

■ *Lowry Caudill*

An Engine of Innovation

In 2010 a dedicated team of UNC-Chapel Hill family—faculty, students, staff, administrators, alumni and friends—was charged by then Chancellor Holden Thorp with creating a strategy that would best position Carolina to produce more innovations faster and, in doing so, change our community, nation and world for the better. The result was the 2010 Innovate Carolina Roadmap.

I am inspired by what we have accomplished together since the launch of the Roadmap. The enthusiasm for and commitment to reaching our goals are shared across the Carolina community. This report reveals the work of many, in a variety of fields and for a variety of purposes. It is impossible to ignore the culture of innovation and entrepreneurship that is becoming embedded through all aspects of our University.

I wear many hats at Carolina—a member of the UNC-Chapel Hill Board of Trustees, an alumnus, an adjunct professor, an innovator, an entrepreneur, a donor and a parent—which allows me to see the effect of this work from many different vantage points. By all accounts, the Roadmap—the vision we laid out in 2010 for what we aspired to achieve at Carolina— has been a success. Now we must build on the incredible momentum created. We must support this work in all of its forms by securing the necessary human and financial resources and by crafting new strategies to propel us forward. We must keep telling our story. **And we need your help,** now more than ever, to become the best public university in the world for innovation and entrepreneurship.

W. Lowry Caudill
Chair, Chancellor's Innovation Circle
UNC-Chapel Hill Board of Trustees, Past Chair

■ *Judith Cone*

A Community of Innovators

When I left the Kauffman Foundation as vice president and came to Chapel Hill to be special assistant to the chancellor for innovation and entrepreneurship in late 2009, I put behind me the privilege of being part of granting for charitable purposes nearly $100 million a year. The foundation sought to advance societal benefit by encouraging entrepreneurship and investing in education.

Stepping out of that position into an unstructured one with no budget, no employees and a tiny office on the ground floor of South Building was exhilarating. I had one job: Help one of the most prestigious universities in the world begin an audacious effort to uncover and unleash the vast potential of its faculty, students, staff, alumni and friends to transform North Carolina and the world through the University's innovators and innovations.

It was clear that if we were to be successful, the strategic direction had to be developed by the faculty, staff and students with input from alumni, parents and friends of the University. The process of creating the Innovate Carolina Roadmap involved bringing together representatives from these groups, learning from others and then coalescing around key goals.

The Chancellor's Innovation Circle, made up of external constituents chaired by Lowry Caudill, the Faculty Steering Committee chaired by John Akin and the Chancellor's Student Innovation Team led by Shruti Shah collaborated in a comprehensive effort to create the Roadmap. This established an agenda that is distinguishing Carolina as being among the best places for big thinking and bold action.

Many have joined the effort to move the work forward since the publication of the Innovate Carolina Roadmap in 2010. The support for this work comes from all levels of University leadership—from the board and senior leaders, deans, administrators and our other campus colleagues who have a passion for innovation and entrepreneurship in all its forms, from the donors who make this possible, and from the volunteers who give so much of their time and talent. Their commitment is transforming the concept of what is possible, and peers and neighbors around the world are taking notice.

Under the name *Innovate Carolina* we unified the University's innovation and entrepreneurship ecosystem. The Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development provides strategic leadership, oversees technology transfer, startup services, communication support, data collection, measurement and reporting. The Office advocates for strengthening the building blocks of innovation, helps fundraise for members of the Innovate Carolina Network and otherwise catalyzes the ecosystem.

Judith Cone
Vice Chancellor for Innovation, Entrepreneurship & Economic Development
judith.cone@unc.edu

UNC-CHAPEL HILL LEADS IN DIGITAL INNOVATION

Robert Allen (above left), James Logan Godfrey Distinguished Professor of American Studies, History and Communication Studies, is the former director of UNC's Digital Innovation Lab. Launched in 2011, the lab undertakes and facilitates the production of digital humanities tools, projects and programs as "public goods."

The Carolina Digital Humanities Initiative (CDHI), which builds on the work of the lab, promotes innovation, interdisciplinary collaboration and engaged scholarship and research at UNC-Chapel Hill and beyond. Digital technologies are radically democratizing access to the record of human cultural activity, which in turn has profound implications for the creation and use of knowledge by scholars and the public alike. CDHI brings humanities into the big data conversation across the University as well as among other leading research universities, federal agencies and foundations.

Allen's first digital project, an online resource documenting the history of moviegoing in North Carolina, was awarded the 2011 Rosenzweig Prize for Innovation in Digital History by the American Historical Association. He was also awarded the University's inaugural C. Felix Harvey Award for launching Main Street, Carolina, a program that engages with cultural heritage organizations in North Carolina in the creation of digital history projects. The program brings together scholarly expertise, world-class technological innovation and the resources of a great library to illuminate the history of the state.

Allen continues to develop new models for public engagement through digital humanities. His latest effort, Digital Loray, the Digital Innovation Lab's biggest project to date, is bringing a century-old mill located in Gastonia, North Carolina, into the digital age. This model, which can be replicated across the country, is an extended, community-based effort to integrate local history into the experience of one of the largest adaptive reuse projects in the state's history. The project has resulted in a rich digital archive and interpretive tools reflecting the history of the mill, the mill village and people and events associated with the mill over more than 110 years. Gastonia residents now have a digital anchor for their memories, and eventually the mill and its history center could become a destination for tourists, history lovers, researchers and genealogists.

Digital humanities is not just about individual scholars using computers in their research. It represents a potentially transformative change across all the ways we work as academics, from the questions we ask, to the kinds of people we work with, from the ways we communicate knowledge to our peers and our students, to the ways we relate to the world beyond the University. – Robert Allen, Former Director of the Digital Innovation Lab

The Innovate Carolina Roadmap:
A Brief History and Background

This report, like most formal reports, is filled with facts and figures. But it helps to know the human story behind the data. The following sections trace the story of the Innovate Carolina Roadmap. They explain how and why the Roadmap came to be, along with the major considerations that went into designing and implementing it. Definitions of key terms and concepts are included throughout. The story begins long ago, when North Carolina was a dynamic new state in a new country.

ROOTS OF THE ROADMAP: A UNIVERSITY GROUNDED IN INNOVATION

Our call to service runs deep. As the nation's first public university, UNC–Chapel Hill was founded by the citizens of a growing society, expressly to help lead them into the future. The University has fulfilled that call for more than 200 years—often by dramatically expanding and reinventing itself through changing times. During the 20th century, Carolina evolved from a segregated men's university to a university for everyone, added groundbreaking new academic units and programs and grew its research enterprise into one of the country's foremost.

As depicted in the Innovate Carolina Roadmap, the University community embarked on a major effort to gear up for the emerging challenges of the 21st century. This has entailed weaving its service mission more deeply than ever into how it conducts education and research. It has meant imbuing every aspect of the University with the spirit and practice of innovation: a dedication to putting new ideas into use to serve the people of North Carolina, the nation and the world.

And in doing so, we built on the exceptional work and forethought of those who came before us.

Throughout its history, UNC–Chapel Hill has had profound impact. Carolina has long been a place of firsts, a place where innovators work with others to make their ideas real. One powerful example came in 1892 when Professor Francis Preston, undergraduates William Rand Kenan Jr. and Thomas Clarke, and alumnus John Motley Morehead III collaborated to identify calcium carbide and its role in making acetylene gas. Put into use, this discovery was a key to launching the modern petrochemical industry, which transformed North Carolina's and the global economy. It led to the founding of Union Carbide, whose creators and their heirs have been generous benefactors to their alma mater.

Carolina's tradition of being first at the cutting edge continued on many fronts. The schools of government and public health were the first of their kind, each established in response to needs expressed by citizens across the state and elsewhere. Morehead Planetarium was the first associated with a university and a training ground for generations of astronauts, including Neil Armstrong and John Glenn.

The path to leadership was not easy. Throughout its long history, the Carolina community forged its way through dark times—through wars at home and abroad. Through depressions. Through civil unrest. Through the shrinking of industries in the state such as tobacco, textiles and furniture manufacturing.

But always, amid the challenges, people found opportunities for growth and renewal. And so it is in the present age, with the technology revolution and the fact that we live in a highly connected global community. These changes offer us unprecedented leverage—the leverage to help lead the state, and the world, to greater levels of human fulfillment—if we develop the capacities to innovate more rapidly and effectively than ever, in keeping with the new realities of the time.

KEY TERMS DEFINED

Innovation:
The successful implementation of a unique, valuable idea. This definition emphasizes the equal importance of three elements: unique – valuable – implemented. In the context of our University, innovation is summarized as: Important ideas put to use for the public good.

Innovation process: Moving from ideation through translation to impact.

Impact: The desired result of innovation, which is positive change for citizens of North Carolina and the world. Impacts can range from direct economic gains (job creation, greater efficiency) to improving the standards of living or quality of life in other ways.

Entrepreneurship: Creating an enterprise to deliver a product, service or process valued by a specific audience, without regard for the resources currently at hand.

Entrepreneurial mindset: A way of thinking that questions the status quo, converts problems to opportunities by finding new and better actions, convinces others to support the new approach, perseveres through the hurdles, and accepts ambiguity and risk as part of the disruption process.

The entrepreneurial mindset—and its related skillset—can be applied in any working environment, not only in startup ventures.

A CHANGING WORLD AT AN ACCELERATED PACE

Today's challenges are inextricably linked to global connectedness. Issues such as offshore manufacturing, the spread of new infectious diseases, terrorism, nuclear proliferation, burgeoning population growth to more than 7.4 billion people worldwide, pollution and climate issues, poverty, food and water insecurity and income inequalities are daunting. These problems are the world's, and they are all brought home to us in North Carolina.

Likewise, today's opportunities are global in nature. The rest of the world is increasingly open to useful new inventions and ideas that are developed in our state. Startup companies and social ventures launched here can attain global reach more readily than before, if they have sufficient merit and support. By excelling at this work, we can attract top innovators from around the world and thus make further strides.

UNC-Chapel Hill began responding to the new challenges and opportunities when they first became apparent. Talented and dedicated faculty, staff and students worked together to figure out ways to be helpful and sometimes to find breakthrough solutions. Over the past several decades, many notable accomplishments laid the groundwork for future growth. In 1985 the Frank Hawkins Kenan Institute of Private Enterprise was established, followed by the Kenan-Flagler Business School's Center for Entrepreneurial Studies in 1997. With these cornerstones in place, a grant in 2004 from the Kauffman Foundation jumpstarted pilot programs and curricula in Innovation and Entrepreneurship (I&E) across the University.

But even as these initiatives were being launched, further needs rose to the surface. With the growing levels of complexity in all fields, convergence of disciplines became imperative. Multi-faceted challenges were requiring people from various areas of expertise and worldviews to work together toward solutions. Carolina began to move in that direction by creating new interdisciplinary research centers and academic units.

And eventually, given the stir of new efforts in many quarters along with ever-rising demands, it became evident that further progress would require University-wide coordination.

## RECOGNIZING THE NEED FOR A ROADMAP

By 2010 the University community was ready when Carolina leaders decided to focus UNC-Chapel Hill in ways that would optimize its ability to have even greater impact in North Carolina and around the world. Innovation—translating important university-born ideas into practical benefit for the public good—became a top priority. At that time two fundamental questions were asked by University leaders: "What are the most pressing problems facing North Carolina and the world today?" and "How will UNC-Chapel Hill best support its talented faculty, staff and students and their research and ingenuity to help solve those problems?"

It was clear from the start that having greater impact meant embedding new methods, procedures and programs throughout the University. For many years, the three-part mission of research, teaching and public service had been heavily weighted toward supporting research and teaching, with the implicit assumption that those two missions would naturally bear additional fruit for the public as they had in the past. The supportive systems for research and teaching were extensive: They involved attracting world-class faculty and top

students and providing them with state-of-the-art buildings and equipment. Incentive systems were aligned to support research and teaching, as was the allocation of budgets, processes, space and talent.

All of this attention produced the intended results, as UNC-Chapel Hill rose to become a top-tier research university and earned consistently high national rankings in teaching. Now, however, it was time to bring more attention to the missing links. Past levels of practical innovation and impact derived from these activities were no longer sufficient for a faster-moving world. And clearly, with its strengths in research and teaching, UNC-Chapel Hill had a great deal of unrealized potential for impact. It needed a plan for more effectively moving ideas through the innovation process.

Acknowledging the complexity of the world today demanded that the University adapt to the new realities. In 2010, then Chancellor Holden Thorp commissioned a working group to make recommendations on how best to meet this challenge and opportunity.

THE INNOVATION PROCESS
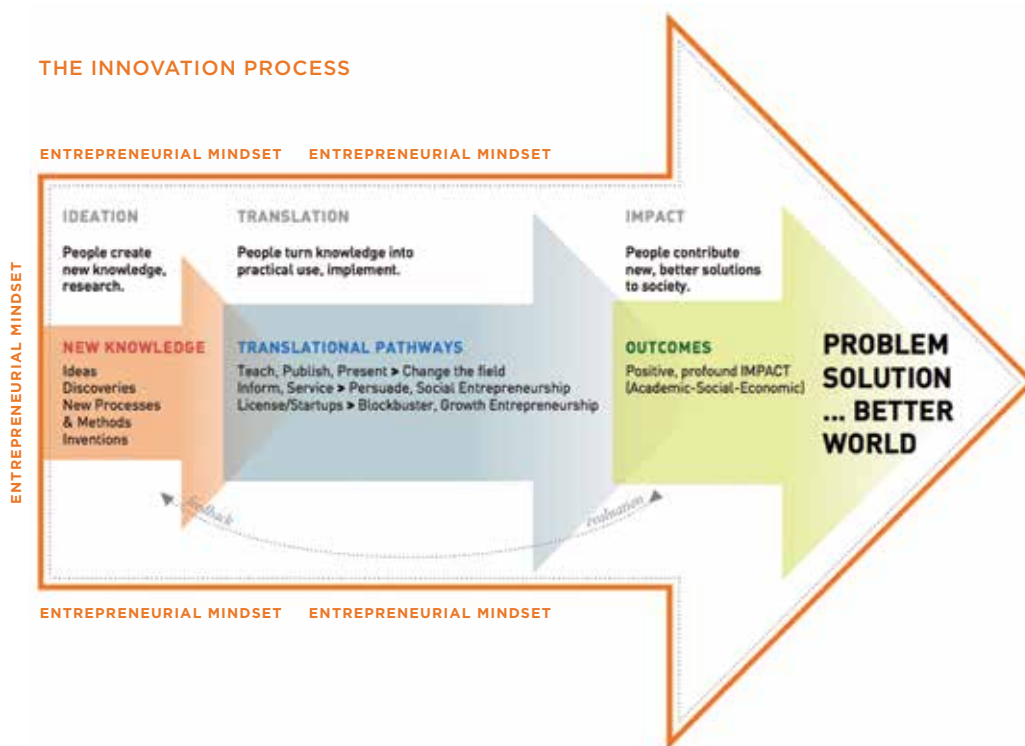
STUDIES AND PLANNING BEHIND THE ROADMAP

With the leadership of the then special assistant to the chancellor, Judith Cone, and the chair of the newly formed Innovation Circle, Lowry Caudill, working with the Faculty Steering Committee and Chancellor's Student Innovation Team, the Innovation Task Force set out to discover how Carolina could be an even greater exemplary source of, and force for, positive change in the world. Task force members wanted to know what it would take to best address the most pressing problems of our time, recognizing that these defy boundaries and require interdisciplinary solutions.

During several months of initial study, the Innovation Task Force took far-reaching preparatory steps. Members examined Carolina's existing programs and processes. They learned how other universities were organizing to have greater impact. This led the Task Force to identify gaps and consider the optimal ways of advancing this work at Carolina. They concluded that having a strategic roadmap would be critical. Having it implemented

meant involving stakeholders in its creation; setting a few key goals; aligning the organization so that resources and processes supported the vision of putting important ideas to use for the public good; and assigning a small team to champion the Roadmap so that it would be widely understood and the goals achieved.

The Innovation Task Force met with constituent groups both on campus and in the region. Members visited leaders in innovation and entrepreneurship at Stanford University, the Massachusetts Institute of Technology, the University of Utah and the University of Florida, to learn how those institutions translate knowledge into outstanding results. In New York City, Innovation Circle member Ben Cameron of the Doris Duke Charitable Foundation partnered with Ruby Lerner of Creative Capital to organize a meeting on how to advance innovation in the arts. The Faculty Steering Committee interviewed their colleagues, and the Chancellor's Student Innovation Team sought feedback from their peers across UNC-Chapel Hill and at other institutions.

LAUNCHING THE ROADMAP: A COMPREHENSIVE, INTEGRATED STRATEGY FOR IMPACT

In 2010 UNC-Chapel Hill formalized its intention to become a world leader in launching university-born ideas for the public good through the release of its Innovate Carolina Roadmap. The document outlined a comprehensive plan to increase the number and speed of innovations coming from the University.

The strategy set forth in the Roadmap was not limited to building a strong entrepreneurship curriculum or nurturing more startups based on intellectual property. To be sure, these are important activities—but the translation of ideas into impact comes in many forms. Recognizing this, the University laid out a broad approach designed to maximize the impact from **three key translational methods.**

TRANSLATIONAL METHODS

1. **Use research to stimulate action.** Groundbreaking research and the new knowledge it provides can be applied in many ways to shape society and the economy for the better. The focus here is on influencing institutions and individuals toward improved rules, practices and behaviors, rather than on creating a new entity. Public health is a classic example. Today, we in North Carolina enjoy much longer average life spans and face fewer risks of debilitating diseases than our forebears did in the early or even mid-1900s, thanks in large part to decades of public health programs and education campaigns based on new knowledge. And UNC-Chapel Hill continues to be at the heart of such efforts, both locally and globally. Faculty throughout the University communicate research knowledge in ways that influence public and corporate policies, inform people's thinking on key issues and advance the state of practice in their fields. Through artistic and social endeavors, other faculty, students and staff provoke new insights into human endeavors.

2. **Launch innovators into the world.** Graduates armed with technical knowledge, grounded in the liberal arts, and inspired to action by example are powerful ongoing contributors to impact. Carolina is preparing students to apply entrepreneurial thinking and action throughout their lives. Some will actually start new ventures, while others will bring their ideas and skills to existing firms—where they are needed to keep the state's major industries cutting-edge—and still others will inject fresh thinking into fields such as education and government.

    Many parties across the University have been working to identify and cultivate new skills that students will need in order to add value in a fast-changing world. For example, the Faculty Working Group on Data Studies recommended that all students graduate data literate, and steps are being taken to that end.

3. **Create social and commercial enterprises.** New enterprises are valuable for several reasons. Frequently they are the best means of bringing new ideas into reality. When they succeed, they become platforms for further innovation and impact, and those that grow substantially are key factors in job creation and economic prosperity.

Our goal is not only to encourage more startups of all kinds, but also to increase their chances for success and growth. This involves a host of measures across and beyond the University, because faculty members commercializing research, entrepreneurs launching non-IP-based companies, and social entrepreneurs each have distinct sets of needs. The new enterprises that generate the most impact in years ahead may come from anywhere in the University community.

All told, the work of translation from idea to impact is too far-reaching to be tied to a few programs or tactics. Innovation and entrepreneurship cannot be confined to any school, department or unit on campus. Only when the innovation process is embedded into the very fabric of the University will Carolina reach its full potential as a force for the public good.

IMPLEMENTING THE INNOVATE CAROLINA ROADMAP: STRENGTHENING A CULTURE AND ECOSYSTEM

Since the adoption of the Roadmap, the University has dedicated its available resources to twin goals. One is to encourage a culture of innovation throughout the Carolina community; the other is to build a cohesive, complementary and effective ecosystem of innovation. Both are necessary, and together they constitute an environment where innovation can flourish.

A *culture* is a set of commonly shared beliefs, values and practices. Thus, a culture of innovation is one where innovation is highly valued and purposefully practiced. The aspirational goal for Carolina is that the vast majority of the University community will see innovation aimed at impact as an integral part of their work.

The term *ecosystem* is used in many fields to describe all of the interconnected elements that generate and sustain certain activities. An innovation ecosystem includes innovators along with all the various resources and support systems they may need. It includes education and mentoring in the skills of innovation and entrepreneurship, along with seed funding and incubation space for early-stage ideas. It requires networks to link collaborators in the development of new ideas and processes that speed such development rather than hinder it.

Both a strong culture and a fully-functioning ecosystem are needed. As UNC-Chapel Hill began this work, it was apparent from the start that creating a state-of-the-art environment of this kind would be a complex task in its own right.

Indeed, without Carolina's long tradition of service and the cornerstone steps mentioned earlier, the effort might have been much more challenging. There was a firm foundation on which to build—yet a vast amount of work lay ahead. Many of the needed ecosystem elements either were absent or existed only in limited form at the start of the Roadmap timeframe, and while a culture of innovation was very much alive at Carolina in certain areas, it was not universally shared nor actively embraced.

Moreover, building and maintaining a community of innovators is a multi-level undertaking. In the most successful cutting-edge regions, innovative activity is both highly distributed and highly focused, so that diverse talents and resources are brought to bear on important goals. Reaching that state at Carolina required engaging many different stakeholders across the University and region, while also providing a central partner to integrate, support and grow the various efforts. That central partner started as a special assistant to the chancellor, and grew into a new vice chancellor position. The term *Innovate Carolina* was adopted to describe the University-wide ecosystem.

The Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development was and is responsible for catalyzing the Roadmap and serves the University by supporting, promoting, integrating and facilitating both centralized and decentralized initiatives. It is designed to do the following:

- **Demonstrate** Carolina's ongoing commitment to respond to complex and compelling local and global challenges with innovative solutions.
- **Emphasize** UNC-Chapel Hill's relevance and contributions to North Carolina and beyond.
- **Engage** internal and external stakeholders in continually setting and refining a strategy for the future.
- **Harness** the resources and work with investors and donors to support the work.
- **Evaluate and communicate** the results to multiple audiences.

As the ecosystem strengthened and more units became engaged, a community of champions saw the need to convene regularly. In 2013 the Innovate Carolina Network was launched, formalizing the interconnection of programs and 200 people working together on innovation and entrepreneurship in areas across campus. At its regular meetings, the network identified areas where new programs, partnerships and processes could bring additional support to innovators, and it introduced a plan for creating these mechanisms.

### AN ECOSYSTEM AT A PIVOTAL POINT: THE PATH TO IMPACT

The implementation of the Roadmap has gone well, as across the University talented people and needed new services have emerged to strengthen a growing culture of innovation, which is championed at the highest levels of leadership. But the creation of such a multi-functional ecosystem is an ongoing process, and that process has reached a pivotal point. The Roadmap period has shown that the innovation ecosystem is viable and relevant to nearly every area of the University. The programs within the Innovate Carolina Network are succeeding, more people are participating and some initial results are evident. The collaborative spirit of the Carolina community enabled many initiatives to thrive and grow, some with very limited resources. Donors supported these activities and are ready to support more.

Now the larger possibilities beckon. Like an emerging company that has validated its business model, this ecosystem is ready for the work and investments that will move it to scale. As the University embarks on a new strategic framework and enters a capital campaign, it is time to solidify the innovation infrastructure, continue to learn from others, better engage strategic partners and dedicate the required resources.

Much more can and will be done. The Carolina community will once again come together, this time to create the Innovate Carolina Roadmap 2.0. In order to produce ever-growing social and economic benefits, the ecosystem needs to be constantly improved and capable of producing both incremental and disruptive innovations at increasing rates.

In short: The University is poised for even greater impact. It is time to scale and sustain the work.

OTHER REPORTS DOCUMENTING THE INNOVATE CAROLINA ROADMAP PERIOD TO DATE CAN BE FOUND AT INNOVATE.UNC.EDU/REPORTS.
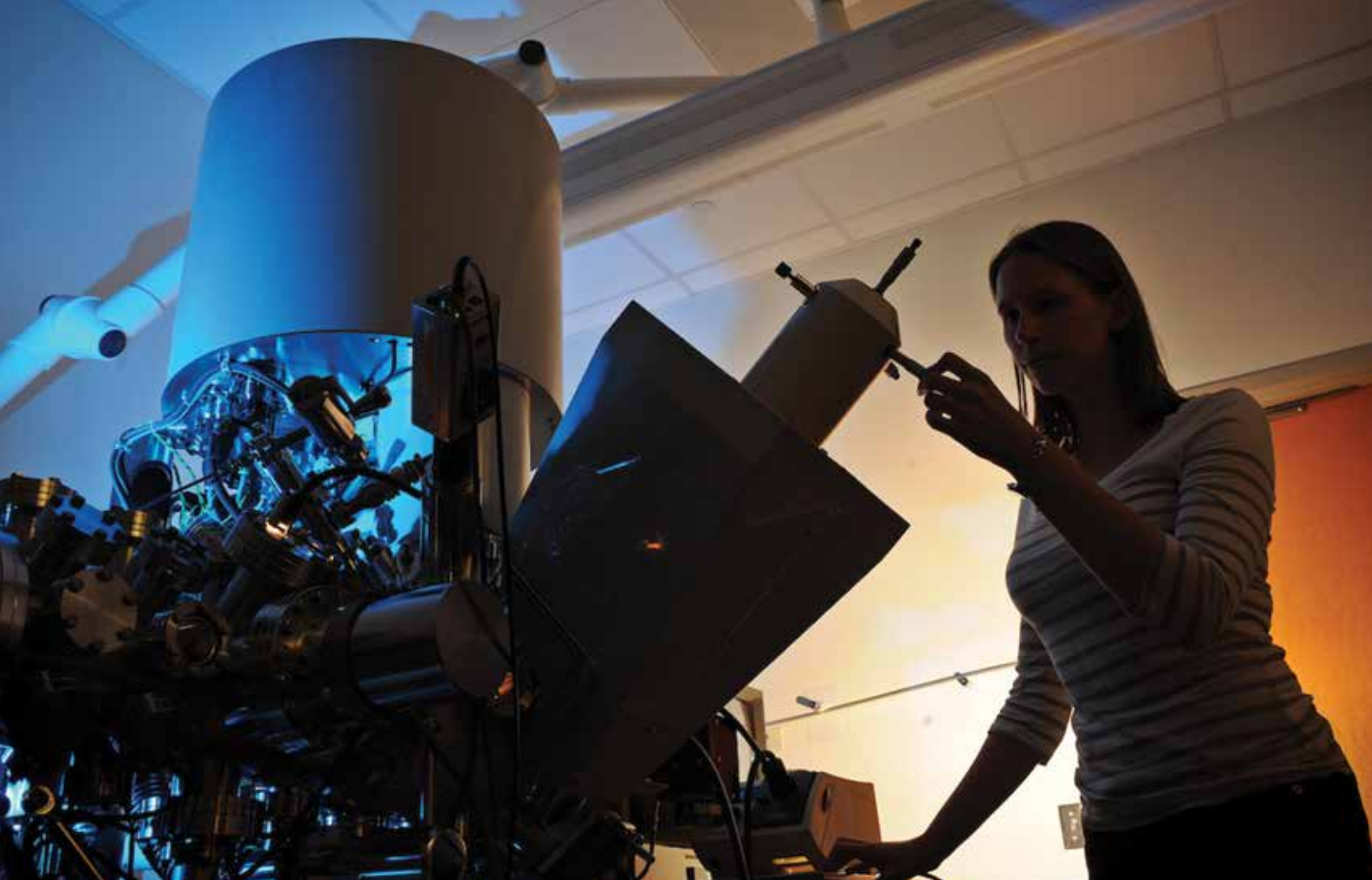
top: Carrie Donley, director of the Chapel Hill Analytical and Nanofabrication Laboratory (CHANL) works with the lab's X-ray photoelectron spectrometer. In 2016 CHANL became part of the Department of Applied Physical Sciences.

bottom: Matt Harris, an undergraduate Communications Studies student, uses an umbrella to control the movement of fish projected on the wall of Gerrard Hall during the C.H.A.T. Festival. The exhibit was titled *The Bathysphere: Motion Capture as Art* and was presented by professors Francesca Talenti, communications studies and Greg Welch, computer science.

At-A-Glance Roadmap Recommendations

■ *Recommendation 1*

Prepare faculty, graduate and undergraduate students, staff and the broader Carolina community with the knowledge, skills and connections necessary to translate new ideas into innovations.

■ *Goal 1.1: Ensure that faculty, students, staff and the broader Carolina community understand the University's commitment to innovation and the resources available to help them reach their related goals.*

■ *Goal 1.2 Learn the skills of innovation and entrepreneurship.*

■ *Recommendation 2*

Collaborate with diverse groups internally and externally to explore issues, options and creative approaches that may lead to innovations.

■ *Goal 2.1: Enhance robust interdisciplinary collaboration among physical and social scientists, humanistic scholars and those in hybrid disciplines, such as bioengineering and applied sciences, to address the great challenges of our times.*

■ *Goal 2.2: Collaborate and coordinate around key themes of local, national and global significance to mobilize the University toward new understanding of issues and solutions.*

■ *Goal 2.3: Improve industry collaborations and increase industry funding.*

■ *Goal 2.4: Extend collaborations with state and regional partners to help North Carolina further develop into a leading competitive, global, entrepreneurial, knowledge and innovation economy.*

■ *Goal 2.5: Strengthen collaborations with Carolina's strategic international partners.*

■ *Recommendation 3*

Translate important ideas more expediently and at an increased volume into innovations that improve society.

■ *Goal 3.1: Support faculty, students and staff as they develop understanding of issues and contribute solutions to complex social and environmental problems through social entrepreneurship.*

■ *Goal 3.2: Effectively organize and manage the University's commercialization services to maximize the quality and volume of potentially important innovations for society. Return revenue from these innovations to the University to support this work.*

■ *Goal 3.3: Measure the impact of innovations and innovators launched at Carolina.*

■ *Recommendation 4*

Align people, incentives, resources and processes to strengthen an intentional culture of innovation at Carolina.

■ *Goal 4.1: Encourage leaders from across the University to support and promote innovation in their schools, departments, institutes, and offices.*

■ *Goal 4.2 Recruit, retain and reward faculty, students and staff who show promise, aptitude and/or achievement in innovation.*

■ *Goal 4.3 Align the University's internal methods and processes to foster innovation, especially in working across schools.*

■ *Goal 4.4: Provide the necessary funds to support nascent and promising innovations on campus.*

■ *Recommendation 5*

Catalyze innovation at Carolina by facilitating the work of faculty, staff and students as they put important ideas to use for the public good.

■ *Goal 5.1: Leverage the talents of leaders across campus to prepare, collaborate, translate and align resources and processes to strengthen an intentional culture of innovation at Carolina.*

■ *Goal 5.2: Create the Chancellor's Catalyze Group to facilitate the implementation of this Roadmap.*

An Overview of Accomplishments

The ultimate goal of the Innovate Carolina Roadmap is to magnify the University's impact in every way possible. To that end, the Roadmap called for getting more people involved with innovation, while building an ecosystem to enable them to be more effective. The resulting initiatives, detailed in the next section of the report, engaged all parts of the University and touched nearly every aspect of its operations.

In some cases, existing assets were enhanced or expanded. In other cases, missing pieces were created. For example, prior to the Roadmap, Carolina had no physical spaces dedicated and equipped for incubating early-stage ventures and now there are several such spaces with more in the pipeline.

Various academic units started initiatives to pilot promising ideas in fields from medicine to journalism, while some initiatives entailed the creation of new units (for example, the Department of Applied Physical Sciences), and many more were interdisciplinary or campus-wide in nature. A host of targeted support programs for innovators are now under way, along with changes to the University's basic policies and processes to make them more conducive to innovation. UNC Health Care is undergoing a significant transformation using novel approaches to deliver higher-value care in response to accelerating pressures. The new vice chancellor for innovation, entrepreneurship and economic development role was created in 2015 as a way to better lead this work.

Finally, many of the Roadmap actions involved new modes of connecting, collaborating and communicating. Innovation thrives in networked environments, where people with different skills and perspectives can interact to develop practical solutions to real-world needs. UNC-Chapel Hill is becoming a highly networked university—both within the campus and with external partners.

Below are highlights of accomplishments in key areas. All reflect the work of many participants, with central coordination and support from the Chancellor's Office of Innovation and Entrepreneurship during the Roadmap period, now the Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development. Note, too, that further work continues in all respects.

EDUCATING STUDENTS TO BE INNOVATORS

The Center for Entrepreneurial Studies at the Kenan-Flagler Business School offers a concentration in entrepreneurship. The College of Arts and Sciences Entrepreneurship Minor, hosted by the economics department and open to all undergraduates, now offers tracks in nine focus areas. Students can learn the skills required for launching commercial or social ventures, or special skills in fields ranging from computer science to arts and media.

Since innovation in every field has come to rely on the analysis and use of data, the new Data Studies initiative—currently in progress under the flag Data@Carolina—is developing curricula to ensure that all students graduate data literate, commensurate with their grade level at the University and their areas of study.

Within particular units:

- The Reese News Lab, in the School of Media and Journalism, engages students in hands-on projects as they pilot new approaches to gathering and disseminating the news.
- At the School of Education, the MA in Educational Innovation, Technology, and Entrepreneurship prepares graduate students to merge new educational technologies with new learning models and organizational forms.

- The Kenan-Flagler Business School reports record levels of enrollment in entrepreneurship courses, and it partnered with the School of Medicine in a joint MD/MBA program that includes a strong emphasis on innovation and entrepreneurship.

- The Department of Computer Science created courses and programs focused on I&E, while the schools of Public Health, Social Work and others have implemented various initiatives.

- The School of Medicine revised its curriculum to better integrate basic sciences and clinical skills, while preparing students for how they will practice medicine in the future.

- The UNC Eshelman School of Pharmacy partnered with the North Carolina Small Business Technology Development Center on an internship program that gives PharmD students hands-on experience in commercializing University startups.

- The College of Arts and Sciences expanded the teaching of entrepreneurial thinking throughout the curriculum.

- The Campus Y developed a social innovation workshop curriculum to support the development of an entrepreneurial mindset and skillset for faculty, students and the community.

New co-curricular events and learning activities played a growing role, too. One notable example is Pearl Hacks, the nation's first all-female hackathon. A student-led event hosted annually by the Department of Computer Science, Pearl Hacks attracts more than 300 young women from across campus and beyond and is part of the University's efforts to involve greater numbers of women and under-represented minorities in innovation and entrepreneurship. Another example is the E(I) Lab program, a six-month experiential opportunity for graduate students, professional students and postdocs to develop and test innovative solutions to unmet healthcare needs.

TRANSLATING RESEARCH

UNC-Chapel Hill is a national leader in research, with externally funded research totaling nearly $1 billion per year. A multitude of initiatives are now under way to help faculty members bring more of this research to market in useful forms. The new Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development is a key resource in this endeavor.

Assistance programs include the Faculty Entrepreneurs Workshop for faculty in all fields; the Launching the Venture (now StartUp UNC) course, open to faculty as well as students; and a growing range of programs for biomedical innovators offered by KickStart Venture Services (formerly Carolina KickStart).

Academic units across the University are expanding their guidelines for tenure and promotion to include consideration of innovation activities. Task forces convened by the vice chancellor for research identified systemic roadblocks to innovation, which are now being addressed. A program for patent landscaping and market-opportunity surveys offers these crucial services free to University faculty.

Startups based on faculty research need early-stage funding, and one response was to create the Carolina Research Ventures Fund, launched with an initial pool of $10 million to help these ventures develop to the point where they can attract substantial private investment. Research-based innovators also have many other needs that are being met by initiatives described in this report.

As a result of these efforts, the Office of Commercialization and Economic Development already reports sizable increases in patenting and IP-based startup formation by faculty. Further gains are expected—and more work lies ahead.

PROVIDING PHYSICAL FACILITIES AND RELATED SUPPORT PROGRAMS

New ventures of all types are proliferating at Carolina. Counting student startups, not-for-profit social ventures, centers and innovation programs in multiple schools, and others based on research, more than 250 ventures have been launched since the start of the Innovate Carolina Roadmap. This great surge of activity would not have been possible without the provision of basic facilities to house and nurture the ventures. New facilities include the Launch Chapel Hill startup accelerator, which provides space and mentoring for selected teams of high-potential entrepreneurs; the 1789 Venture Lab for students; the Campus Y CUBE Social Innovation Incubator; and the KickStart Labs and Eshelman Institute for Innovation MicroIncubator facilities for faculty entrepreneurs needing both office and wet-lab space on campus.

These startup spaces and their affiliated support programs have quickly been filled to capacity. The present infrastructure can only be seen as a starting point. Plans are in progress for an integrated network of facilities, including a major Innovation Center.

Nor are new facilities limited to housing startups. In 2016 the BeAM (Be a Maker) initiative opened a series of makerspaces on campus, with state-of-the-art equipment for making physical prototypes of new products. This was an essential component of the innovation agenda, because innovation is tied to economic growth, which cannot be built solely upon the standard formula of software and services. Manufactured goods must be part of the picture—and a good bit of tomorrow's manufacturing may stem from exploratory work done in our makerspaces.

BeAM Maker-in-Residence (spring 2017) Donovan Zimmerman from the Paperhand Puppet Intervention instructs students in the construction of frames for life-sized puppets as part of their spring collaborative.

SEEDING LEADERSHIP AND NETWORKS ACROSS THE UNIVERSITY COMMUNITY

One goal of the Roadmap was to have innovation **embedded** in the fabric of the University. This means that the process of translating ideas into impact would be viewed not as an add-on to research or teaching, but as a natural extension of scholarly work. Reaching such a state requires human infrastructure: it calls for building networks of people to serve as leaders, liaisons and advocates.

Innovation leaders now permeate all levels of University life. The UNC-Chapel Hill Board of Trustees backed the Roadmap agenda from the start and formed two committees to see that the work is carried forward; one of those, the Committee for Commercialization and Economic Development, has a term running to 2017.

Chancellor Folt created the Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development. Throughout the University, numerous academic units have appointed I&E liaisons and officers with titles such as associate deans or department heads for entrepreneurship and/or innovation. Experienced Entrepreneurs-in-Residence (including social EIRs) now populate many parts of the campus, serving as mentors to new ventures and helping to link them with needed expertise. The Innovate Carolina Student Leadership Team provides peer-to-peer leadership among students and helps with student-led I&E activities, including TEDxUNC and Global Entrepreneurship Week.

Since 2011 the Center for Faculty Excellence, a unit of the Provost's Office, has offered the Faculty Learning Community on Strategy and Leadership, which provides a year-long program to teach innovation, entrepreneurial thinking and strategy to faculty leaders of departments, centers, institutes and programs. Since 2009 UNC-Chapel Hill has provided a four-day residential entrepreneurship training seminar for its faculty leaders; three years ago the program expanded to include faculty leaders across the UNC system.

Linking all these nodes, the Innovate Carolina Network is a meta-group of more than 200 I&E leaders who meet regularly to create new connections, identify gaps and strengthen the ecosystem.

Moreover, the new connections that are being created extend well beyond the campus.

PARTNERING WITH EXTERNAL ORGANIZATIONS

Many experts have observed that we live in an age of **open innovation** when almost no organization can create and contribute effectively on its own. The world is so complex, and expertise and resources are so widely distributed, that collaborating outside one's borders is far more powerful.

The Roadmap called for Carolina to reach past its borders and, in doing so, work with many external partners. One major thrust is building industry partnerships. A new post in the Vice Chancellor's Office, director of strategic partnerships, was created in collaboration with the offices of Research and Development. The Research Office is streamlining back-office support for sponsored research projects and clinical trials to enable more efficient collaboration with industry, and exciting new collaborations were put into motion.

A partnership with GlaxoSmithKline created a University research center dedicated to finding the cure for HIV/AIDS, along with a jointly owned startup company to produce the treatments and bring them to market. UNC Health Care collaborations with the global software firm SAS, the technology giant Cisco and with Blue Cross and Blue Shield of North Carolina are creating advances in health care delivery. The School of Medicine formed a multi-pronged partnership with Duke University, NC State University, industry partner Siemens and the Carolina startup company XinRay to develop a nanotech-based radiation system for diagnosing and treating cancers. Other industry partnerships are working in areas from medicine to materials science. The University also is collaborating with public and private entities in the region and statewide on economic

development, as well as on specific innovations. Forging a new and stronger team approach to development of the Triangle region is a priority, and the Office of Innovation, Entrepreneurship and Economic Development is taking a lead role in this effort, while also exploring new avenues to growth across the state.

A major step now well under way was started at the beginning of the Roadmap process, when UNC-Chapel Hill partnered with other universities in our region to create the Blackstone Entrepreneurs Network for North Carolina. This network, launched with initial funding from the Blackstone Charitable Foundation, has a mission to spur economic growth by linking venture creators with seasoned entrepreneurs, dealmakers and other forms of assistance. Blackstone has provided many of the Entrepreneurs-in-Residence on the Carolina campus and conducts a growing range of related activities. This had led to further joint programs.

COLLABORATING IN AREAS OF NEED AND OPPORTUNITY

Most of the world's greatest needs call for focused collaboration across disciplines.

In recognition of this reality, campus themes were established to draw innovators from many fields together around major global issues. The first theme, *Water in Our World* (2012-15), was built on the University's recognized expertise in water-quality and water-supply topics to galvanize interest in new developments. The second theme, *Food for All* (2015-17), focuses on issues of food security and access.

Elsewhere, the new Department of Applied Physical Sciences is inherently cross-disciplinary (as well as explicitly focused on applied results). The expansion of the Digital Humanities Lab enabled promising new work in a variety of multidisciplinary areas, as well.

In addition, the University is conducting regular events that promote interdisciplinary innovation in key growth-market sectors, while raising the University's profile in those sectors. The Carolina Apps competition puts software developers together with subject-matter experts to invent new mobile apps. And the annual Clean Tech Summit conference, drawing participants from across the state, helps to position UNC-Chapel Hill as a hub for innovation in the many diverse fields that comprise clean technologies. Similarly, the annual water conference draws experts from such fields as public policy, science, medicine, psychology and city planning.

The University of North Carolina at Chapel Hill and GlaxoSmithKline announce the creation of the dedicated HIV Cure center and the jointly owned Qura Therapeutics.

FUNDING, RECRUITING AND COMMUNICATING

Raising funds to support expanded innovation is a multifaceted task in itself that is being pursued on all possible fronts. The University Development Office is including innovation activities in the new capital campaign. Increased partnerships with industry mean more funding from companies. Major private donors have supported projects such as the Gillings Innovation Labs in the Gillings School of Global Public Health, the Eshelman Institute for Innovation in the Eshelman School of Pharmacy, the Launch Chapel Hill accelerator, 1789 Venture Labs and the Entrepreneurship Minor. Private donors are eager to support more. Carolina partnered with neighboring universities in the Triangle region to launch the Triangle Venture Alliance, aimed at drawing angel investors for new ventures from among the ranks of the universities' alumni.

Finally, it should be noted that when ventures progress along the path to success, they draw investment to the region on their own. Startups nurtured at Launch Chapel Hill have raised upward of $15 million in external funding and created more than 1,000 jobs (250 in Orange County) in the three years since its opening—a reminder that eventually innovation and entrepreneurship move from being cost centers to generators of income and growth.

To expand innovation at Carolina, recruiting top student and faculty talent is essential and the University is making strides on this front. Leading nanomedicine researcher Alexander (Sasha) Kabanov and 20 of his research colleagues were recruited from the University of Nebraska to UNC-Chapel Hill. Stephen Frye, an experienced medicinal chemist with GlaxoSmithKline, was recruited to the Eschelman School of Pharmacy and serves as a leading innovator there. New faculty members recruited to Applied Physical Sciences are working on practical innovations that range from lab-on-a-chip systems for medical diagnostics to new technologies for solar energy.

Gianpietro Dotti, MD, and Barbara Savoldo, MD joined the UNC Lineberger Comprehensive Cancer Center in 2015 to help lead groundbreaking immunotherapy clinical trials that will test an experimental treatment in which patients' own immune cells are genetically engineered to fight their cancer. The clinical research program is the first of its kind at UNC Lineberger and in North Carolina, and it is unique to a handful of academic medical centers around the country. Attracting top student innovators has also been a priority. Full Innovation Scholarships have been awarded to 14 students during the Roadmap period who have demonstrated high-level skills in STEM disciplines combined with an innovative mindset. And to close this overview of Roadmap accomplishments: Building a culture of intentional, widespread innovation requires communicating effectively. People in every part of the Carolina community must be kept aware of new advances, emerging needs and opportunities, and be supported in developing their own ideas.

Communications amplify I&E impact in a number of ways. Offices throughout the University have worked together to leverage their efforts. A central online information portal was created—innovate.unc.edu—and various units are disseminating innovation news through means that range from online and social media to newsletters, speaking engagements and face-to-face communications.

The following pages contain a formal report on work done to meet all the recommendations and goals of the Innovate Carolina Roadmap. The next section includes much more information than this overview, and it is organized in five key strategic areas: *Prepare, Collaborate, Translate, Align* and *Catalyze* the University for world-class innovation. Under the list of goals in each strategic area, there are entries describing *Actions Taken, What We've Learned* and *Next Steps* that lie ahead.

This format provides a fine-grained view of the Roadmap's intentions and allows a point-by-point assessment of progress made.

RECOGNITIONS

KEY RECOGNITIONS DURING ROADMAP PERIOD:

- UNC-Chapel Hill won the prestigious "Entrepreneurial University Award" in 2015 from the Deshpande Symposium on Innovation and Entrepreneurship in Higher Education for excellence in student engagement and curriculum innovation.

- The Deshpande Foundation's Deshpande Symposium Awards also recognized Judith Cone, vice chancellor for innovation, entrepreneurship, and economic development, in 2015 as the national recipient of the "Outstanding Contributions to Entrepreneurship and Innovation in Higher Education Award."

- Launch Chapel Hill, led by Dina Rousset, was ranked No. 4 among best-performing university business accelerators in North America, based on a 2015 benchmark study by UBI Global, a thought leader in performance analysis of business incubators around the world. The UBI Global award recognizes that Launch Chapel Hill provides more value for the ecosystem and its startup clients than its regional or global peers and produces better outcomes on economic enhancement, access to funds and post-acceleration performance indicators.

- In 2015 the United States Association for Small Businesses and Entrepreneurship® (USASBE), the largest independent, professional academic organization in the world dedicated to advancing the discipline of entrepreneurship, elected as its president Ted Zoller, the director of the Center for Entrepreneurial Studies and a clinical associate professor of strategy and entrepreneurship at the Kenan-Flagler Business School.

- RealTalk, a startup founded by two graduate students in the Gillings School of Global Public Health and an MBA student from Yale University, received the 2016 Innovation Next Prize, sponsored by the National Campaign to prevent Teen and Unplanned Pregnancy. In the first round of the challenge, the team received $80,000 to further develop their concept of a phone-based app for middle school students. In the final round of the competition, RealTalk received the top prize of $325,000. As student startup teams grow in their sophistication, the University is increasingly supporting their participation in competitions across the country to compete for prizes such as the ACC InVenture Prize and the Hult Prize.

top: Allan Friedman, a graduate student in the music department, demonstrates the interface between music and technology at the Annual Technology Expo.

bottom: Twenty undergraduates participated in the inaugural maker-in-residence project in 2016. The students, from diverse backgrounds and majors, used the BeAM maker network to build and give artistic flair to a functioning telescope.

Details of Accomplishments

THE FOLLOWING SECTION PROVIDES DETAIL TO DATE ON ACCOMPLISHMENTS IN THE FIVE AREAS OF RECOMMENDATION.

PREPARE

TRANSLATE

COLLABORATE

CATALYZE

ALIGN

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

INNOVATE
CAROLINA

■ *Recommendation 1 – Prepare (2 Goals)*

Prepare faculty, graduate and undergraduate students, staff and the broader Carolina community with the knowledge, skills and connections necessary to translate new ideas into innovations.

This recommendation has two goals: 1) build awareness and 2) learn the skills of innovation and entrepreneurship.

■ *Goal 1.1: Ensure that faculty, students, staff and the broader Carolina community understand the University's commitment to innovation and the resources available to help them reach their related goals.*

ASPIRATIONS

In the future, Carolina's commitment to innovation will be well understood and embraced by the campus community. Faculty, students and staff will consider how their work in the classroom, lab, studio and that of the entire research enterprise can advance Carolina's collective, positive impact on society. From the moment they are recruited through the day of graduation, students will have the opportunity to experience how their learning applies to innovation and what they can do to actively participate in the process. Faculty, students and staff will be drawn to Carolina because of its commitment to innovation and entrepreneurship.

ACTIONS TAKEN

Since 2010 the Chancellor's Innovation and Entrepreneurship Office—which became the Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development in 2015 under the leadership of Judith Cone—advanced a communication strategy and executed key initiatives that continually demonstrated the University's commitment to innovating for the public good. Additionally, it reinforced Carolina's reputation for fostering creativity and discovery, encouraged involvement from diverse stakeholders and illustrated the University's impact on the community, state, nation and world. The Innovate Carolina community created a pan-university network relying on the Vice Chancellor's Office to champion and communicate about innovation at UNC-Chapel Hill. The collective work of the University was branded *Innovate Carolina* to represent the campus-wide efforts of people and programs dedicated to making Carolina a place where innovators thrive.

The central Innovate Carolina office, led by Michelle Bolas, served as a catalyst and communications hub for a wide range of on- and off-campus activities under the *Innovate Carolina* brand. The vision behind Carolina's innovation work was communicated regularly to key audiences by multiple means, including online platforms (web, e-newsletters, social media) and presentations to groups locally, statewide and nationally. Innovate.unc.edu became a central repository for the University's innovation news, as well as a one-stop portal to information about relevant programs and events for all who wished to take part in the work.

Several other University offices and media platforms played key roles in the communication effort, as follows:

- The Office of Communication and Public Affairs (now known as University Communications) led by Vice Chancellor Joel Curran, the Office of Research led by Terry Magnuson, and the distributed communicators' network serving University units all contributed to communicating the impact of the

Innovate Carolina Network. They produced and promoted stories on every aspect of faculty and student innovation and entrepreneurship. Stories were regularly featured on the UNC-Chapel Hill home page (unc.edu) and were cross-promoted through many social media platforms.

- The Office of Research Communications in the Office of the Vice Chancellor for Research focuses on translational research and its impact. It consistently featured innovation stories in the *Endeavors* online magazine (endeavors.unc.edu).

- Unit communication teams regularly used their own websites, news operations and media to target various audiences. They produced high-quality print pieces, conducted conferences and had faculty, student and staff innovators represent key messages at international symposia. Stories of UNC-Chapel Hill impact were disseminated through their various communication platforms.

- Development officers located centrally and in units across the University also served as important ambassadors for the innovation message, raising awareness among alumni and potential strategic partners as they engaged with these supporters through day-to-day work.

WHAT WE'VE LEARNED

Having senior leaders understand and support the innovation vision, mission and goals outlined in the Roadmap was important in communicating this work. They encouraged their colleagues to report on innovation from their units' perspectives as well.

The need for strategic communication about Carolina innovators and the impact that they have is ongoing—both within the University community and to the rest of the world. It is not uncommon to hear people say, "We need to tell our story better." There are still many people on campus, and beyond it, who do not understand the work of the Innovate Carolina Network or its relevance to them. Often, potential innovators are not aware of the resources available to assist them in putting ideas to use for the public good. Externally, much work is needed to target messages to potential partners and contributors.

NEXT STEPS

In order to reach more audiences and better tell our story, it will be important to effectively gather and pool content on Innovate Carolina activities through a strong collaboration between the central communications office, campus communicators and the Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development. Having sophisticated portals and pathways for faculty, students and external audiences to learn about innovation and entrepreneurship programs specific to their needs will make it quick and easy to find the resources they need.

Working with Provost Jim Dean and his office, the Vice Chancellor's Office will create a dashboard showing the University's social and economic impact. This dashboard will be a resource used to inform our strategies for engagement with multiple stakeholders.

Engines of Innovation
THE ENTREPRENEURIAL UNIVERSITY IN THE TWENTY-FIRST CENTURY

Holden Thorp & Buck Goldstein

ENGINES OF INNOVATION

In *Engines of Innovation*, former UNC-Chapel Hill Chancellor Holden Thorp and University Entrepreneur-in-Residence Buck Goldstein make the case for the pivotal role of research universities as agents of societal change. They argue that universities must use their vast intellectual and financial resources to confront global challenges such as climate change, extreme poverty, childhood diseases, and an impending worldwide shortage of clean water. The book is an urgent call to action and a practical guide for our nation's leading institutions to make the most of the opportunities available to be major players in solving the world's biggest problems.

Ultimately, strong communication helps to shape reality. As UNC–Chapel Hill continues building a national profile as a thought leader in innovation and entrepreneurship, this will help to grow the Innovate Carolina ecosystem—attracting more partners, more funding and more faculty and students dedicated to accelerating ideas that are put to use for the public good.

VENTURE CAPITAL INTERNATIONAL COMPETITION

In 1998 UNC's Kenan-Flagler Business School flipped the pitch competition model and created the global Venture Capital Investment Competition (VCIC), drawing students from 78 universities around the world to compete in events held on three continents. The culmination of these events is the VCIC Global Finals, held at UNC-Chapel Hill each spring.

■ *Goal 1.2 Learn the skills of innovation and entrepreneurship.*

ASPIRATIONS

In the future, a broad representation of the Carolina community will gain the knowledge, skills and connections needed to translate their ideas into greater benefit to society. Faculty, students, staff and members of the Carolina community who wish to learn about innovation and entrepreneurship will have easy-to-find, appropriate and engaging opportunities.

Courses will help participants develop ideas and apply translation methods. Participants will understand that calculated risks and inevitable failures are part of learning, that translation best occurs by collaborating with a diverse team and that skills such as negotiating and communicating are important to the process. They will learn how to translate ideas into impact through research-based programs and social and commercial ventures.

Students will have the opportunity to be involved in one or two University-wide initiatives addressing a single topic of importance that will yield new understanding and catalyze incremental and radical innovations. Upon graduation, students involved in these programs will appreciate how innovative thinking can help them analyze situations, assess needs, grasp opportunities, create new approaches, test methods and measure results. They will have experienced the entrepreneurial process and will believe in their ability to apply their skills to new endeavors.

ACTIONS TAKEN

The Innovate Carolina Network members created so much new curricular and co-curricular activity in innovation and entrepreneurship that an entire lengthy report could be written on this subject alone. Units and programs that serve as cornerstones of this work, such as the Kenan-Flagler Business School's Center for Entrepreneurial Studies and the Entrepreneurship Minor in the economics department in the College of Arts and Sciences (open to all undergraduates), were enhanced and expanded. Co-curricular programs at the Campus Y and elsewhere delivered important experiential learning opportunities.

During the Roadmap years, educators and program leaders at UNC-Chapel Hill began to work together to evaluate how they were teaching entrepreneurship. Traditionally, the business plan was the main curricular template, but as new methods emerged, UNC-Chapel Hill educators adopted new methods, including incorporating Lean Startup, Business Model Canvas, design theory and reverse pitch. They also incorporated onsite learning opportunities in New York and Silicon Valley. More practitioners were brought to the University as entrepreneurs-in-residence, adjuncts and professors of the practice. Leaders in the Minor in Entrepreneurship, Bernard Bell and Jan Davis, led initiatives to reach more minority and female students through mentorship.
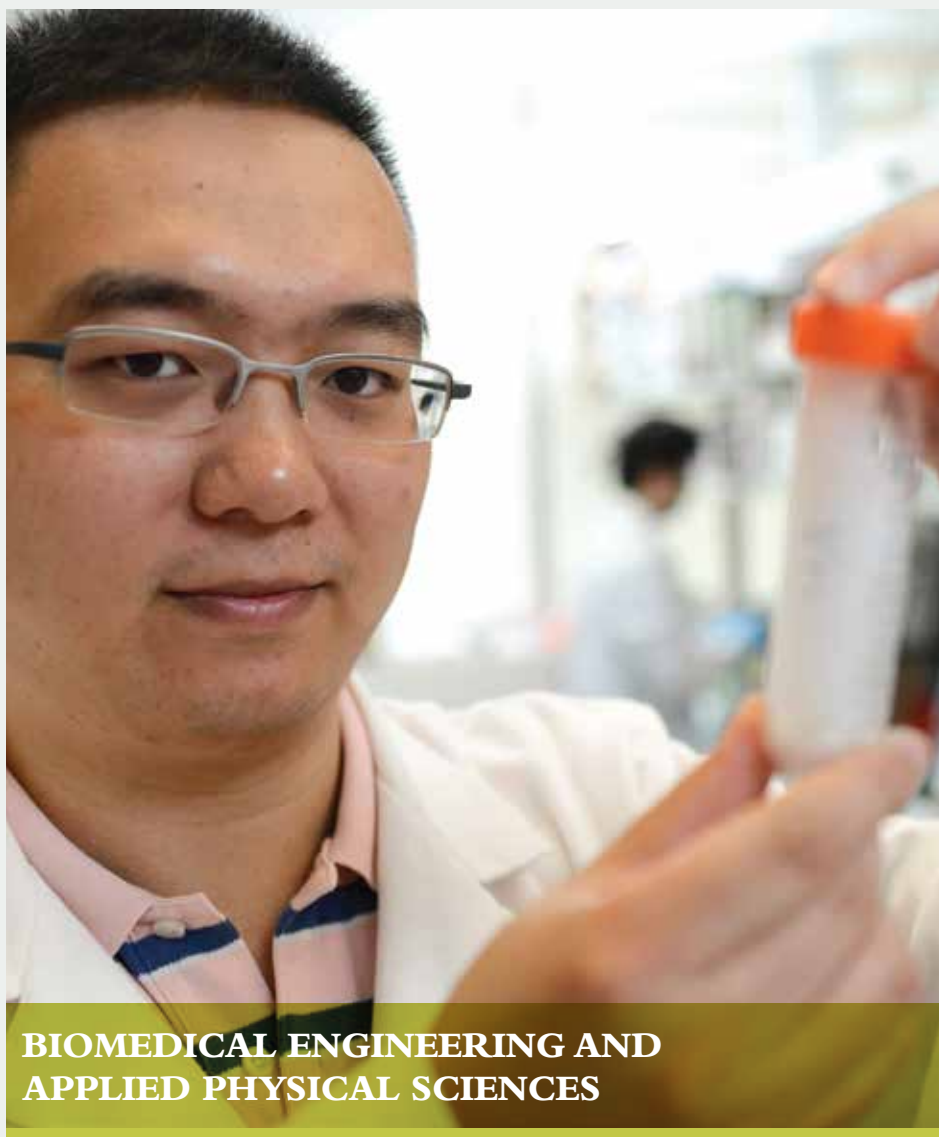
# BIOMEDICAL ENGINEERING AND APPLIED PHYSICAL SCIENCES

UNC-Chapel Hill has one of North Carolina's four medical schools, but no engineering school. NC State has an engineering school and a veterinary school, but no medical school. In 2003 the two universities agreed to form a joint biomedical engineering program, permitting students to take classes at both schools toward a biomedical engineering degree awarded by both universities.

Among the technologies in development at the joint department is a smart insulin patch developed by Zhen Gu (pictured above), a professor in the Joint UNC/NC State Department of Biomedical Engineering. The patch for diabetes works fast, is easy to use and is made from nontoxic, biocompatible materials. It has only been tested in mice, but if it works, diabetics would no longer need syringes to administer insulin. Nancy Allbritton, MD chair of the department, says the research is meant to keep pace with industry trends bridging medicine and engineering. She estimates that 10 percent of the program's 100 graduate students are involved in a startup, and this entrepreneurship trend among students is growing quickly. The program also aims to work with the military because some University biomedical research could apply to soldiers in the field.

The applied physical sciences department, led by Edward T. Samulski, Cary C. Boshamer Professor of Chemistry, may be the first of its kind in the country. It combines more than 20 new faculty affiliates across the disciplines of chemistry, physics and astronomy, mathematics, biology and medicine, and includes dedicated labs for testing applications. The department also supports BeAM (Be A Maker), the new makerspace initiative aimed at cultivating and empowering the UNC community to integrate making into their work. The recently opened makerspace based at Murray Hall is co-located with Applied Physical Sciences Faculty Labs.

Among the focus areas of the applied physical sciences department are solar energy, lung disease, medical imaging devices and nanotechnology. For example, Scott Warren, assistant professor with a joint appointment in the chemistry department, uses nanomaterials only a few atoms thick to build solar cells and smart windows that change color depending on the time of day or year. Another example is an interdisciplinary team working on a Virtual Lung Project that focuses on alleviating lung conditions, particularly those related to cystic fibrosis.
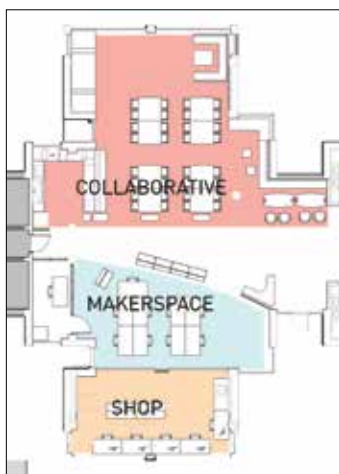
Blue, a 3,000 square foot design and maker lab in Carmichael Residence Hall will open in the Fall of 2017. Comprised of the BlueBeAM program and the BlueSky Innovation Community, this partnership between BeAM, Carolina Housing and the Center for Entrepreneurial Studies at the Kenan-Flagler Business School has a driving goal of shaping a forward-thinking, collaborative residential community for over 400+ students using physical and virtual tools to engage in self-discovery, build diverse connections and accelerate ideas to reality.

Additional activities include:

- **Student competence in the global language of today—*data***. Innovations in all fields are growing ever more reliant on the analysis and use of data. The vice chancellor for IEED convened a faculty task force to address this question: What would it take to graduate all students data literate, commensurate with their levels in college and their areas of study? The task force presented its findings to the provost, and the resulting data studies initiative is now part of a comprehensive program called Data@Carolina. The Roadmap advocated for expansion of the computer science department because so many ideas worthy of development need the skills of computer scientists. Many startups are built primarily around new ideas in computing such as new software apps.

- **Health care data and analytics capabilities.** The Carolina Health Informatics Program (CHIP) is a rapidly growing interdisciplinary research and training program dedicated to improving health through health informatics research, data sharing, development and education. CHIP draws faculty, health care professionals and students from across the UNC-Chapel Hill campus to conduct basic and translational research and to offer graduate training in health informatics for scientists and clinicians in medicine, nursing, public health, dentistry and pharmacy. CHIP leverages talent in departments in the College of Arts and Sciences; nationally recognized professional schools; a world-class health care system; a national data science center; and corporations, think tanks and government agencies in the Research Triangle region.

- **BeAM (Be A Maker) network of on-campus makerspaces**. Led by Rich Superfine, BeAM provides equipment and instruction for faculty, staff and students to prototype and build advanced physical products. Three makerspaces have recently been opened, located at the Kenan Science Library, the Hanes Art Center and Murray Hall, to engage the UNC-Chapel Hill community in using tools and space to turn various materials into innovative solutions for scientific, technical and artistic challenges.

Altogether, the breadth of activity University-wide—and the fact that most new courses and programs are quickly filled—reflects strong interest in innovation and entrepreneurship.

Considerable attention was given to ensure that participation reflects the diverse nature of the Carolina community. Program and unit leaders recognized that the potential to innovate is widespread but is not always fulfilled. For example, studies nationwide have shown that while women are very active in and excel at research, there is a gender gap in the patenting and licensing of the work—and though many women hold high posts in large organizations, very few become founders of high-impact startup firms. Moreover, both men and women in some ethnic, racial and socioeconomic groups are under-represented in I&E activities. On our campus this meant that we were under-utilizing innovative brainpower. And with inclusiveness a priority at Carolina, units started initiatives that went beyond traditional inclusion programs. One notable step was that the Department of Computer Science hosted the country's inaugural all-female hackathon, to encourage women in information technology. Three hundred women participated in the first student-led Pearl Hacks event. Now in its third year, Pearl Hacks attracts even more women annually from across the United States. The Department of Computer Science also strives to nurture interest in technology and help undergraduates build important networks in

INNOVATION FOR AT-RISK POPULATIONS

Jim Johnson is the William R. Kenan Jr. Distinguished Professor of strategy and entrepreneurship at the Kenan-Flagler Business School and leads the social track for the Minor in Entrepreneurship in the College of Arts and Sciences. He is also the Director of the Urban Investment Strategies Center and Competitive Economies Idea Lab at the Frank Hawkins Kenan Institute of Private Enterprise. The center works to help North Carolina nurture and grow an innovation economy that is more inclusive of people of color and women and will likely yield significant socioeconomic dividends.

In 2015 Johnson created the Elder Care Economy Innovations Hub at the Frank Hawkins Kenan Institute of Private Enterprise. The joint venture with Kenan-Flagler Business School and Gillings School of Global Public Health is leveraging the intellectual capital and entrepreneurial acumen of scholars and practitioners in UNC's business, medicine, public health and social work schools, as well as its biomedical engineering, city planning and public policy departments to develop leading approaches for addressing the needs of the aging population.

top right: At the THINKposium Conference Johnson showed the impact of race, immigration and an aging population on America's future.

bottom right: Second grade teacher Villa Gaddy, left, and teacher's aide Sharonda Johnson welcome pupils to the Treasure Chest, the name of their classroom at Union Independent School in Durham, N.C. started by Johnson.

the field by providing stipends that allow students to attend the Grace Hopper Celebration for Women in Computing. In 2016 the department sent 35 female students to this event—the world's largest gathering of female technologists. Working with UNC's Office of Diversity and Multicultural Affairs, other programs were developed to reach out to minority and female participants.

The following are more specifics of accomplishments and initiatives in various areas:

The Kenan-Flagler Business School supported entrepreneurs through courses and many other forms of structured learning. Its Center for Entrepreneurial Studies (CES), led by Ted Zoller, serves the entire University as a hub for developing and delivering special curricular and co-curricular offerings, with core programs that include the following:

- Launch Chapel Hill—a joint partnership among the University, the town of Chapel Hill, the Downtown Partnership, Orange County Economic Development and a private donor, this structured accelerator program attracts faculty, student, alumni and community startups. Since its opening in 2013, 63 ventures have participated, raising more than $15 million in external funding, generating 1,000 jobs (250 in Orange County) and contributing thousands of dollars in direct economic impact to the businesses on Franklin Street.

- The Adams Apprenticeship—a selective mentorship network that matches high-achieving students with successful UNC-Chapel Hill alumni to shape, support and speed their transition to entrepreneurial careers. This program serves top undergraduate and graduate students across the University, with more than 160 of its most successful alumni entrepreneurs now serving as part of the mentor networks. This program is funded primarily by alumnus John Adams.

- Carolina Challenge—an annual startup competition open to all University-affiliated individuals, funded by the Stedman family.

- Entrepreneurship Lab (ELab)—a program to explore the challenges faced by entrepreneurs at all phases of new and growing ventures.

- Kenan-Flagler Private Equity Fund—a student-run fund with more than $4.4 million of committed capital under management.

- Venture Capital Investment Competition (VCIC®), led by Patrick Vernon—an annual program attracting nearly 30 schools from 13 countries, more than 150 venture capitalists and 125 startups to participate in a flipped-model pitch competition.

Student-led Pearl Hacks 2016 draws female coders from across the nation and engages participants in problem solving activity

- StartUp-UNC—Formerly known as Launching the Venture, StartUp-UNC is an academic program at the Kenan-Flagler Business School designed to equip and inspire entrepreneurship across all disciplines to launch new commercial and social ventures. It combines lectures, workshops, guest speakers and hands-on expert coaching as part of an intensive applied curriculum and features a distinguished group of faculty members, domain leaders and proven entrepreneurs who work closely with teams to help them determine key deliverables and achieve relevant milestones. Since its start in 1999, StartUp-UNC has aided in the creation of more than 60 startups.

The Kenan-Flagler Business School saw record levels of interest in entrepreneurship and innovation.

- 77% of the Undergraduate Business School Class of 2015 (301 out of 391 total students) were enrolled in entrepreneurship courses.
- 90% of full-time MBA students (251 out of 277 total students) in the Class of 2015 took entrepreneurship courses.
- 75 MBA students in the Class of 2015 self-identified as pursuing the entrepreneurship concentration.
- 43% of the MBA Class of 2016 (120+ students) took entrepreneurship courses in their first year after completing the required core.
- 103 MBA Class of 2016 students self-identified as pursuing the entrepreneurship concentration, the highest number in school history.

Many of these students were active in the MBA Entrepreneurship and Venture Capital Club. The Executive MBA and MBA@UNC-Chapel Hill students showed overwhelming interest, as 173 EMBA students and 227 MBA@UNC-Chapel Hill students took entrepreneurship courses in Chapel Hill or online. Both programs have generated new entrepreneurship venture clubs.

The Entrepreneurship Minor (E-Minor), which is housed in the economics department in the College of Arts and Sciences, is open to all undergraduates seeking to develop the entrepreneurial mindset and skillset. Pat Conway, chair of the department of Economics, and Charles Merritt, executive director, expanded the E-Minor to offer a choice of nine venture creation tracks, each taking students through the process of starting a venture in a specific area: commercial, social, scientific, artistic, sport, public health, design, computer science and media.

Left: Deborah R. Gerhardt (top and bottom), School of Law, practices the winning pitch with their team at the 2015 Faculty Entrepreneurship Workshop. Right: Dina Rousset (center), Associate Director at UNC Kenan-Flagler's Center for Entrepreneurial Studies at the Adams Apprenticeship Gala Awards Ceremony with students accepted into the program.

BEAM

BeAM (Be A Maker) is the University-wide network of makerspaces supporting the creation of physical objects for education, research, entrepreneurship and recreation.

THE HELPING HAND PROJECT

The Helping Hand Project is a nonprofit that prints 3D prosthetic hands for children who cannot use or afford traditional devices. Founder Jeff Powell first started using a 3D printer as a biomedical engineering student. Now, the project uses open-source and custom designs to make its prosthetics. These are produced free of charge at UNC-Chapel Hill through the BeAM network and help children who suffer from symbrachydactyly, a condition where the hand stops developing early in amniotic development. UNC General Administration President Margaret Spellings observes.

Currently, more than 100 students graduate from the E-Minor each year, with many more participating in the Introduction to Entrepreneurship course, which is open to the campus and averages more than 400 students.

The Faculty Entrepreneurs Workshop, started by Buck Goldstein and sponsored by the Vice Chancellor for IEED, is designed and managed by faculty from the School of Education. Coaches and mentors from across the University provide expert leadership for the program. The multi-day workshop, led by faculty member Keith Sawyer, is offered for aspiring faculty entrepreneurs from universities across the state who are invited by UNC-Chapel Hill's Chancellor. Participants learn about an innovation mindset and skillset, and how to apply that approach to their own ideas. At this writing, more than 200 faculty have completed the workshop, which also won support in recent years from the University of North Carolina General Administration.

The Center for Faculty Excellence has offered the **Faculty Learning Community on Strategy and Leadership (FLC)** since 2010 with leadership from David Kiel, now led by Erin Malloy. This year-long program provides training and consultation on strategic thinking and planning for leaders of departments, programs, institutes and centers. Participants discuss how to focus their programs for greater impact, think entrepreneurially about revenue and resource generation, and create a culture of innovation. More than 80 faculty leaders have participated in two versions of the program.

The Center for Faculty Excellence also produced the **Good to Great video series** moderated by Chancellor Emeritus James Moeser and produced by UNC News Services. This series inspires and instructs the next generation of faculty innovators and entrepreneurs by telling the story of how faculty leaders created the innovative institutions that have distinguished the University: The Institute for the Arts and Humanities, the Lineberger Comprehensive Cancer Center, the Office of Undergraduate Research, The Durham Scholars Program, the Southern Oral History Program, the Carolina Population Center, the UNC AIDS-HIV initiative and others.

The **Campus Y,** led by Richard Harrill, provided space and programs for social innovators from across the University to collaborate and learn from experts in the field. The CUBE Social Innovation Incubator was started in 2013 to house emerging ventures while co-curricular activities provided training and support in areas such as needs assessment, project planning, fundraising, evaluation, finance and communication. The Campus Y also brought in social entrepreneurs-in-residence and helped run UNC-Chapel Hill's participation in the General Administration's system-wide Social Entrepreneurship Competition. To date, 28 teams have participated in the CUBE programs, leveraging $180,000 in funding from the Campus Y to yield an additional $1.52 million in support.

INNOVATION IN ECONOMIC DEVELOPMENT

Attracting any kind of private investment into severely distressed areas—small towns, rural areas, or downtowns where most of the structures are vacant, underutilized, or blighted—is a central challenge faced by communities across North Carolina and nationally.

The UNC School of Government created a unique solution to this challenge— the Development Finance Initiative (DFI), launched in 2011 with $1 million seed funding via an innovation partnership with Local Government Federal Credit Union (LGFCU). LGFCU president Maurice Smith and School of Government dean Mike Smith envisioned DFI as a new way to further use the School's expertise in local communities, most of whom had been negatively impacted over the years by loss of industry and the recession. Led by faculty member, Tyler Mulligan, and director, Michael Lemanski, DFI works with local governments to attract private investment for transformative economic development projects by providing specialized finance and innovative development expertise. Over the last five years, DFI has been deeply engaged in 75+ communities working on 100+ projects. DFI's pipeline includes an expected $500 million plus of direct private investments into distressed project areas over the next three years. Without taking on any new communities or projects, the expected total direct investments are projected to exceed $1 billion. DFI is currently named as a semi-finalist in Harvard's Kennedy School's 2017 Innovations in American Government Awards.

DFI is building innovation skillsets and future capacity by training graduate students in its Community Revitalization course. UNC students from public administration, business, planning, and other professional degree programs at UNC-Chapel Hill as well as other UNC universities, learn public and private sector revitalization techniques by assisting the communities with actual redevelopment projects. Students serve local governments as research fellows during their tenure in the course, and often go on to become future leaders in the field.

REESE NEWS

The disruption of new technology and the fingertip availability of information have devastated traditional news organizations. The Reese News Lab opened in UNC-Chapel Hill's Media and Journalism School in 2010 to develop and test new ideas for the media industry. Students research ideas for media products that are financially sustainable, working on real-world challenges provided by industry practitioners.

The **Reese News Lab,** led by Ryan Thornburg, previously led by John Clark, in the School of Media and Journalism, led by Dean Susan King, was established as an experimental project to test new ideas for media industries in the form of pre-startups. Student teams developed prototypes of products and services that could be used to gather or deliver news in new ways, or to assist reporting, and then tested their viability. Actual startups emerged from the lab, such as Capitol Hound, a service that records and archives legislative proceedings to create an online, searchable database for subscribers.

The **MA in Educational Innovation, Technology and Entrepreneurship**, led by Keith Sawyer, was developed to prepare students to create educational innovations grounded in the learning sciences. Students explore new ideas in education technology, curricula and organizational forms and practice. The program is housed in the School of Education, led by Dean Fouad Abd-El-Khalick, with students also taking courses in business, computer science and library science, and serving an internship with an innovative educational organization.

The **Gillings School of Global Public Health**, led by Dean Barbara Rimer, created **Research and Innovation Solutions**, led by Julie MacMillan, to help students and faculty accelerate their responses to pressing public health problems across North Carolina and worldwide. An example of a startup helped by this group and entrepreneur-in-residence Don Holzworth is Aquagenx, maker of a portable, affordable kit for testing water.

The **School of Medicine**, led by Dean Bill Roper, revamped its curriculum to create *Translational Education at Carolina*. TEC transforms the way medical students learn the art and science of medicine by integrating basic sciences and clinical skills, providing longitudinal patient care experiences and offering earlier clinical opportunities in specialty fields to better inform residency program decisions. This novel curriculum reflects the ever-changing practice of medicine, meets the desire for early career differentiation and exploration, and incorporates the learning preferences of today's medical students.

Additionally, the **School of Medicine** and the **Kenan–Flagler Business School**, led by Dean Doug Shackleford, established an MBA Fellowship Program for medical faculty to receive $10,000 toward Kenan-Flagler's MBA@UNC and Evening and Weekend Executive MBA programs. The University's MD/MBA program—which lets medical students earn both degrees in five years—goes beyond health care management courses by integrating leadership, innovation and entrepreneurship into the curriculum. The schools also collaborated to develop a health care-focused curriculum for students in the full-time MBA program. The curriculum includes seven elective courses covering areas such as health care entrepreneurship, pharmaceutical economics, health care operations and health care consulting.

The **UNC Health Care System and School of Medicine Center for Health Innovation**, led by David Rubinow, MD and Associate Director Carol Lewis, was created to support disruptive innovation in the delivery and financing of health care. The center created and manages a portfolio of novel projects, offers programs covering the entire life cycle of innovation from ideation to implementation, fosters external partnerships, and advises and connects internal and external innovators. Focus areas include novel care delivery models, payment model redesign, digital health, data sciences and analytics, and translational research. Two popular programs include annual innovation pilot awards of up to $50,000 each and the newly created Digital Health Innovation Sprint, an open series of events that brings together industry collaborators, local entrepreneurs and UNC Health Care clinicians to take a digital health solution from idea to demo and pilot, while learning and applying design thinking.

The **UNC Eshelman School of Pharmacy,** led by Dean Bob Blouin, is transforming its PharmD curriculum to not only train exemplary pharmacy practitioners, but inquisitive and innovative leaders. As part of this transformation, hands-on courses focused on pharmacy innovation and problem solving are now a required part of the PharmD curriculum. The **Eshelman Institute for Innovation**, established in 2015, accelerates the creation and development of ideas leading to discoveries and transformative changes in education, research and health care. Through strategic collaborations inside and outside of the University of North Carolina, the Institute helps create jobs and spur economic development in the state of North Carolina and beyond. To date, the Institute has provided more than $13 million in funding to 49 faculty, staff and student projects.

In 2012 the **Department of Computer Science**, led by Kevin Jeffay, opened the Entrepreneurs' Lounge, a dedicated space in Sitterson Hall where budding computer science entrepreneurs meet with colleagues from other disciplines. Organizations such as the Computer Science Entrepreneurs Club hold events, technology transfer staff meet with potential licensees for patents and copyrights, and computer science startup companies meet to plan and organize. Other initiatives include:

- CS faculty members launched several successful startups such as 3rd Tech, Altometrics, Impulsonic, InnerOptic and Morphormics. Impulsonic was recently purchased by Valve.

- CS hosts three major student-led hackathons each year, where students form teams and compete to create innovative ideas: Pearl Hacks, the first all-female hackathon; HackNC, a co-ed hackathon that attracts close to 700 students; and Raspberry Jam, an all-day event where hardware hacker enthusiasts share knowledge and create programs using Raspberry Pi technology. In 2017 CS is expecting to host its first data science hackathon being planned by the recently formed Carolina Analytics and Data Science Club.

- Each academic year, CS hosts three entrepreneurship-oriented courses. The first, How to Build a Software Startup, which is part of the E-Minor, is designed to provide undergraduates with the experience of building a real-world software startup (web, mobile or infrastructure). The course includes a mentorship program where each student team is paired with an experienced entrepreneur. The second, Software Engineering Technology, teaches students the skills necessary to build a software project. As a team, they work to create a solution for a client, such as a nonprofit organization. The third, Serious Games, introduces students to the field of serious games and includes a final course project where students build a serious game for an outside client. All three courses help students understand the opportunities and challenges of conceiving and building software that delivers real value to a set of customers.

- During its 50th Anniversary Celebration, CS hosted a startup panel and conference track featuring alumni entrepreneurs, which allowed students to hear first-hand about the entrepreneurship focused experiences and research.

A student team wins first prize in the 2015 HackNC competition organized by students in the computer science department.

A HOME FOR SOCIAL INNOVATION

The Campus Y launched a social innovation incubator located in its historic building on the main quad to encourage activism and entrepreneurial responses to social issues. Residence in the CUBE (Creating University Born Entrepreneurs) is open to student teams across campus (not limited to Y groups) and can include hybrid social/for-profit ventures. Selected teams receive individualized mentoring and support for their project development, capacity-building curriculum delivered through expert workshops and space for one year for their ventures.

top right: A CUBE team receives mentorship on its business plan.
bottom right: Undergraduate student Dani Nicholson, co-chair of Carolina Kickoff 2015-16, shows off the Why Do You Do What You Do project. The project was started by alumnus Tony Deifell, current CEO of Awesome Box.

- The various labs in Sitterson Hall are a place of technical experiential learning, where students can program but also engage in creating physical products, such as robots and 3D printed prototypes.

- CS fosters an interest in social entrepreneurship through an Enabling Technology course, which culminates in Maze Day, an annual event that brings hundreds of visually impaired children to the department to test student-designed software programs. One enabling technology created by faculty and students is Tar Heel Reader. Nearing its 10,000,000th book read, Tar Heel Reader enables visually impaired individuals throughout the world to read and write their own books.

The School of Social Work, led by Dean Gary Bowen, previously Jack Richman, developed several initiatives during the period of the Roadmap. The Middle Space, led by Gary Nelson, currently a project within the School's Jordan Institute for Families, offers innovative leadership, instructional design and learning services through a model that builds the capacity of organizations to create social, financial and environmental benefits for the populations they serve.

In partnership with the Campus Y, Social Work also created a Social Entrepreneurship and Innovation Clinic at the American Underground in Durham. The clinic is providing graduate students and community partners with interdisciplinary learning to help them design, support and/or launch social enterprises that have measurable social, financial and environmental benefits.

Key co-curricular programs throughout the University helped innovators learn and advance in a variety of ways—through mentoring, technical assistance, networking and provision of needed resources (such as space for new ventures). Major programs include the following:

- KickStart Venture Services, led by Director Don Rose and Assistant Director Tim Martin, and 4D, led by Andy Kant, which help faculty commercialize their research.

- Blackstone Entrepreneurs Network, led by Bryan McGann, a regional network of successful serial entrepreneurs coaching high-potential startups from the Triangle's four research-intensive universities and the community.

- Campus Y CUBE Social Innovation Incubator and Launch Chapel Hill business accelerator provide space and business support.

- 1789 Venture Lab, founded by alumnus Jim Kitchen, is a central hub for student entrepreneurs.

- Adams Apprenticeship Program, led by Ted Zoller and Dina Rousset, is a mentorship network that matched graduate and undergraduate students with alumni entrepreneurs.

Student Activities included Innovation and Entrepreneurship programs led or largely conducted by students, along with fellowship and scholarship programs that enabled high-promise students to develop their potential as innovators.

- Student-led events and groups proliferated. Examples include TEDxUNC, hackathons organized by student groups in Computer Science, Global Entrepreneurship Week, Carolina Creates, Kairos (featuring top student startup leaders), Design for America, University Innovation Fellows and BeAM Student Leaders.

E-MINOR INTERNSHIPS ABROAD

Undergraduate student Kevin Jang participated in the Minor in Entrepreneurship's Beijing Program, attended classes at Peking University and interned at The Wine Republic.

"It may not seem obvious at first, but the wine business in China is one of the most entrepreneurial ventures in the world. In order to penetrate the market, the first entrepreneurs had to overcome cultural, financial, and geographical barriers to establish a wine culture in China. They saw an opportunity in the country for a thriving wine market during China's huge economic growth, jumped right in, and are now reaping the profits. Wine companies are constantly looking for new markets to enter and ways to innovate their products. To me, this is the true spirit of entrepreneurship, which is the ability to revolutionize a market that has existed for thousands of years. I can say without a doubt that my time interning at The Wine Republic in Beijing has given me a treasure trove of information about entrepreneurship that I could never learn by reading a textbook." – Kevin Jang

EXPERIENTIAL LEARNING: INCUBATORS *and* ACCELERATORS

At the **CUBE**, students and faculty tackle pressing social issues. CUBE social ventures receive seed funding, mentoring, pro-bono support services, expert feedback from nationally renowned social entrepreneurs and individualized assistance to create successful social enterprises. Together the **28 social ventures** that have participated in the 18-month program have raised more than **$1.5 million** and impacted more than **40,000 people**. CUBE also offers a workshop series open to the Carolina community and the public covering topics like legal incorporation and liability, organizational messaging, leadership, marketing, entrepreneurial finance and impact assessment.

Carolina students are seeking entrepreneurial solutions to today's pressing problems. At **1789 Venture Lab** current UNC-Chapel Hill students and recent Carolina alumni can find others who are passionate about moving ideas forward and working collaboratively. Since 2014, 1789 Venture Lab has supported students and alumni in **110 startups**. 1789 Venture Lab has also become a favorite event space for many of UNC-Chapel Hill's entrepreneurship activities including courses, workshops and networking events organized by UNC campus partners.

At **Launch Chapel Hill**, the best entrepreneurs in our community come together through an intensive six-month program to take their startups to the next level. Launch is an award-winning startup accelerator that opened in 2012 as a public-private partnership among the Town of Chapel Hill, Orange County Economic Development, the Downtown Partnership, UNC-Chapel Hill and the Becker Family—donors to the University. Twice a year Launch welcomes a new class of entrepreneurs who are committed to building their early-stage, high-potential businesses. Launch provides the support, tools and knowledge needed to decrease risks, reduce go-to-market time and accelerate growth. To date, Launch Chapel Hill has served **63 companies** that have raised more than **$15 million** during their time at Launch and created more than **1,000 jobs (250 in Orange County).**

- Student Innovation Teams—The Innovate Carolina Student Leadership Team provided leadership and served as connectors on student-related I&E activities. Members include students from major campus organizations including Student Government, the Carolina Union Activities Board, the Black Student Movement and the Campus Y.

- The Innovation Scholars program is managed by the E-Minor and was created to recruit top high school seniors each year to come to Carolina on full undergraduate scholarships to pursue their studies. The scholars are enrolled in the E-Minor (they choose any major) and are provided access to many other forms of mentoring and support. At the graduate level, the Blackstone Fellows program enables students to pursue innovation through paid internships, work on faculty spinouts and other activities.

- The University Libraries created opportunities for students to learn, practice and showcase technology-enabled research and entrepreneurial skills. The Undergraduate Library's Skillful Tech workshops are a way for students—and anyone else on campus—to develop core design, web publishing and data visualization skills. The Health Sciences Library sponsored a Data Visualization Showcase and Contest for students in 2016 to highlight graphic representations of original research, such as the reduction of maternal mortality in Nigeria. And the libraries have sponsored map-a-thons, edit-a-thons, transcribe-a-thons and other ways for students to directly apply skills and creativity to real-world problems.

Research on Innovation and Entrepreneurship was another important component, as scholars across campus conducted research that helped to inform and enhance the University's efforts in I&E and helped link them with economic development. Notable contributors include Maryann Feldman in Public Policy, Howard Aldrich in Sociology and Jim Johnson in Strategy and Entrepreneurship.

WHAT WE'VE LEARNED

Among undergraduates, innovation and entrepreneurship programs of all types are popular throughout the University, not just for students in areas normally thought of as relevant to I&E. Students are drawn to activities that allow room for creativity, exploration and growth. They enjoy designing new solutions to real-world problems; they see benefit in learning the skills involved and many are eager to start their own enterprises. One way of channeling this entrepreneurial interest into greater impact is to focus on the idea-generation stage. Many student startup ideas tend to be disconnected from significant areas of expertise and research at the University. Engagement with some of those areas, and with the faculty, can spur new ventures that address major challenges on which Carolina researchers are taking the lead. Having faculty experts speak to entrepreneurship classes about the needs and opportunities in a special area has proven helpful in expanding the recognition of pressing societal needs and possible areas of opportunity.

Another key area where more can be done is assisting graduate students outside the Kenan-Flagler Business School, as well as postdocs and faculty not involved in tech transfer. They have few educational or co-curricular opportunities to build their entrepreneurial capacity. Expanding programs of these types could lead to high returns.

Innovation and entrepreneurship does not only apply to enterprise development outside of UNC-Chapel Hill, but inside as well. Faculty can become intrapreneurs as well as entrepreneurs. If provided the tools, support and guidance, faculty leaders of centers, departments, institutes and programs of public service, research and graduate and undergraduate instruction can find ways to generate new revenues, and greatly increase the positive impact of their programs on the University, on students and in the community.

NEXT STEPS

Much of the work ahead will consist of expanding and enhancing current initiatives for undergraduates. For instance, program leaders will continue developing the entrepreneurship curricula in academic units to include methodologies for the entire innovation process—imagine-design-build-grow—and incorporate creativity and design more fully in entrepreneurship programs. The Innovation Scholars program will be expanded and curricula will be built up in Applied Physical Sciences, Biomedical Engineering, Data Studies and Computer Science.

While Innovate Carolina Network program leaders wish to work together, they often are too busy to self-coordinate their various programs. The Vice Chancellor's Office of IEED will lead a curricular initiative that involves the entire network. Delivery methods will include credit classes, co-curricular workshops, activities, online modules and personal coaching. This integrated approach will make it easier for students and/or faculty to have a consistent experience as they move their ideas forward.

We also are looking at how to address the gaps and needs noted under *What We've Learned*. This work includes the following: exposing students to areas outside their personal knowledge to expand their thinking and better align their innovation with the University's research agenda; expanding I&E programs and involvement for graduate students and postdocs; and creating targeted programs to best meet the needs of faculty entrepreneurs. For the latter, an efficient way to proceed could be to focus on just-in-time learning with a mixture of online tutorials, mentoring and small groups.

top left: First-year student Marisa Rose works on Lego robot in the first-year seminar Robotics with Legos.

top right: Students in the first-year seminar Robotics with Legos.

bottom left: Chancellor's Science Scholars Program students Kristen Adams, Anna Atencio and Young Yun join others to tour a lab in the Lineberger Comprehensive Cancer Center.

bottom right: Debra Barksdale (nursing), center, and graduate students Ninhee Suh, left, and Jeongok Logan examine an impedance cardiograph that provides 24-hour ambulatory monitoring of various cardiovascular parameters such as cardiac output, stroke volume and total peripheral resistance.

SUPPORTING INNOVATORS

The Community Development Law Clinic at the UNC-Chapel Hill School of Law is a two-semester clinic where third-year law students provide pro-bono corporate and transactional counsel to UNC-Chapel Hill nonprofit social ventures and community development organizations in North Carolina. Each year, the clinic partners with CUBE to help early-stage social ventures develop by-laws, legally incorporate their organizations, form a board, assess legal risks and draft contracts. The clinic is led by professor Tom Kelley, an expert on nonprofit law and acting director of clinical programs at the School of Law.

The Intellectual Property Clinic is a two-semester clinic to train law students in lawyering skills and federal and state laws that govern trademark rights. Students enrolled in the clinic learn to be effective pro-bono advocates for startup and nonprofit clients that need to protect their intellectual property. The clinic was launched by professor Deborah Gerhardt who is an expert on trademark law. In 2015, Gerhardt was invited to participate in the Faculty Entrepreneurship Bootcamp where she led her team to win the pitch competition. She also coached UNC's trademark moot court team to a regional victory and a top 10 finish nationally.

The Entrepreneurial Law Association is a student organization that promotes entrepreneurial law within the School of Law, hosts panels and speakers to address topical issues within entrepreneurial law and bridges the divide between UNC Law and the Research Triangle's business startups and social enterprises.

■ *Recommendation 2 – Collaborate (5 Goals)*

Collaborate with diverse groups internally and externally to explore issues, options and creative approaches that may lead to innovations.

This recommendation includes five goals in the following areas:
1) interdisciplinary collaboration, 2) key themes, 3) industry relations,
4) regional and state connections and 5) global reach.

■ *Goal 2.1: Enhance robust interdisciplinary collaboration among physical and social scientists, humanistic scholars and those in hybrid disciplines, such as bioengineering and applied sciences, to address the great challenges of our times.*

ASPIRATIONS

Collaborations within and beyond Carolina—including with other universities, the private and social sectors, communities and government—will leverage talent, innovation and non-traditional partnerships to achieve ever-greater impact.

Those seeking collaborations will find a supportive environment in which the rules have been examined and rewritten to smooth the path for interdisciplinary opportunities. Carolina will have highly rated hybrid disciplines such as biomedical engineering, environmental engineering and applied sciences. Faculty and students in these disciplines will work together with social scientists and humanities scholars on some of the most serious challenges facing society locally, nationally and globally, with resources to support their efforts. All of this is especially important for two reasons. Complex issues require solutions that combine expertise from multiple fields of study, and Carolina, having no engineering school, must seek to excel by building hybrid units and interdisciplinary work, as well as working with NC State's College of Engineering and with industry.

ACTIONS TAKEN

The 2011 Academic Plan established interdisciplinarity as a central focus in teaching, research and service, and the University made progress toward that, as well as the other kinds of collaborations named in this section's *Aspirations*. The following initiatives were created and/or expanded:

- The University created the Department of Applied Physical Sciences, led by Ed Samulski, previously led by Peter Mucha, and expanded the Joint Department of Biomedical Engineering, led by Nancy Allbritton, a joint department with N.C. State University. Both are interdisciplinary in nature.

- The Digital Innovation Lab, led by Dan Anderson, previously led by Bobby Allen, was created to expand research and teaching at the intersection of computing and humanities. This lab addresses a variety of topics, which range from curating online collections to data mining in the humanities.

- UNC-Chapel Hill led a national conversation on interdisciplinary collaboration and cross-pollination. Chancellor Folt and Chemistry professor Joe DeSimone helped organize this National Academies conference on convergence in science.

- Expanded research-based interdisciplinary work, often in collaboration with colleagues at other institutions and/or in the private sector, was fertile ground for innovation. For example, the Water

Institute, led by Jamie Bartram, and the Institute for the Environment, led by Larry Band, drew experts from around the world into multidisciplinary efforts to solve issues of access to safe, clean water.

- The University hosted an annual Clean Tech Summit for the past three years (2014-15-16). Organized by Greg Gangi at the UNC Institute for the Environment, and the Center for Sustainable Enterprise, led by Al Segers, previously led by Carol Hee, at the Kenan-Flagler Business School, the event drew more than 300 experts, practitioners and policymakers from across the Southeast at its first event. It now has close to 1,000 attendees. The growing clean technology industry is highly multidisciplinary, involving many different ways to reduce environmental impacts. The summit has quickly become a premier venue for highlighting the latest innovations, trends and pressing challenges, along with North Carolina's central role in the industry.

- The Libraries' Research Hub, with locations in the Davis, Kenan Science and Health Sciences libraries, provided high-tech environments where Carolina researchers could work and collaborate. The hub aided interdisciplinary projects in areas such as data visualization, GIS (geographic information systems) and mapping and business research.

- The School of Medicine received a $54.6 million Clinical and Translational Science Award from the National Institutes of Health, providing a second five years of funding for the North Carolina Translational and Clinical Sciences Institute (2013-2018). This central hub fundamentally changed the clinical and translational research landscape of UNC-Chapel Hill and across the state. It was strategically designed to overcome barriers, which historically have been responsible for fragmenting and delaying research efforts. The faculty and staff offer targeted comprehensive and interdisciplinary solutions to investigators in the area of clinical and translational science, while actively engaging stakeholders in each of North Carolina's 100 counties. The renewal brought a new level of partnership with UNC-Chapel Hill, RTI International and North Carolina A&T University around three strategic initiatives: using new technologies to transform clinical research and practice; conducting robust comparative effectiveness studies; and exploring new paradigms in drug, device and diagnostics development.

- The Office of the Vice Chancellor for Research, led by Terry Magnuson, previously led by Barbara Entwisle, in conjunction with the Department of Computer Science, led by Kevin Jeffray, and the Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development, led by Judith Cone, sponsored Carolina Apps, an initiative to bring Carolina-born ideas to wider audiences through the creation of new mobile applications. This use of mobile apps is a relatively new frontier for the University, combining research and knowledge from many disciplines with mobile technology to deliver practical innovations.

- The Office of the Vice Chancellor for Research is expanding its campus Office of Research Development to provide more central support for development and management of large, cross-cutting and interdisciplinary research opportunities. These are projects that draw together faculty researchers from a diversity of schools and departments in multiple fields where UNC has preeminence nationally. It is currently developing Campus Creativity Hubs designed to provide strategic investment and support for such opportunities.

- The Carolina Digital Health Research Initiative catalyzed research and innovation by beginning to provide workshops and seminars; building a collection of digital health devices that may be borrowed for research; and providing information consultations in the field of digital health. The initiative is an interdisciplinary partnership among the Health Sciences Library, School of Medicine and UNC Health Center for Innovation. Additionally, the Health Sciences Library staff created a searchable database of researchers and entrepreneurs with interest in health, wearable devices and digital health techniques.

WHAT WE'VE LEARNED

Building interdisciplinary and collaborative capability is a complex task, and Carolina has been fortunate to have the necessary contributions from many. The board, chancellor, provost and deans provided high-level commitment to the goal, while leading faculty members put great effort into working groups such as the Applied Sciences Task Force, the Data Studies initiative and the Commercialization Task Force. These individuals thought strategically about how to proceed step-by-step with finite resources. All recognize that the ultimate purpose of creating new collaborative structures is to enable excellent interdisciplinary research, leading to high-impact solutions.

It is evident that the University still has rules and processes that are impediments to collaboration across units. This issue is noted again under Goal 4.3.

NEXT STEPS

Work continues on many fronts. Focus areas include the following: identifying and lowering barriers to collaboration, aggressively building up the new Department of Applied Physical Sciences and supporting the Joint Department of Biomedical Engineering, continuing to strengthen existing inter-unit alliances (such as that between the School of Medicine and Kenan-Flagler), and seeking prime opportunities for new collaborations. Underlying all efforts is the need to keep finding sustainable financial support.

■ *Goal 2.2: Collaborate and coordinate around key themes of local, national and global significance to mobilize the University toward new understanding of issues and solutions.*

ASPIRATIONS

In the future, through the collaborative Campus Themes Initiative that examines one important topic at a time such as water, poverty or economic disparities, the Carolina community will stimulate intellectual exchange and discovery across the humanities, fine arts, social and natural sciences, and professional schools. This approach will yield a dramatic positive impact on our community's understanding of the issues it seeks to address, build collaborative bridges between disciplines, produce new collaborative teaching and research, and result in significant innovations.

left: Mark Sobsey, co-founder of Aquagenx and inventor of the Aquagenx Compartment Bag Test (CBT) in his lab at the Gillings School of Global Public Health.
right: Volunteers with the NGO Clear Cambodia use the Aquagenx CBT kit to test open well water used by a school.

ACTIONS TAKEN

The University's initial campus theme, *Water in Our World* (2012-15), co-chaired by Jamie Bartram and Terry Rhodes, drew wide participation and was deemed a major success in that regard. The second, *Food for All* (2015-17), co-chaired by Alice Ammerman and Marcie Ferris, is underway at this writing. While the full impact of campus themes will be evident only over the long term, early results have been promising.

Proposed by Carolina faculty and units at the forefront of water research, the *Water in Our World* theme addressed issues pertaining to access to safe water and the management of water resources. The Global Research Institute and its fellowship program along with UNC Global, the Institute for the Environment, the Water Institute, and the Institute for Global Health and Infectious Diseases initially committed two academic years to the water theme. The theme brought together students and faculty from areas including public policy, planning, sustainable development, environmental engineering, business, law, marine sciences, natural hazards and disasters and global health. Fine arts and humanities also focused on the theme in various ways (under Emil Kang's leadership), winning a major grant for a joint re-restaging of *The Rite of Spring* by Carolina Performing Arts at Memorial Hall and several productions by the PlayMakers Repertory Company.

During this period, the water theme resulted in major collaborative research grants, art installations and projects: A Drink for Tomorrow collaboration, the integration of water-related sustainability measures into the 2015 UNC-Chapel Hill Sustainability Plan, the development and launch of the WaSH performance index by the Water Institute to track improvements in water access and sanitation in countries around the world, and other outcomes too numerous to list in full here.

The *Food for All* theme challenged all areas of the University to examine topics ranging from food cultures and nutrition to food security, world hunger, sustainable development, and the effects of climate change and international trade on food supplies. In one example of broad involvement, all student venture projects for the popular Economics 125 Introduction to Entrepreneurship course were dedicated to the food theme. Food experts from across the University made reverse pitches to the course's 400 students, describing food-related challenges worldwide and inviting teams of future entrepreneurs to create products or services to address them. (A reverse pitch is defined as a presentation delivered by experts in a topic to people seeking to find solutions to that topic.)

WHAT WE'VE LEARNED

Campus themes clearly have value. Since they involve a large amount of work, planning and managing such a pan-university initiative takes a combination of elements: interest from the faculty, leadership at the provost level, a process that enables buy-in across campus to select a topic, significant administrative and financial support, a dedicated project manager who knows the subject matter well and a dedicated fundraiser. Also, it is important to allow sufficient time for planning, staffing and build-up.

NEXT STEPS

UNC-Chapel Hill will continue investing the time and resources for work across disciplines that advances understanding of complex issues, builds cross-campus relationships and stimulates new knowledge and solutions.

Faculty leaders could benefit from planning the next themes two to three years in advance. This would include building in a one-year planning phase to identify support before kick-off of a new theme and begin fundraising well in advance.

Goal 2.3: Improve industry collaborations and increase industry funding.

ASPIRATIONS

In the future, Carolina will have strong industry partners, working collaboratively toward mutually beneficial goals. Research dollars will grow significantly in the next five years due to our strategic attention to this opportunity. Industry will view Carolina as a smart, fair, speedy and service-oriented partner with brilliant researchers working at the cutting edges of their fields. Across the University, leaders are working together to strengthen relationships with strategic partners.

ACTIONS TAKEN

The University approached this goal as a multifaceted issue, since industry and universities interact in a variety of ways. Areas of mutual interest include research and technology development, workforce development and the strength of the regional ecosystem for startups as well as existing firms. Each area holds potential for collaboration, and Carolina is striving to maximize all of them.

Academic units across the University generally have good relations with industries related to their disciplines. Several new initiatives were established at the vice chancellor level:

- The University Development Office made increased industry funding an objective of its new campaign strategy. Judging from the experience of other universities, most of this funding will be for research, though another opportunity is attracting industry donors to help build new innovation spaces.

- The Innovation, Entrepreneurship and Economic Development Office created a new industry liaison position. Bryant Moore, former vice president at Medtronic, became the first director for strategic partnerships. He works closely with a campus-wide planning group that includes representatives from Development, Research, and from individual schools and departments. These include Mark Meares and Joonhyung Cho in Corporate and Foundation Relations, as well as Joyce Tan and Don Hobart in University Research. The Research Office took practical steps to streamline procedures and thereby make it easier for industry to work with the University. One example is the creation of the new Office of Industry Contracting, to consolidate back-office support. This group now handles the contracting work previously handled by the Offices of Sponsored Research and Clinical Trials for more agreements with private industry, while the Office of Commercialization and Economic Development in IEED will continue to handle all licensing of University intellectual property.

  In 2014, UNC-Chapel Hill's Vice Chancellor for Research announced the University would no longer charge overhead costs, commonly referred as "F&A," to small business startups that receive federal Phase 1 SBIR or STTR grants and that need university assistance with their research. Those overhead charges are often 50% of the value of a grant, and by waiving them, the University made it possible for innovative small businesses to take full advantage of their early-stage grant dollars for translational research and development.

Meanwhile, there are many examples of academic units engaged in major new projects with industry partners:

- UNC Health Care formed a number of industry partnerships related to innovation in health care. One project involved partnering with global software firm SAS to personalize health care for diabetes patients by using big data. Another created a high-tech onsite employee health clinic offering a full scope of health and wellness services to Cisco employees in RTP. The Carolina Advanced Health collaboration with Blue Cross and Blue Shield of North Carolina resulted in a successful pilot of an advanced patient-centered medical home that achieved significant results in improving health care quality and patient satisfaction.

DESIGNING THE FUTURE

Workroom FashionMash is a product and experiential design incubator led by Professor of the Practice Dana McMahan in the School of Media and Journalism. It is an actual workroom space for prototyping and building, as well as a way of thinking. The program pairs clients with students and challenges them to move beyond the page or the screen to bring concepts to life. It also connects students to a network of fashion and retail initiatives.

"Workroom is such an incredible experience because we actually practice skills instead of focusing on theory. Rather than reading from a textbook, we traveled to New York to see world-class retail experiences and then tried to put on one of our own. It's so inspiring to actually work through the creative process like we can in this class." – *Will Schoeffler, Class of 2017*

above: A student experiences the Workroom FashionMash and Ad Campaigns joint project during the 2016 homecoming weekend.

- The School of Medicine formed a well-integrated, multidisciplinary research team from UNC-Chapel Hill, Duke and NC State to create a nanotechnology-based microbeam radiation system that could dramatically alter cancer-detection imaging. This work is supported by industry partner Siemens and the UNC-Chapel Hill startup company XinRay, along with government agencies. It has resulted in multiple research papers and media coverage.

- The radiation oncology department and the National Cancer Institute's Carolina Center for Cancer Nanotechnology Excellence are conducting research on other nanotherapeutics for cancer treatment. This collaborative effort secured a clinical trial funded by Cerulean Pharma Inc.

- The Department of Psychiatry, led by David Rubinow, MD launched UNC-Chapel Hill's first iPhone-based research project, PPD ACT, using Apple's research kit with partners that included Apple, National Institutes of Mental Health, Postpartum Progress, the International Postpartum Depression: Actions Towards Causes and Treatment Consortium and Foundation of Hope. PPD ACT is a free iPhone app to engage women in a genetics research study about postpartum depression. More than 10,000 women enrolled in the study within one month of the launch.

- Lineberger Comprehensive Cancer Center, led by Ned Sharpless, MD partnered with IBM Watson and more than a dozen leading cancer institutes. The goal is to leverage Watson's advanced cognitive capabilities to look at variations in a patient's genome; examine data sources such as treatment guidelines, research, clinical studies, journal articles and patient information; and provide results to oncologists so they can make more informed treatment decisions.

- UNC-Chapel Hill and Eastman Chemical Company formed an alliance to conduct research in chemistry and materials science through a $1.5 million, six-year agreement. Chemistry faculty submit research proposals in response to Eastman-developed problem statements, with the most promising ideas funded each year by Eastman.

- UNC-Chapel Hill, with its significant expertise in basic and clinical research on HIV, and GlaxoSmithKline, a global, research-based pharmaceutical and health care company with a legacy of success in developing treatments for HIV, together created an HIV Cure Center, led by David Margolis, MD and a jointly owned company to focus on discovering and delivering a cure for HIV/AIDS. This unique public-private partnership is redefining the traditional way of conducting research and creating a new model to seek the breakthroughs needed to tackle an extraordinarily challenging global health issue. The HIV Cure Center is located on the UNC-Chapel Hill campus. The new company, Qura Therapeutics, handles the business side of the partnership, including intellectual property,

Eastman Chemical Company partnered with UNC-Chapel Hill to provide world-class competencies in chemistry and other disciplines to Eastman's innovation initiative.

commercialization, manufacturing and governance. Together, the HIV Cure center and Qura Therapeutics serve as a catalyst for additional partners and public funding that will be needed. The collaboration is also expected to help recruit and attract top talent from around the world.

- UNC's Renaissance Computing Institute (RENCI), led by Stan Ahalt, has launched two industry consortia to engage IT and data science leaders with the University and academia. Its National Consortium of Data Science brings together companies like Deloitte, IBM and GE to identify common big data challenges, plot strategies to tackle them and build education and training programs aligned with industry needs. RENCI's iRODS consortium engages companies like Seagate, Bayer, and Intel to support the iRODS open source data management software used by industries worldwide to manage big data. RENCI was recently awarded an NSF grant to establish a regional big data innovation hub to work with businesses and research organizations on data solutions.

WHAT WE'VE LEARNED

The topic of industry relations is broad and touches nearly every part of the University. Just as UNC-Chapel Hill is a large, complex organization, many industry partners are large multinationals with different units and people focused on different functions. Using GlaxoSmithKline as an example, it has an ongoing need to build its product portfolio through R&D, which makes various parties at the company interested in UNC-Chapel Hill research. Across GSK, many units (not just R&D) hire University graduates; conversely the University and its spinouts hire former GSK employees. The company's corporate foundation has a wide breadth of interests, and GSK has a local presence in the Research Triangle Park. Optimizing the complexities of such a relationship is a challenge, and one the University is eager to address.

It is not feasible to have all activities handled by a central office, as illustrated by the difference in mission and goals between career services and technology licensing. Indeed, some schools (such as the School of Medicine and Eshelman School of Pharmacy) have invested in staff of their own to help develop partnerships with industry and grow their industry-supported research portfolios.

NEXT STEPS

The work of coordinating and expanding industry relations within the University will continue. This includes aligning University policies and procedures with industry practices and expectations whenever possible, creating front-door processes that make it easy for industry partners to engage with UNC-Chapel Hill and sharing best practices for building successful partnerships across the University. It will also be important to strengthen coordination among the offices of research, development and innovation and entrepreneurship. Outward communication—to let industry know that UNC-Chapel Hill is actively seeking partnerships—is a priority for the future.

STUDENT INNOVATION LEADERS

The Innovate Carolina Student Leadership Team was started in January 2010 to integrate student ideas into the strategic Roadmap and to establish a student liaison to Innovate Carolina. Shruti Shah, the first student innovation leader, played a key role in understanding the landscape on campus.

Every year, more than 30 undergraduate student leaders from clubs across campus join the team. They are charged with sharing information about entrepreneurial resources for students and collaborating with student organizations and departments to identify ways to link innovation and entrepreneurship to existing activities. Past chairs have included Shruti Shah, Hudson Vincent, Mackenzie Thomas, Courtney Sanford, Rangoli Bhattacharjee and Sean Petersen.

> ■ *Goal 2.4: Extend collaborations with state and regional partners to help North Carolina further develop into a leading competitive, global, entrepreneurial, knowledge and innovation economy.*
>
> ### ASPIRATIONS
>
> In the future, the Research Triangle Park (RTP) region will be a leading entrepreneurial engine in the United States. Governments and industry leaders around the world will contact North Carolina leaders when considering significant investments, partnerships and resource allocation. Entrepreneurs will have the knowledge and skills they need to grow companies and will be connected into a strong network of seasoned business people. The path will be smoothed for them and the needed funding available. The Governor's Innovation Council and other strategic initiatives will have been successful in solidifying North Carolina's economic future with leadership from top UNC-Chapel Hill administrators.

ACTIONS TAKEN

Blackstone Entrepreneurs Network, led by Bryan McGann, was created in 2011 by UNC-Chapel Hill in partnership with Duke University, NC State University and NC Central University with a gift from the Blackstone Charitable Foundation. This regional network was formed to help catalyze growth of the Triangle's entrepreneurial ecosystem and thereby strengthen economic development in the state. Tapping the region's veteran entrepreneurs, the network created a team of Entrepreneurs-in-Residence (EIRs) that helps identify marketable innovations at universities and startups with high growth potential and mentor those companies. This group of successful entrepreneurs have themselves founded a total of 48 companies, raised more than $1.5 billion with six IPO's and exit values of more than $11 billion. Companies in the network enjoy access to sector experts, venture coaches, angel investors, and administrative and marketing support from BEN fellows. Since the beginning of 2012 the Blackstone EIR's have met with more than 800 companies, and those companies have raised more than $400 million. In 2014 the Blackstone Charitable Foundation gave UNC Chapel Hill an additional $1 million to replicate the BEN model in Boulder, Colorado. The replication was led by Sheryl Waddell and Mark Meares out of University Development's Office of Corporate and Foundation Relations.

UNC-Chapel Hill has played a leadership role in the **North Carolina Healthcare Quality Alliance (NCHQA)**, a statewide collaboration for using evidence-based strategies to improve the quality of care in practices across the state. Through the UNC North Carolina Area Health Education Centers program, the alliance integrates quality improvement into its support services and helps practices implement technology for that purpose. North Carolina is the only state in which health care quality improvement goals and health information technology support are seamlessly integrated.

The University expands its global reach through collaborations like **PharmAlliance**, a partnership among the Eshelman School of Pharmacy, Monash University and the University College London. PharmAlliance promotes international collaboration in training leaders and practitioners to address major research challenges in pharmacy and the pharmaceutical sciences.

UNC-Chapel Hill's Center for Excellence in Community Mental Health, led by Thava Mahadevan, started developing the Farm at Penny Lane in Pittsboro, N.C. Its goal is to create a respite center for persons with severe mental illness. The Farm offers therapy programs and activities such as gardening. The **UNC-Chapel Hill Hemophilia Pharmacy** has a unique collaboration with North Carolina Medicaid to optimize cost-effective delivery of blood-clotting factors to patients statewide. The **Carolina Geriatric Education Center** at UNC's Center for Aging and Health is addressing the risk of falls for older adults through new approaches that include working with Orange County EMS to link callers to services.

NC Growth, led by Mark Little, at the **Frank Hawkins Kenan Institute of Private Enterprise**, led by Greg Brown, works with small businesses in rural North Carolina to help them grow robustly and create jobs. Through the program, University experts and MBA students assist companies on critical matters such as business and marketing strategy, inventory and supply-chain management and human resources.

The **Triangle Venture Alliance** is a recent collaboration among Duke, UNC–Chapel Hill, NC State and NC Central to build a network of alumni angel investors to invest in startup companies founded by alumni, parents, staff, faculty and students. A university-oriented angel network is not new, but it is unique to have four universities working together in such a way. The universities estimate they have a collective 200,000 alumni who qualify as accredited investors. Even if half a percent of that group gets involved, there will be 1,000 angel investors funding companies affiliated with the region's largest institutions.

The **Vice Chancellor's Office of Research** has made it a point to broaden and deepen UNC–Chapel Hill's research ties to NC State. The University is heavily involved in the NCBC Regional Precision Health Alliance.

The **joint UNC/NC State Biomedical Engineering program** opened a satellite office in RTP and partnered with a national Veterans Incubator Entrepreneur nonprofit called Bunker Labs. Faculty and students work with veterans to create biomedical devices to aid injured veterans.

The Vice Chancellor for Innovation, Entrepreneurship and Economic Development served on the **Governor's Innovation to Jobs (I2J) Task Force.** The group was charged with creating recommendations to attract more venture capital, develop new entrepreneurs and retain North Carolina talent. One significant achievement was the creation of a $60 million venture capital multiplier fund launched in November 2016.

WHAT WE'VE LEARNED

There is a widespread belief that the Triangle region has the potential to be one of the country's top entrepreneurial hotspots. Some important building blocks are in place. Few places anywhere have a comparable grouping of major research universities—they, with RTI, bring in a combined $2 billion in research funding annually—and recent studies have noted other advantages as well.

The *2016 Innovation That Matters* report ranks the region fourth nationally in potential for capitalizing on the next waves of digital-related innovation. (This report, from the U.S. Chamber of Commerce Foundation and its research partners, gives the Triangle region high scores in categories including openness to new ideas, quality of life and a favorable regulatory structure.) Also the current Innovators Report from North Carolina's Council for Entrepreneurial Development (CED) finds the life sciences sector to be particularly strong for innovative activity. The entrepreneurial potential is clearly present—but gaps and shortcomings have been noted, too.

Currently the region underperforms on several indicators, including a key measure: the amount of venture capital invested. And while many factors may affect this issue, a core requirement is a strong supply of investable deals—promising startups that have reached a stage at which they merit substantial investment. UNC–Chapel Hill has been working

KAY WAGONER

As a successful entrepreneur and loyal alumna of UNC-Chapel Hill, P. Kay Wagoner '86 has dedicated the past several years to fostering startups through her work as a Blackstone Entrepreneur-in-Residence, as an advisor with UNC's KickStart Venture Services and as University Life Science Entrepreneur-in-Residence with the Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development. Wagoner is also an Adjunct Associate Professor in the UNC School of Medicine's Department of Cell and Molecular Physiology and has served on many boards including the NC Biotechnology Center Board, the Biotechnology Industry Organization's Emerging Companies Board and the Eshelman School of Pharmacy Board of Visitors.

to generate investable deals by increasing the quantity and quality of startups based on research. This, in turn, has created a growing need for management talent and for very-early-stage funding in order to de-risk ideas enough to make them attractive to equity investors.

Also, across many fronts, the University is deeply engaged with public- and private-sector leaders and experts in finding innovative solutions to the most pressing challenges faced by North Carolina. Since this work is led largely within schools and units of the University, it has been challenging to articulate to state leaders a comprehensive view of how UNC-Chapel Hill is applying its innovation agenda to benefit North Carolina. Indeed, few people in any capacity know about the full extent of the University's collaborations and their impact.

In sum, the region and state have great potential, and a broad range of ongoing efforts will be needed to realize it fully. By working together with partners locally and statewide, by being connected via a few strong regional hubs, and by recruiting talent and investment dollars from outside the region, the Triangle can become an even more dynamic entrepreneurial hotspot and benefit the entire state of North Carolina.

NEXT STEPS

To strengthen the Innovate Carolina ecosystem at the University and within the region, these steps are priorities:

- Continue to build on relationships with NC State, Duke, NC Central and RTI and identify specific opportunities for collaboration on projects related to innovation and entrepreneurship.
- Increase the University's investment in end-to-end support for commercializing intellectual property created through faculty research. Not only would this stimulate startups and attract venture capital, it is crucial for increasing impact generally.
- Involve potential investors early in the idea-development stage.
- Engage more effectively with alumni who can help in a number of ways.

To ramp up efforts statewide, key steps include the following:

- Enhance the benefits that the University provides to the state of North Carolina by better leveraging existing programs and creating new ones.
- Raise awareness of programs through more effective communication.

from left: David Margolis, MD with UNC's Margolis Lab Group of scientists and clinicians working to achieve a better understanding of HIV latency to address roadblocks to a cure.

Myron Cohen, MD, Director of the UNC Institute for Global Health & Infectious Diseases received an award for his lifetime of work on HIV/AIDS at the 2013 Clinton Global Initiative.

The late Saye Baawo, MD a former UNC Gillings Global Gateway Initiative Mentor and an assistant professor Public Health, with children in Liberia.

INNOVATION IN THE ARTS

Mark Katz (top right), distinguished professor of humanities and former chair of the music department, had a vision to bring non-traditional music making to UNC-Chapel Hill. With a seed grant from the Institute for the Arts and Humanities (IAH), which he now directs, the Beat Making Lab was created as a way to combine hands-on music making with entrepreneurship and community engagement.

Since its launch in 2011, Beat Making Lab has been taken to countries around the world, collaborating with local partners to offer beat-making training to talented underserved youth. With the goal of making the local labs self-sustaining, the project donated equipment and software to local community centers. The project became so successful that it was made the subject of a web series by PBS Digital Studios.

Expanding its reach even further, Katz was awarded more than $2.5 million from the U.S. State Department to launch Next Level, an initiative led by UNC-Chapel Hill's music department to create a new international exchange program that fosters international diplomacy and conflict resolution through music and dance. The program has already coordinated exchange programs in Bangladesh, Bosnia and Herzegovina/Montenegro, India, Senegal, Serbia, Zimbabwe, El Salvador, Honduras, Tanzania, Thailand and Uganda.

"In hip-hop, when artists say that they want to 'take it to the next level,' they are saying that they want to improve themselves, to surpass their current abilities. The name has another meaning, too. We want to use this as a way to model peaceful and productive collaboration, to transcend conflict in creative ways."—Mark Katz, Director of the Institute for the Arts and Humanities

- Create an economic development strategy that addresses both the region and the state. The Office of Innovation, Entrepreneurship and Economic Development will work with senior leaders at the University to help develop new strategies for working with (and for) people across North Carolina. In every sense, the University is working to further leverage UNC-Chapel Hill as an engaged collaborator in building the state's future.

- Develop a data-driven approach to understand the true impact of UNC-Chapel Hill on North Carolina.

- Collaborate with the Office of the Vice Chancellor for Public Affairs to inform and engage leaders at the federal and state levels.

■ *Goal 2.5: Strengthen collaborations with Carolina's strategic international partners.*

ASPIRATIONS

In the future, Carolina will enhance and leverage the relationships with its emerging roster of close strategic international partners—universities such as National University of Singapore, King's College London, Tsinghua University, Universidad San Francisco de Quito (which is instrumental to the Galapagos projects) and other partners. When working on important complex global problems, these strong, complementary institutions offer vital knowledge, resources and access.

ACTIONS TAKEN

The University has been leveraging its global reach and reputation in a number of ways, such as by recruiting globally and convening international leaders around complex issues. The UNC-Chapel Hill brand helps position faculty as leaders in setting strategic agendas with federal agencies and other policy and funding groups, while helping forge strategic partnerships as well.

UNC Global continued building strategic international partnerships with the schools mentioned in the *Aspirations* section as well as others. UNC Global strengthened these partnerships through internal and external efforts. On campus, UNC Global established a Partnership Roundtable with delegates representing each of the University's existing and emerging partnerships, or areas of the world in which it sought to develop them. Led by the University's chief international officer Ron Strauss, the Roundtable contributed to the support

From Left: UNC's Kenan-Flagler Business School partnered with the Chinese University of Hong Kong (CUHK), and the Copenhagen Business School (CBS) to launch GLOBE, a pioneering international program in undergraduate business.

Channing Der, Kenan Distinguished Professor in the Department of Pharmacology, visits Carolina for Kibera in Kenya

Students in Beijing participating in UNC's Minor in Entrepreneurship internship program abroad

and extension of the partnership network. Externally, the Global Relations office within UNC Global developed collaborations with the corresponding international offices at partner institutions.

UNC-Chapel Hill's **Global Education Center** increased opportunities for undergraduate students to not only study abroad but also engage in community-based scholarship and service around the world. The result is an increase in global nonprofits founded by students or recent alumni, such as A Ban Against Neglect (empowers young mothers in Ghana by selling unique handmade products from recycled materials), Nourish International (working to eradicate hunger globally through a network of domestic university organizations), and Carolina for Kibera (working to alleviate poverty through community collaboration in the Kibera slum of Nairobi).

The *Water in Our World* campus theme provided an outstanding example of global leverage. It was co-led by Jamie Bartram, director of the internationally recognized Water Institute in the Gillings School of Global Public Health, and Terry Rhodes, senior associate dean for fine arts and humanities in the College of Arts and Sciences. The water theme advanced understanding of the issues, raised Carolina's already-strong global profile in water research, built relationships on and off campus, and led to new knowledge and solutions. The exceptional work of the Water Institute, together with the Institute for the Environment, drew experts from around the world to its annual water conference. Further, it inspired multidisciplinary efforts to solve issues of access to safe water, sanitation and hygiene globally.

Another example of the University's global reach is related to innovations in **AIDS treatment and cure**. One lab in this area is led by David Margolis, MD and another by Myron Cohen, MD. Through the Margolis Lab, UNC-Chapel Hill is part of the international consortium CARE (Collaboratory of AIDS Researchers for Eradication of the disease). Meanwhile, a world-renowned research team led by Cohen has shown that with the right type and time of delivery of antiretroviral treatments, sexual transmission of HIV-1 can be prevented. Cohen's work was recognized by *Science* magazine as the Breakthrough of the Year in 2011.

The Gillings School of Global Public Health put global in its name in 2008 although it has always had a global perspective. The School's new **Gillings Global Gateway** initiative makes its world-renowned experts more accessible and engaged through partnerships, internships, outreach and communications.

The Kenan-Flagler Business School developed a multi-year global strategy. Programs included **GLOBE®** (Global Opportunities in Business Education), which brings together three of the world's best business schools to provide a premier international business education for

SPORT ENTREPRENEURSHIP

The sport industry is a critical economic driver, particularly in North Carolina. It embodies values of teamwork, discipline, drive, leadership, role playing and fairness, while providing opportunities to all students regardless of experience and socio-economic background. Students are increasingly demonstrating interest in sport entrepreneurship. In 2016, a student-led startup called Cool Soles was the winner of Carolina Sport Court, a sport business pitch student competition in North Carolina.

Under the leadership of Deborah Stroman (right), professor at the Kenan-Flagler Business School and Director of the Center for Sport Business, an affiliate of the Frank Hawkins Kenan Institute of Private Enterprise, UNC has taken efforts to support sport entrepreneurship across campus:

- The Minor in Entrepreneurship in the College of Arts and Sciences has a sport track.

- The Kenan-Flagler Business School hosts the annual Basketball Analytics Summit, which also features entrepreneurial innovations in the basketball industry. The nationally recognized event features collaborations and identifies best practices among business professionals, researchers and students around the increasing roles of big data and analytics.

- The Center for Sport Business conducted a study of the economic impact of sport in North Carolina through an inventory of sport-related businesses.

undergraduates. UNC-Chapel Hill partners with the Chinese University of Hong Kong and the Copenhagen Business School to offer a unique, integrated global curriculum to prepare students as future business leaders.

The **Venture Capital Investment Competition** turns the traditional business plan competition on its head by bringing in teams of students from around the world who want to try their hand at awarding investment dollars to worthy startups. Created by the Kenan-Flagler Business School's Center for Entrepreneurial Studies in 1997, this annual event draws teams from dozens of schools across multiple countries and continents.

The **Entrepreneurship Minor's China Program** is a notable international collaboration. Each summer, 15–20 students in the E-Minor travel to learn first hand about entrepreneurship in China, in collaboration with the study-abroad group CET Academic Programs. The students learn the intricacies of starting a business in China, study Mandarin and Chinese culture and history, and gain valuable personal experience while living with Chinese roommates in the country's capital city.

WHAT WE'VE LEARNED

UNC-Chapel Hill's global strategy has many components, and it has played a significant role in advancing a broad-reaching innovation agenda. High-profile multidisciplinary efforts led by distinguished faculty are creating solutions to global challenges, often in collaboration with international partners, and the cross-campus themes are powerful springboards for international collaboration. Initiatives like these, as well as the ongoing work of institutes and centers that address complex global issues, need to be well-resourced. Further, connecting students' international experiences to opportunities for creative problem-solving in communities around the world contributes to the development of an innovation mindset and skillset that is fundamentally global.

NEXT STEPS

To grow the University's role as an international force in research and innovation requires faculty and graduate students to be globally oriented and have a strong translational bias. This will be a major consideration in recruiting. Two areas to be pursued for upside potential are: leverage the Carolina community to grow a global innovation ecosystem and explore the idea of regional hubs to support the ecosystem. Finally, while supporting the *Food for All* initiative through its 2017 conclusion, the University will plan for future initiatives of this type.

bottom: Diane Pozefsky (left) in Computer Science collaborates with Maria Ferris (right), a clinician and researcher working with children with chronic kidney disease, on a gaming platform for condition management.

INNOVATING THE FUTURE OF MANUFACTURING
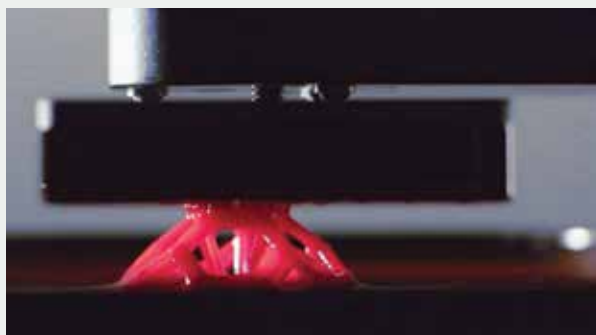
Joseph DeSimone, Chancellor's Eminent Professor of Chemistry at UNC-Chapel Hill, is a successful serial inventor and entrepreneur. He has published over 300 scientific articles and has more than 150 issued patents in his name with more than 80 patents pending. He has received more than 50 major awards and recognitions including the National Medal of Technology and Innovation, the nation's highest honor for achievement and leadership in advancing the fields of science and technology, and the renowned Lemelson-MIT Prize. DeSimone is also one of fewer than 20 individuals who have been elected to all three branches of the National Academies: Institute of Medicine, National Academy of Sciences and the National Academy of Engineering.

The DeSimone Laboratory at UNC-Chapel Hill conducts research at the interface of polymer science, medicine, energy and other advanced technologies areas. Among the notable research breakthroughs are PRINT® technology, central to both life science and materials science research; Safe Energy Storage, next-generation polymeric electrolytes for lithium-ion batteries that demonstrate high thermal and electrochemical stability and ionic conductivity; and CLIP, which is currently being explored for its potential use in the fabrication of very small defined structures for medical applications.

In 2004 DeSimone launched Liquidia Technologies, which now employs roughly 50 people in RTP and has raised more than $60 million in venture financing, including the first-ever equity investment by the Bill and Melinda Gates Foundation in a for-profit biotech company.

More recently, DeSimone co-founded and became the CEO of Carbon, a new venture-backed 3D printing company that is poised to revolutionize additive manufacturing. Since its launch in 2013, Carbon is now at the forefront of the emerging 3D printing industry and has raised more than $230 million, including a $100 million round in August 2016 led by Google Ventures. Its valuation is already estimated to be more than $1 billion without releasing anything more than a product for early customer trials. In the years ahead Carbon will continue to use its technology across an array of industries including automotive, aerospace, athletic shoes and life sciences.

> ■ *Recommendation 3 – Translate (3 Goals)*
>
> Translate important new ideas more expediently and at an increased volume into innovations that improve society.
>
> This recommendation has three goals: 1) create social projects and enterprises, 2) commercialize university ideas, and 3) measure impact.
>
> ■ *Goal 3.1: Support faculty, students and staff as they develop understanding of issues and contribute solutions to complex social and environmental problems through social entrepreneurship.*
>
> ### ASPIRATIONS
>
> In the future, social entrepreneurship will flourish, resulting in innovations that help address some of the most challenging issues locally, nationally and globally. UNC-Chapel Hill will be highly regarded for its rigorous attention to evaluation and assessment as a core pillar of its service activities, and the University will be known for the number of successful social businesses, nonprofits and triple–bottom–line companies that it produces.

ACTIONS TAKEN

The Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development convened leaders in all programs and units engaged in social innovation and entrepreneurship to discuss how their work fits into the campus ecosystem. Many strong initiatives are under way, with the Campus Y and the Carolina Center for Public Service being key leaders in advancing the conversation. The task force will release its report in May of 2017.

The Campus Y's major efforts included the following:

- Formed an advisory board and developed an integrated strategy for the creation and nurturing of social ventures at UNC-Chapel Hill. The advisory board includes representatives from Student Affairs, Innovate Carolina, the Office of Diversity and Multicultural Affairs and numerous academic units and centers as well as student representatives.

- Created a social innovation incubator, the CUBE, in the historic Campus Y building. Residence is open to student teams across campus and can include hybrid social/for-profit ventures. Support ranges from co-curricular programs to individualized mentoring for teams with high potential.

Alec Guettel, UNC Alumnus and Founder of Sungevity, became UNC's Social Entrepreneur-in-Residence (2013-2014).

- Offered free co-curricular programs to students that included workshops in social entrepreneurship in areas such as planning, finance, communications, legal issues and fundraising.

- Brought expertise to campus through a vibrant social entrepreneur-in-residence (SEIR) program. SEIRs included Dennis Whittle, Earl Phalen, Alec Guettal and Phaedra Boinodiris.

Highlights of activities across the University:

- The Carolina Challenge and the E-Minor continued to grow their popular social tracks, while social entrepreneurship courses were integrated into the curriculum across campus.

- The College of Arts and Sciences, Gillings School of Global Public Health and the Center for Global Initiatives housed social entrepreneurs-in-residence, in addition to the Campus Y.

- Gillings Innovation Labs is a path-breaking program launched with funding from a $50 million Gillings gift. It funds research that can open up new solutions to public health challenges by soliciting proposals from across the University. It now attracts other partners who commission Innovation Lab projects.

- The Carolina Center for Public Service, led by Lynn Blanchard, created the Robert E. Bryan Social Innovation Fellowship for aspiring social change-makers with entrepreneurial projects that can address community issues locally or worldwide.

- The C. Felix Harvey Award was established to support innovation in the arts and humanities. Each year, an award is given to advance a faculty project involving multidisciplinary teams of on- and off-campus stakeholders in areas where translational funding is typically more difficult to find, such as archeology, social work, journalism and the digital humanities.

- The School of Social Work's Jordan Institute, led by Gary Nelson, created The Middle Space, a nonprofit to help private companies, public agencies and other nonprofits improve their triple bottom line—their economic, environmental and social performance.

- The Vice Chancellor's Office for IEED led several social initiatives—such as organizing reverse pitches to entrepreneurial students, to connect them with faculty research in developing new approaches to pressing social challenges, and recruiting and coaching teams for the annual Social Innovation Conference held by UNC General Administration to address social challenges in North Carolina.

- Many entrepreneurs in the education space create nonprofits and are driven by a social mission. The MA in Educational Innovation, Technology and Entrepreneurship program in the School of Education was established to provide students with the skills to create effective social ventures.

- The University Libraries, led by Sarah Michalak, provided research and information support to bolster social entrepreneurship among students and faculty. Librarians helped students conduct market research that led to the opening of The Meantime coffee shop in the Campus Y. In partnership with UNC-Chapel Hill's Center for Social Justice and Social Innovation/CUBE, librarians presented workshops about turning data into infographics, creativity and entrepreneurship, and process improvement.

WHAT WE'VE LEARNED

Carolina students, faculty and staff have shown they are eager to improve the world through social innovation and entrepreneurship, as programs in these areas draw heavy participation. The main challenge is to assure that this energy is translated into lasting impact. It requires rigorous planning and training to equip people with the skills they will need. It also requires attention to outcome evaluation.

NEXT STEPS

Going forward, the University needs to continue and/or increase efforts on several fronts:

- Provide a rigorous academic foundation for students who pursue social innovation. Advanced education is needed on topics such as organization-building and performance measurement for social ventures.
- Both students and faculty need individual coaching, including access to mentoring from EIRs and from other experts within and outside the University.
- Funding is a primary concern for all activities at UNC-Chapel Hill. Priorities in this area include providing seed funds for social innovation and ensuring that social initiatives generally receive fundraising support at a University-wide level.
- Complete a comprehensive analysis with recommendations on how to maximize social innovation.

> ■ *Goal 3.2: Effectively organize and manage the University's commercialization services to maximize the quality and volume of potentially important innovations for society. Return revenue from these innovations to the University to support this work.*
>
> ## ASPIRATIONS
>
> In the future, more innovative ideas will be developed at Carolina and launched efficiently into the commercial sector. Carolina will be recognized as one of the top leaders in technology development and transfer because of the breadth of our innovations and the effectiveness of our leadership, people, strategies, policies and their resulting impacts.

ACTIONS TAKEN

In recent years, universities have learned that more than a good technology-transfer office is needed to commercialize research effectively. In 2015 Carolina moved to a comprehensive approach, taking key steps throughout the University to improve every stage of the process, with input and support from many.

This topic was discussed early in the Roadmap period when Innovation Circle members convened a campus-wide meeting on commercialization in 2011. Ongoing coordination was provided by the special assistant to

left: Buck Goldstein, center, talks to the "final four" project teams prior to the selection of the winning team at the final meeting of the introduction to entrepreneurship class at the University of North Carolina at Chapel Hill.
right: Undergraduate students participating in the Carolina Challenge Pitch Party in 2015 during Global Entrepreneurship Week.

the chancellor. Continuing beyond the initial Roadmap period into the present, a host of parties have played major roles. The Office of Research led multiple efforts to plan strategically and attract diversified funding for research, including translational work and early-stage spinout formation. Numerous academic units and centers upgraded or enlarged their own commercialization efforts.

KickStart Venture Services, StartUp-UNC, Carolina Challenge, the Blackstone Entrepreneurs Network, unit liaisons and others are working together, resulting in an increased number of startups in the pipeline. And there have been major changes (along with performance gains) in Carolina's tech-transfer offerings.

Chancellor Carol Folt created the **Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development** to further institutionalize this work. The office reports to the chancellor and was given the charge to integrate the various components more fully. This included leading the technology transfer office into greater productivity. UNC-Chapel Hill's technology transfer office was one of the least-funded, most-understaffed offices of its peer institutions; thus its output numbers were less than expected. The chancellor increased the budget and has supported the work in many ways. The University and health care system, with leadership from the Vice Chancellors for Finance and Administration Matt Fajack, for University Development David Routh and for IEED Judith Cone, invested $10 million into the Carolina Research Fund and made it possible to set up the Carolina Angel Network. Commercialization programs from NC TraCS and the Kenan Institute of Private Enterprise are now part of the Vice Chancellor's Office. A new faculty outreach program was developed, as well as increased engagement with industry partners. A new website and marketing of available technologies have positioned the office for future success. Being heavily weighted toward life science means that often it takes more than a decade to see the result of actions taken today, plus a significant investment of dollars is required to move the technologies into the marketplace.

The Office of Commercialization and Economic Development recorded substantial improvement in technology development outcomes during the Roadmap period, with trend lines suggesting greater gains ahead. The five directors within OCED played a significant role in this improvement: Trude Amick, Michael Kline, Bryant Moore, Jackie Quay and Don Rose.

Keeping in mind that outcome figures can vary for reasons unrelated to the work put in, these results are most notable:

- The University is spinning out IP-based startups at a consistently higher rate. There have been a total of 110 IP-based startups from 1994-2016. Comparing the 5 years before the Roadmap and 5 years during the Roadmap shows a 133% increase, from an average of 4.2 to 9.8 per year.

CAROLINA CHALLENGE

Each year the Carolina Challenge, UNC-Chapel Hill's flagship startup competition, gives students the chance to win seed funding for their early-stage ideas. The latest challenge, culminating in the Spring of 2016, saw more than 108 student teams participate. Eight finalist teams were invited to pitch to judges and the UNC-Chapel Hill Board of Visitors on the day of the Carolina Challenge.

The winning team won $10,000 for their idea "Unisource," an online platform connecting college students with project-based work opportunities inside of early-stage startups. The top finalists also included Talk With Sam, a mobile app that helps Asian students develop their English skills by speaking with an on-demand native speaker, and LineLeader, a mobile "fast pass" app that allows customers to pay to skip lines at restaurants, bars, nightclubs and other venues The Carolina Challenge is endowed by John Stedman '47.

KICKSTART'S ROSE CO-AUTHORS BOOK ON STARTUPS

Don Rose, director of KickStart Venture Services, is a recognized expert in supporting biomedical entrepreneurs at UNC-Chapel Hill. Along with his background as a research scientist, venture investor and startup-company executive, Rose has now co-authored a book on the dynamics and importance of university startups. His *Research to Revenue*, co-written with New York medical executive Cam Patterson, MD was published last year by UNC Press and has been called the "first comprehensive guide" to startups spun out from university labs.

- Patenting activity is growing markedly—a significant sign for the future, since patenting is a key early step in taking innovations to market. From 2009-2016, patent applications rose from 106 per year to 194, and U.S. patents issued rose from 19 to 47.

Steps taken to enhance various stages of the commercialization process include the following:

- The Carolina Express License, implemented toward the start of the Roadmap period, gained national recognition as a model of how to expedite commercialization. A standard, easy-to-execute agreement designed for UNC-Chapel Hill startups, it offers the University's best possible deal in terms of royalties and other provisions to encourage quick licensing and broad application of the technology. At this writing, 40 companies have executed an Express License, and the model has been adopted by several other institutions.

- KickStart developed a series of programs to advance commercialization including the BioEntrepreneur Workshop, New Enterprise Opportunity Program and KickStart Commercialization Awards. It is now expanding its reach to provide services more broadly across the University.

- Administered by KickStart Venture Services, the New Enterprise Opportunity (NEO) program facilitates the development of faculty-founded early-stage startup companies at the University by building them around University intellectual property. The program supports these startups by conducting an early assessment of the commercial potential of the technology prior to expensive intellectual property investments and by offering legal, financial planning, communications and business advising support.

- A program started in 2012 includes the Patent Landscaping, Market Opportunity Research Service. These services are used to assess the technical and market potential of early-stage innovations and can also help guide development of an idea into the most promising directions. The program delivers the services free to UNC-Chapel Hill innovators and recipients of Technology Commercialization Carolina grants. As of December 2016, more than 300 projects had been completed, with a combined value to UNC-Chapel Hill and North Carolina of more than $3 million.

- The annual Innovation Showcase, co-produced by the Vice Chancellor's Office, RENCI, KickStart Venture Services and Kenan-Flagler Business School, connects founders of UNC-Chapel Hill spinout companies to large groups of investors, consultants and service providers.

- Throughout the University, there is growing emphasis on providing mentorship to faculty, staff and students who aspire to commercialize technologies.

Examples of initiatives within academic units are:

- The Eshelman School of Pharmacy demonstrated its leadership by naming Dhiren Thakker associate dean for innovation and strategy and associate director for entrepreneurial development, establishing a Center for Drug Discovery, recruiting a noted translational scientist to bring his entire team to Carolina, and recognizing entrepreneurial activities as a factor in tenure decisions. The Eshelman Institute for Innovation, funded by a $100 million gift from alumnus Fred Eshelman, provides faculty with resources to engage in opportunistic research, education and practice, so Carolina can drive innovation across the University and into society. In its first two rounds of funding the Eshelman Institute for Innovation has awarded $13.4 million to pharmacy faculty, students, postdoctoral fellows and staff.

- It also created the Young Innovators Pilot Program, which provides exceptional high school students with an immersive laboratory experience over the summer. In addition, the Dean of Pharmacy, Bob Blouin, established the Center for Drug Discovery led by Stephen Frye.

WHAT WE'VE LEARNED

The increase in commercialization activity is a positive sign. This increase also creates growing needs for services and support. It becomes more urgent than ever to maintain a strategic, coordinated approach to supporting innovators, and the University will need to add tech–transfer capacity, including an appropriate budget to keep moving major innovations out into the world in a timely manner.

Early in the Roadmap process it became apparent that ramping up innovation campus–wide would require an optimum mixture of localized, specialized efforts with central leadership and coordination. The University now has such a mixture, with the Vice Chancellor's Office playing the centralized role while many programs and initiatives are distributed across the University.

Not all faculty wish to be involved in translating their research into practical innovation; communicating with faculty that innovation is about impact can help to engage a broader audience. Faculty who do wish to commercialize their research may not know how to navigate the process or where to turn for help; many are not seasoned in this type of work and would benefit from added guidance and services. Finally, the management of conflict of interest remains a frequent barrier to commercialization—better solutions are being sought.

NEXT STEPS

To assure that the rate and volume of commercialization keeps increasing and has maximum impact, it will be necessary to focus on a number of areas:

- High-quality research, both basic and applied, is the basis of commercialization and must be sustained.
- Faculty members who do promising research but do not commercialize it represent untapped potential. It is important to address various factors that may be

HARVEY AWARDS

The C. Felix Harvey Award was created by members of the Harvey family to honor the legacy of their father's entrepreneurial spirit. For each of the past eight years, one faculty-led project in the humanities and social sciences has been selected through a rigorous process to receive the award. These faculty are creating solutions that directly and positively impact constituencies outside the University.

In 2016 two awards were given. The latest recipients are faculty members from the schools of nursing and social work, each recognized for their exemplary faculty scholarship reflecting the University's commitment to innovation.

Coretta Jenerette, associate professor of nursing, is seeking to improve the lives of patients suffering from sickle cell disease. She is developing a web-based virtual training tool enabling patients to better communicate with their healthcare providers, ultimately achieving better health outcomes and relief from pain and symptoms.

Amy Blank Wilson, assistant professor at the School of Social Work, is working with partners across the region to meet a critical need for those with serious mental illness who live in non-urban areas. University and community collaborators are building a community of tiny homes to house people with serious mental illness.

The community is embedded at The Farm at Penny Lane under the direction of Thava Mahadevan, who also directs UNC's Center for Excellence in Community Mental Health. Located on 40 acres in northern Chatham County, The Farm uses a holistic and sustainable approach to enhance the quality of life of individuals with severe and persistent mental illness. The Farm currently includes a community garden, a greenhouse, an apiary with nine beehives, a flock of heritage-breed chickens and a walking trail.

holding them back. Some need to see translation as an extension of their scholarly pursuits, not a diversion. Others need to be incentivized and assisted, by giving them time for translational work and guidance through the process. Guidance can be enhanced by expanding the Faculty Entrepreneurship Workshop or similar programs, and by having experienced faculty innovators serve as mentors to their colleagues.

- For students, entrepreneurship curricula must constantly be updated, refined and expanded. Graduate students and postdocs in the sciences represent another source of untapped potential; a range of strategic efforts is needed to get more of them involved in translational work.

- Conflicts of interest situations naturally occur in the process of commercializing University intellectual property. The goal is not to avoid them but to deal with them appropriately and promptly. Streamlining the review process will expedite matters. All involved must be educated on how to recognize and manage conflicts of interest.

- The University's commercialization work must be adequately funded so it can return social and economic value to the state and back to the University.

- A comprehensive, integrated program to guide faculty, staff and students is needed.

- The Office of the Vice Chancellor for IEED's Strategic Plan and Roadmap 2.0 must support the Blueprint for Next: University Strategic Framework, particularly related to the goal of Innovation Made Fundamental.

COMMERCIAL COMPANIES
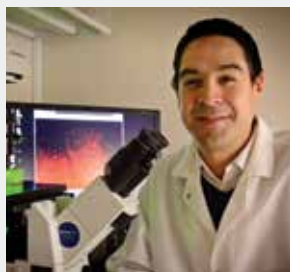
FALCON THERAPEUTICS

Glioblastoma is the most common form of primary brain cancer and also one of the deadliest. The current standard of care—surgery and chemo radiation—extends patient life only by about a year. For nearly three decades, there has been no significant improvement in care. Falcon Therapeutics is advancing a new approach using tumor-homing stem cells to treat glioblastoma cancer.

SPYRYX

Currently there is no cure for cystic fibrosis or chronic obstructive pulmonary disease. Sypryx was founded in 2013 to commercialize a unique approach, which was invented by specialists at UNC-Chapel Hill, for treating both devastating lung conditions. To help Spyryx prepare for outside investment, North Carolina Biotechnology Center awarded Spyryx a company inception loan in late 2014, which enabled Spyryx to be well positioned to eventually secure an $18 million Series A investment to advance the idea and conduct clinical trials.

IMPULSONIC

Impulsonic was founded by students and researchers from the GAMMA lab in the computer science department at UNC-Chapel Hill. Over the past six years, the GAMMA lab has leveraged its high-performance computer graphics expertise to develop cutting-edge technology for real-time sound synthesis and rendering for a variety of applications, ranging from movies and games to architectural design and outdoor noise modeling. In 2015 Impulsonic secured a $700,000 grant from the National Science Foundation to bring next-generation audio and acoustics technology to these applications through innovation. In 2017, they were acquired by Valve, becoming the first company issued a Carolina Express license to successfully exit.

Goal 3.3: Measure the impact of innovations and innovators launched at Carolina.

ASPIRATIONS

In the future, the University will know the extended benefits, including the economic impact, of Carolina innovators and innovations to society.

ACTIONS TAKEN

A first step toward effective measurement of UNC-Chapel Hill's impact on the state was to track the economic output of University-affiliated startups. In 2013 the Special Assistant to the Chancellor worked with the research team at the Frank Hawkins Kenan Institute of Private Enterprise to create the Innovate Carolina Startups Database. This longitudinal database now tracks firms as far back as 1958. In 2015 the research team became part of the Office of the Vice Chancellor for IEED and has detailed information on 418 startups. The startups are coded in three categories. The first includes startups that spun out of UNC-Chapel Hill based on University intellectual property (IP/technology). The second includes those companies that benefited from the services provided by members of the Innovate Carolina Network (assisted). The final includes those that were started by people while at the University, or shortly after leaving, but received no University-assistance (independent).

Since this is a dynamic database, the statistics on these firms are reported twice a year – in January and June. The **418** firms in the database founded between 1958 and December 2016 created **44,491** jobs and **raised a total of $6.5 billion** during that period. Out of the 418 firms, 353 are still active, and of those still active 311 are headquartered in North Carolina. Two multinationals contributed significantly to these numbers and added additional economic benefit to the state by being headquartered here for many years. Quintiles Transnational was founded in 1982 by UNC-Chapel Hill Professor Dennis Gillings. RTI International was co-founded in 1958 by NC State, Duke and UNC-Chapel Hill. Taking a snapshot of one year, 2015, there were 8,449 employees in North Carolina alone. In that same year, the 353 active firms had total revenues of $6.6 billion. Quintiles accounted for the majority of that total with revenues of $4.4 billion, and 26 of the 353 companies had revenues greater than $10 million. A major outlier like Quintiles is the hope of economic development professionals. For instance, NC State has SAS. The University of Florida has Gatorade.

Effective data gathering on entrepreneurship and startup activities helped along numerous fronts - from the submission of data to ranking agencies to the information provided to leaders and decision-makers regarding the impact of their investment in innovation and entrepreneurship. Clearly the economic impact from UNC-Chapel Hill affiliated startups was significant. By demonstrating this value, it became apparent that helping startups was an excellent return on the investment of time and money. Programs like KickStart Venture Services, Launch the Venture, the Executive MBA, Launch Chapel Hill, Carolina Research Ventures Fund and the Carolina Angel Network helped create more and stronger startups to fuel the economy of North Carolina.

WHAT WE'VE LEARNED

Creating a longitudinal database such as this is a complex undertaking. The benefits of startups that grow into stable firms is a story worth documenting. Not only do these firms provide jobs, generate tax revenue, hire vendors and give back to their communities, they create wealth. Often the wealth generated through this process yields significant philanthropic contributions back to higher education.

DENTISTRY

UNC-Chapel Hill's School of Dentistry has a number of centers dedicated to cutting-edge research and practice. Its Center for Pain Research and Innovation brings together clinicians and researchers who seek to alleviate the suffering of individuals with uncontrolled orofacial pain. The Center of Oral and Systematic Diseases conducts high quality multidisciplinary research to explore the relationships between oral and systematic conditions. And the Craniofacial Center is a multidisciplinary approach dedicated to caring for patients with craniofacial abnormalities.

UNC STARTUP IMPACT DATA AS OF 12.31.2016

$6.5 BILLION
FUNDING RAISED
(1958-2016)

$6.6 BILLION
ANNUAL REVENUE
(IN 2015)

311
HEADQUARTERED
IN NORTH CAROLINA

353
ACTIVE

418
STARTUPS
TOTAL

8449
EMPLOYEES IN
NORTH CAROLINA
(IN 2015)

44 K
EMPLOYEES TOTAL
(1958-2016)
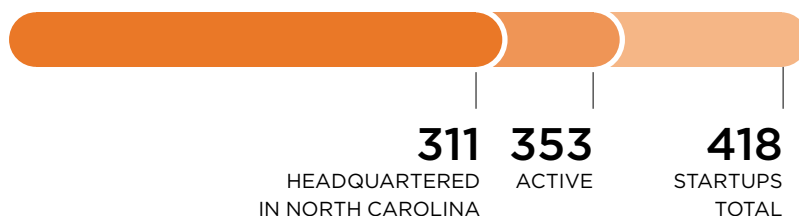
Innovate Carolina Startups Database Definitions and Resources—Sources of data are vetted for accuracy and timeliness. They include government databases and reporting sources, subscription databases (via our University Libraries), and from the startups (with secondary source/data verification). Sources include US SEC filings (annual reports, Form Ds, IPO-related documents), SBIR/STTR awards database at SBIR. gov, NIH RePORTER, NSF awards database at NSF.gov, USAspending.gov, IRS at IRS.gov, Federal Procurement Data System, states' websites for Department of Secretary of State (Commerce), funding agencies' websites (such as NC OpenBook), InfoUSA's ReferenceUSA database, private foundations (such as the Bill & Melinda Gates Foundation), LexisNexis, Factiva, Hoover's PitchBook, CB Insights, PrivCo, Standard & Poor's, Dun & Bradstreet, Thomson ONE, ORBIS/Zephyr (Bureau van Dijk), regional business journals, company websites, and reputable news aggregation websites.

NEXT STEPS

Although the path to comprehensive impact measurement is a journey of many steps, there is now strong initial work to build upon. Implementation and growing use of the Innovate Carolina Startups Database continues. UNC-Chapel Hill's significant role in the regional economy can—and will—be well documented. Having recognized that innovation can benefit society in a multitude of ways, the office is studying and measuring the broader impacts and building data-driven outcome assessments into I&E programs.

OUTSIDE IN
CHANCELLOR'S INNOVATION SUMMIT

CHANCELLOR'S INNOVATION SUMMIT

In 2015 Chancellor Folt invited entrepreneurs, venture capitalists and other thought leaders to the Chancellor's Innovation Summit. This was a day-long program that engaged stakeholders from across the country in an important conversation on how the University can help advance innovative solutions to local and global challenges. The Summit included a creative, public collaboration between students, faculty and staff that featured effective solutions developed by UNC-Chapel Hill in partnership with communities in the state and around the world.

To represent UNC's accomplishments in innovation, six solutions were showcased as interactive public experiences housed in shipping crate sized containers. The installations were constructed through a partnership with Habitat for Humanity and were curated and assembled by student teams under the leadership of Dana McMahan, professor of the practice in the School of Media and Journalism. Each installation highlighted a challenge such as preventing the spread of infectious disease, economic dislocation or environmental protection, and told a story of seeing a need, responding to it with inventive solutions, and translating those solutions into tangible impact.

"Finding solutions to the complex problems of our time requires collaboration from all sectors of our community. And it's critically important to have participation from many types of people with different backgrounds, ideas and experiences if we hope to achieve the greatest outcomes." – *Chancellor Carol L. Folt*

■ *Recommendation 4 – Align (4 Goals)*

Align people, incentives, resources and processes to strengthen an intentional culture of innovation at Carolina.

This recommendation has four goals: 1) strengthen support from University leaders; 2) recruit, retain, reward innovators; 3) align processes; and 4) fund innovations.

■ *Goal 4.1: Encourage leaders from across the University to support and promote innovation in their schools, departments, institutes and offices.*

ASPIRATIONS

In the future, administrators and University leaders will seek and include ways to advance innovation in their strategic planning. When faculty and staff members have promising ideas, leaders will be flexible and creative in finding ways to assist them as appropriate.

ACTIONS TAKEN

Senior leaders throughout the University have been actively committed to the innovation agenda. Further, the culture of innovation is being institutionalized—that is, built into the structure of the institution—in three very tangible ways: creating new positions and roles for key people devoted to innovation and entrepreneurship, providing dedicated physical space for such activities and adequately budgeting for innovation.

At the senior leadership levels, the UNC-Chapel Hill Board of Trustees made innovation a priority, while the chancellor and vice chancellors, the provost and vice provosts, and the vice chancellor for innovation, entrepreneurship and economic development all were instrumental leaders. Importantly, deans championed innovation in the academic units. Highlights are as follows:

- Trustees formed two committees to oversee vital work and assure that it is carried into the future—the Innovation and Entrepreneurship Committee (2013-2015, led by Phil Clay and Lowry Caudill) and Committee for Commercialization and Economic Development (2015-2017, led by Julia Sprunt Grumbles).

- As the University's chief academic officer, the provost directly supported key strategic initiatives including the data studies and maker initiatives, as well as the buildup of the innovation-intensive departments of Biomedical Engineering, Applied Physical Sciences and, more recently, Computer Science.

- Support of the deans has been most visible in academic areas that are commonly related to translational work and impact. For instance, this report contains much news of I&E work in the Schools of Medicine, Business, Public Health and Pharmacy, and their deans have helped lead those advances. The same is true for the dean of Arts and Sciences, working with the computer science and chemistry departments, and deans of units such as the School of Media and Journalism. Finally, the professional schools in addition to those mentioned above are training next-generation innovators across sectors—the Schools of Social Work, Education, Information and Library Sciences, Government, Law, Nursing and Dentistry, and the Graduate School—actively support innovation and impact in their fields as well.

The creation of new positions and roles is important for several reasons. It gives highly qualified people a specific mandate to serve as advocates for innovation, and it creates a cadre of in-house experts to whom aspiring innovators can turn for assistance and support. Highlights are as follows:

- UNC-Chapel Hill is among the first to name a vice chancellor for innovation, entrepreneurship and economic development, dedicated to advancing those functions in parallel.

- Within the University, the list of academic units with designated I&E officers keeps growing. At this writing, the Eshelman School of Pharmacy has an associate dean for entrepreneurship, computer science has an assistant department chair, the schools of Medicine and Public Health have dedicated directors of innovation, and other units have leaders with various I&E titles.

- Entrepreneur-in-Residence programs are flourishing across the University. Currently there are EIRs serving pan-campus in the Department of Economics; the schools of Public Health, Social Work, Education, Public Policy, Medicine and Business; and with the Blackstone Entrepreneurs Network. This roster, too, keeps growing as more units find value in bringing EIRs on board to spur and assist translational pursuits.

- Dedicated physical spaces for I&E activities are essential to support the work of innovators. New ventures need spaces to incubate and grow. Some innovators need special facilities, such as wet labs. A host of other innovation activities—from ongoing programs and special workshops to informal working sessions—must be housed in places suited to their needs.

  Many in the University community, including external partners and donors, collaborated to plan, fund and create new spaces. The University Master Planning Committee included innovation spaces as a top priority and is actively exploring ways to create an integrated, interlinked network of I&E spaces, with provisions for flexibility and expansion.

  Before the Roadmap, UNC-Chapel Hill had no formal spaces for early-stage startups, and little to none for specialized I&E work other than the Kenan Center (which houses the Frank Hawkins Kenan Institute of Private Enterprise). Significant progress has been made in just a few years.

At this writing, the space inventory includes the following, all opened since the start of the Roadmap:

- Launch Chapel Hill—a startup accelerator for both University-related and community ventures in downtown Chapel Hill. Capacity is 12 to 15 ventures. The space was created with initial co-investment from the University, Town of Chapel Hill, Orange County Economic Development, Downtown Partnership and the Becker family, plus in-kind donations.

- 1789 Venture Labs—an incubator at the edge of campus for student ventures of all types (for-profit, social, artistic) except those needing scientific resources. Approximately 40 ventures use 1789 as a co-working, flexible space at any given time, and the program also regularly hosts workshops and events for up to 100 people. Current funding is from a combination of private-donor and University support.

- Campus Y CUBE Social Innovation Incubator—for student and faculty ventures. The space can house 15 ventures and is also used for a variety of workshops, special events, mentoring services and other co-curricular programs. The Vice Chancellor's Office for IEED provided funding for a staff position, and private fundraising is relied upon for the rest.

- KickStart Labs Faculty Entrepreneurs Office and Wet Lab Space—for commercialization of scientific research by the faculty. Funded by the Vice Chancellor's Office for IEED, KickStart Labs provide 2,000 sq. ft. of office and meeting space, a 4,000 sq. ft. wet lab with pre-established terms for faculty use (including clear conflict of interest terms), and the capacity to incubate 10-12 startups. This facility in the Kenan Labs 9th floor is convenient for faculty to move between their academic and startup work, but the space is temporary and limited.

- Eshelman Institute for Innovation MicroIncubator provides office and web lab space to support up to seven Pharmacy-founded startups. In addition to the standard facilities and services provided to all startups, equipment use agreements may also be put into place to allow for company use of UNC Eshelman School of Pharmacy-owned equipment for a fee.

- Entrepreneurs Lounge CS (Computer Science)—provides meeting space for student and faculty groups of up to 15.

- Carolina Health Informatics Program (CHIP)—central offices and collaboratory space for this interdisciplinary research and training program opened in the Health Sciences Library. CHIP faculty come from the Schools of Information and Library Science, Public Health, Pharmacy, Nursing, Medicine, Dentistry and the Department of Computer Science. The partnership capitalizes on the function of the Health Sciences Library as a central hub for informational support for clinical care, public health and biomedical research.

- The Kenan Science Library—redesigned its facilities to create important collaborative spaces including four group study rooms, two co-working rooms, a "huddle" brainstorming space and a design and modeling center, in addition to the makerspace described elsewhere.

- Facility Use Agreements—about 8,000 sq. ft. of laboratory/workspace on campus is under agreement for use by faculty startup companies. UNC has the ability to house startups through a Facility Use Agreement (FUA), usually in the faculty founder's lab. FUAs have been a good stopgap solution, but they have limitations including poor oversight and management of activities (e.g., who pays for broken equipment?), poor optics (i.e., perception from the outside) and no interactions or synergies between companies.

- The Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development worked with UNC-Chapel Hill master planning firm Ayers Saint Gross to complete a preliminary concept for centralizing and expanding innovation and entrepreneurship space on campus.

Other I&E-related spaces include the Kenan Institute Reading Room, a small meeting space and the makerspaces (discussed elsewhere in this report) that are now being opened across campus.

WHAT WE'VE LEARNED

Embedding innovation in the University's culture requires sustained effort and the alignment of resources and systems. The commitment shown by the trustees and senior leaders has been vital.

Chancellor Folt listens to a presentation from the Department of Biomedical Engineering's innovative program at a University Board of Trustees meeting.

The new physical spaces on and around the campus were much needed and are proving valuable, but they do not yet add up to a long-range solution. There is much more to be done in this regard. Most spaces quickly fill to their limits and cannot meet all present demands, let alone growing future ones. Some spaces are temporary, due to expiring leases and the competing needs of other users.

For a dynamic, fully functioning innovation ecosystem, UNC-Chapel Hill needs a sustainable constellation of innovation spaces that are woven together into an integrated, flexible and expandable whole. The University is working toward that vision, as it engages in the new 10-year master plan.

NEXT STEPS

The UNC-Chapel Hill Board of Trustees, the chancellor, senior leaders, deans and student leaders are continuing to focus on innovation as a top priority by including related goals in their strategies and actions. The chancellor and provost are working closely with other leaders on strategic planning, which will bring University resources and processes into further alignment. The Development Office is raising funds through a capital campaign that incorporates innovation goals.

For the deans, the general goal within their schools is to continue creating structures and environments that support innovation. This includes communicating to faculty about the value of innovation, aligning incentives and rewards to encourage it, and appointing special I&E liaisons or officers in units that do not yet have them.

Enhancing innovation spaces is a major priority. Key next steps include the following:

- Allocate adequate space for Applied Physical Sciences, Biomedical Engineering and makerspaces. The chancellor, provost, dean of medicine and dean of arts and sciences are addressing these needs and have made significant investments.

- Find permanent, suitable wet lab and office space on campus and in Chapel Hill for faculty entrepreneurs. The Master Planning Committee has these items on its agenda.

- Create an innovation headquarters on the central campus. This would serve as a visible front-door location where people can come for assistance, and donors can be inspired by a tangible reminder that Carolina is having impact.

- Build a world-class UNC-Chapel Hill Innovation Center. This facility will house new ventures and I&E activities that are now in temporary spaces and/or spaces insufficient for the growing demand. It will also house investors, service providers and strategically chosen industry partners. The University has been working with the architectural planning firm Ayers Saint Gross on innovation center plans that will now need to be carried to full fruition.

THE NEW SHAPE OF EDUCATION

Our students are a renewing resource and arguably our greatest resource. About 30,000 are on campus every year; most will be out in the world working for more than 40 years—and they are being prepared in a new way.

Conventional wisdom says effective people need "T-shaped" skills, with core strength in a specialty (the vertical) and related cross-functional or cross-disciplinary knowledge. But it takes more to lead and succeed in today's world, so at Carolina we are educating all students to have I-shaped skills.

- The vertical core is still deep domain knowledge, developed in majors and minors.

- The top crossbar is the quality of being a global citizen—competent across cultures as well as across disciplines, able to interact with people from any background and to understand, literally, how the world works.

- The base of the "I" stands for innovation skills. This means being able to bring ideas into the world, through the capabilities and mindset of an entrepreneurial thinker.

Many steps are under way to build I-shaped skills. They include expansion of the E-Minor and other entrepreneurship programs, an increased focus on experiential learning and addressing major real-world needs, and embedding the innovation process throughout the curriculum. New co-curricular programs, such as the makerspaces (above), also support this goal, along with growing efforts for inclusion and global outreach.

The Data Studies initiative is crucial to I-shaped skills, too. With data now shaping innovation in nearly every field, the goal is that all Carolina graduates will be data literate and fluent in today's global language—digital.

> ■ *Goal 4.2 Recruit, retain and reward faculty, students and staff who show promise, aptitude and/or achievement in innovation.*

ASPIRATIONS

In the future, faculty, students and staff will be rewarded for pursuing promising ideas to their ultimate application. When the most talented, innovative prospective faculty, staff and students make their choices of which institutions to join or attend, the supportive innovation culture will weigh favorably for Carolina.

ACTIONS TAKEN

UNC-Chapel Hill boasts a world-class faculty and gifted student body. The following are snapshots of achievements by Carolina innovators, along with examples of the University's ability to compete for top faculty talent:

- ■ Kevin Guskiewicz, dean of the College of Arts and Sciences and Kenan Distinguished Professor in the Department of Exercise and Sport Science, has made major advances in the diagnosis, treatment and prevention of sports-related concussions. Guskiewicz received a MacArthur Foundation Fellowship (commonly referred to as the Genius Award) in 2011 for his work, which continues.

- ■ Distinguished nanomedicine researcher Alexander (Sasha) Kabanov, and a group of 20 research colleagues, were recruited from the University of Nebraska to UNC-Chapel Hill. Kabanov now leads the Center for Nanotechnology and Drug Delivery in the Eshelman School of Pharmacy. He established the field of polymer genomics; he is a pioneer in the use of nanotechnology to treat cancers and has invented promising technologies for the treatment of brain-related diseases such as stroke, Alzheimer's and Parkinson's.

- ■ Stephen Frye was recruited because of his extensive industry background as a medicinal chemist with GlaxoSmithKline. Frye is director of the Center for Integrative Chemical Biology and Drug Discovery; a Fred Eshelman Distinguished Professor of Pharmacy; and lead principal investigator for the North Carolina Comprehensive Chemical Biology Center, a UNC-Chapel Hill-based, National Cancer Institute-designated center for oncology drug discovery.

Left: Researchers at the Center for Integrative Chemical Biology and Drug Discovery at the Eshelman School of Pharmacy. The center is dedicated to evaluating and developing potential drug targets discovered by UNC faculty.

Right: Applied Physical Sciences Chair Ed Samulski (left) in chemistry and affiliate Richard Superfine in physics and astronomy are part of Carolina's collaboration culture.

- Carolina Innovation Scholars are some of the brightest and most sought-after students in the country. Chosen for their high promise as innovators, they receive full undergraduate scholarships and are linked, through the E-Minor, to mentoring and enrichment from across the University. The program is funded by multiple donors and had nine scholars (from first-year students to seniors) during the 2015-16 academic year; its full impact will be realized as cohorts of scholars begin making their marks in the world.

- New faculty hired into Applied Physical Sciences are joining an extensive interdisciplinary faculty cohort, including a number of scientists in other UNC-Chapel Hill departments who have been instrumental in the formation of APS. Affiliated faculty have utilized nanotechnology to target drug treatments for cancer and for cystic fibrosis, among other diseases. They have developed improved lab-on-a-chip technologies to develop new devices for clinical diagnostics and for environmental monitoring. And they are working across many fronts to make solar energy more economical.

In terms of recognizing and rewarding innovation, policies on tenure and promotion have begun to change. For example, new policies adopted by the Department of Communication Studies in 2013 include the following passage:

> … In addition to long-standing criteria for such evaluation, innovative faculty work in these areas should also be considered when germane. Thus, tenure and promotion guidelines must balance the need for precedent and consistency with openness to new approaches and ideas … Candidates for promotion and their departments share the responsibility for effectively evaluating innovative contributions. Candidates should help articulate the nature and value of their new work. Departments should continually educate themselves on the changing landscape of the profession, and they should consider when to seek evaluations of the candidate's work that inform and can help explain particular innovations.

Other academic units have updated their policies with similar language. This is a significant change in institutional culture and an important step for attracting and retaining talented young faculty.

NEXT STEPS

Clearly, UNC-Chapel Hill's demonstrated focus on innovation and entrepreneurship is attracting top faculty and students from across the country. Entrepreneurship is intriguing to many incoming students and a useful recruitment tool for faculty as well. To keep the best innovators, tenure policy and reward systems need to be in line with recruitment and retention efforts, and it will take constant vigilance to ensure that Carolina is and remains the place where innovators thrive.

LOOKING TO THE FUTURE

Carolina wants to attract faculty and administrators who believe in putting ideas to use for the public good as well as those faculty dedicated to basic research. When appropriate, search committees will consider a translational attitude and past performance as an important part of the desired criteria. For young faculty, this might be demonstrated in their doctoral and postdoc work. Making the commitment to innovation clear when forming search committees and hiring search firms will help align the people hired to this part of the University's mission.

In order to cultivate and retain strong innovators among the faculty, students and staff, reward systems need to encourage innovation. Periodic reviews of tenure and promotion policies continually improve that process, and other forms of rewards include scholarships, fellowships, grants, cash prizes, time, space and recognition. For faculty, a key reward is often simply the freedom to pursue an innovation.

FUNDING INNOVATORS

Startups based on faculty research need early-stage funding for proof-of-concept work. UNC-Chapel Hill created the Carolina Research Ventures Fund (CRVF) with an initial pool of $10 million to help move research assets to market. The fund, established in 2016, is to offer critical early-stage investment in startups based on University research.

In addition, UNC-Chapel Hill created the Carolina Angel Network. This came as part of a coalition of neighboring universities in the Research Triangle region that launched the Triangle Venture Alliance, aimed at drawing angel investors for new ventures from among the ranks of the universities' alumni. The alliance is a recent collaboration among UNC, Duke, NC State and NC Central to build a network of alumni angel groups to invest in startup companies founded by alumni, parents, staff, faculty and students. A university-oriented angel network is not new, but it is unique to have four universities working together in such a way.

■ *Goal 4.3 Align the University's internal methods and processes to foster innovation, especially in working across schools.*

ASPIRATIONS

In the future, Carolina will regularly assess its internal methods and procedures and make needed changes to support the innovation culture. The University will be known for its entrepreneurial can–do attitude and willingness to quickly address roadblocks to innovation. There will be no incentive for faculty to go outside the system to pursue their translational opportunities. Those pursuits will be easier through the University because of its added value, service attitude and efficiency.

ACTIONS TAKEN

While progress has been made in changing rules and regulations to be more supportive of the innovation process, work remains to continue integrating translational activity in tenure and promotion considerations and to improve Conflict of Interest processes to be more transparent and manageable for faculty and graduate students. The new vice chancellor for innovation, entrepreneurship and economic development is working with others to address University-wide roadblocks to innovation, some of which were identified by the task forces on Industry Relations, Commercialization and Clinical Trials convened by the vice chancellor for research.

WHAT WE'VE LEARNED

There is a desire to work in a collaborative, innovative manner. The University has institutional features that often frustrate those who want to work outside their units or are trying to use outdated systems to produce novel results. Processes need significant attention.

NEXT STEPS

Many universities share this same predicament; Carolina can distinguish itself by solving it. The chancellor is committed to process improvement and efforts are under way. Attention needs to remain focused on changes that can significantly impact I&E work.

> **■ *Goal 4.4: Provide the necessary funds to support nascent and promising innovations on campus.***

ASPIRATIONS

In the future, advancing innovation activities will be an important part of the criteria for allocating resources. Grantors and donors will fund such activities because of their confidence in the University's ability to increase the number and pace of promising ideas moving through the development process to deliver value to society.

ACTIONS TAKEN

Since the start of the Roadmap, the University has raised more than $200 million for initiatives described in this document plus others related to innovation and entrepreneurship. There have also been major new steps in using resources to advance this work, including the following:

- The Carolina Research Ventures Fund (CRVF) provides critical early-stage investment in startups based on University research. The fund was started with an initial pool of $10 million to help move research assets to market.

- New grant and award programs created include those from the E-Minor in the College of Arts and Sciences, KickStart Venture Services, Institute for the Arts and Humanities, the Campus Y Incubator and OCED technology development grants.

- The UNC Health Care and School of Medicine Center for Health Innovation provided pilot funding of $665,000 for five projects from 2013 to 2016 aimed at disruptive innovations in health care delivery and financing.

- The University Libraries instituted a competitive Innovation Grant program to incentivize and support innovative experimental and pilot projects proposed by staff members. Ten projects have been funded since 2014, including ones to explore data visualization and 3D scanning, to investigate the use of wearable health devices for research and to organize complex biomedical data sets.

- UNC Health Care's Rex Health Ventures, one of just a few venture capital funds nationwide created and operated by a hospital, was started with $10 million and then expanded to $18 million based on the success of its early investments. Rex Health Ventures has invested about $8 million so far in eight health care startups, five based in the Triangle.

WHAT WE'VE LEARNED

University Development is structured to provide co-ordination and some centralized functions for decentralized development offices that are located in and support individual units. Cross-cutting initiatives like Innovate Carolina need special support to both raise funds to provide centralized innovation and entrepreneurship services to the University, while also advocating for individual programs and initiatives that contribute to the whole ecosystem.

LOOKING TO THE FUTURE

The multi-billion dollar University fundraising campaign currently in the quiet phase is a critical opportunity for securing needed support for young I&E programs. The Office of the Vice Chancellor for IEED is working closely with University Development to ensure that the central and distributed needs of the Innovate Carolina ecosystem are included in campaign goals and have the appropriate development staff support to reach those goals.

> ■ *Recommendation 5 – Catalyze (2 Goals)*
>
> Catalyze innovation at Carolina by facilitating the work of faculty, staff and students as they put important ideas to use for the public good.
>
> This recommendation has two goals: 1) Leverage the talents of leaders across campus to strengthen the culture of innovation, and 2) Create the Chancellor's Catalyze Group to facilitate Roadmap implementation.
>
> ■ *Goal 5.1: Leverage the talents of leaders across campus to prepare, collaborate, translate and align resources and processes to strengthen an intentional culture of innovation at Carolina*
>
> **ASPIRATIONS**
>
> In the future, faculty, staff and students will lead a wide variety of integrated initiatives focused on translating promising ideas into innovative practices. Program leaders will meet regularly to leverage resources, assess the overall culture of innovation, and take steps to fulfill Carolina's innovation mission. This cooperative network approach will encourage widespread experimentation, autonomy and integration.

ACTIONS TAKEN

The work of advancing the innovation agenda has indeed been done by many people and offices throughout the University, along with the Board of Trustees, dedicated alumni and other partners. The results speak for themselves. The University facilitated the launch of social ventures, student startups, faculty spinoffs and other innovative projects at an unprecedented rate.

The Chancellor's Office of Innovation & Entrepreneurship was established in 2010 for central leadership and coordination then was changed to a cabinet-level priority in 2015 with the creation of the new office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development. The Innovation and Entrepreneurship work writ large was branded as *Innovate Carolina* to create stronger connectivity and integrate a diffused network of people and programs dedicated to helping people achieve their impact goals.

Judith Cone, Vice Chancellor for Innovation, Entrepreneurship and Economic Development, leads efforts to translate University research and ideas into practical benefit for society, while enhancing economic prosperity in North Carolina and beyond.

Major achievements to promote cross-campus networking include the following:

- Formed the Innovate Carolina Network, with more than 200 University leaders who meet regularly to create new connections, foster collaboration, identify gaps and work together on strengthening the University-wide support systems for innovation and entrepreneurship.

- Created weekly *In the Know* newsletter to highlight the Innovate Carolina Network.

- Created the Innovate Carolina Student Leadership Team and Graduate Student Innovation Team, to harness the talent of student I&E leaders, bring them into the design of strategy to create and advance initiatives that meet a diverse range of student needs and to provide peer-to-peer leadership.

- Developed innovate.unc.edu as an online gateway to campus resources for innovation and entrepreneurship. As noted elsewhere, units and programs throughout the University link to this website as a central portal to innovation activity and engage with Innovate Carolina through social media platforms.

- Created and launched an active social media presence (Twitter, Facebook, LinkedIn) for Innovate Carolina as a way to cross-promote events, programs and success stories across the University.

There has been a pronounced increase in communication about innovation and entrepreneurship. Through a mixture of formal communication efforts (via websites, other media outlets, conferences, creation and dissemination of formal reports) and personal networking, there is now a collective, ongoing conversation about I&E that continues to expand to include more and more people across and outside the University.

WHAT WE'VE LEARNED

Building an effective, collaborative ecosystem for innovation is a people-intensive process that involves nurturing relationships and building trust among individuals and groups who sometimes feel under-supported. It requires working across all dimensions of the University, and though great gains have been achieved, there is more to be done. Strengthening the Innovate Carolina ecosystem requires consistent effort over time.

INNOVATE CAROLINA NETWORK

From the beginning, faculty, staff and student leaders have been involved with creating and implementing the Innovation Roadmap. In order to more effectively work together as a pan-university collaborative body, the Innovate Carolina Network was established. Regular Network Forums draw from a group of more than 200 members, each of whom is invested in entrepreneurship and innovation through curriculum and programs. They make connections with one another, discuss best practices, identify gaps and work together to fill them.

Student organizers of the LINC conference, which brought together for the first time students from NCSU, UNC-Chapel Hill, Duke, and NC Central to explore entrepreneurship and opportunities to collaborate.

TED*x*UNC

TEDxUNC is the largest student-led TEDx event in the nation. The group was started in 2012 by the Innovate Carolina Student Leadership and has been supported by the Office of Innovate Carolina since its launch. For the past five years, it brought ideas worth spreading and inspired the University's community to think creatively about addressing some of humanity's fundamental concerns. A local extension of the TEDx program, TEDxUNC is an independently organized annual conference run entirely by students.

Last year TEDxUNC explored the theme *Bodies: Being Human*, which focused on issues affecting the human body—mentally, physically and spiritually. In previous years, themes of TEDxUNC included *Assembly Required*, on the tools available to us to take action; *Taking Flight*, which focused on understanding the power of failure and how ideas gain momentum; *Common Threads*, which focused on generating new ideas by connecting existing resources; and *Global Initiative*, which focused on interdisciplinary solutions to global problems. To date, TEDxUNC has drawn more than 1,000 attendees per year, engaged more than 50 speakers from around the world, and reached many more through live-streaming the conferences.

NEXT STEPS

Key priorities are as follows:

- Continue to work with colleagues across the University to connect them to each other, raise awareness, leverage existing resources and fill in gaps.

- Continue to be a catalyst. Articulate vision and mission, engage a wide variety of internal and external stakeholders, support a culture of innovation and entrepreneurship campus wide and build a robust ecosystem.

- Raise funds to support this work.

■ *Goal 5.2: Create the Chancellor's Catalyze Group to facilitate the implementation of this Roadmap.*

ASPIRATIONS

In the future, the goals described in this Roadmap will receive the targeted attention and resources needed over time to realize the vision. The Chancellor's Catalyze Group (now embodied in Innovate Carolina and the Office of the Vice Chancellor for Innovation, Entrepreneurship and Economic Development) will continually encourage the integration, collaboration and alignment of resources and processes. The University will have a virtual entry point for anyone interested in learning more about innovation activities and how their plans fit with those initiatives. Further, it will have central data services, evaluation and reporting assistance and access to required resources. The collective story of innovation at Carolina and its profound impact on society will be widely disseminated.

INNOVATION IN PRACTICE

Casey Emerson talks with Ben Halligan at UNC-Asheville on the video conference robot as he walks down a hall in the Eshelman School of Pharmacy at the University of North Carolina at Chapel Hill. In schools, departments and programs across the University faculty and staff are seeking and developing new methods and tools for delivering the most impactful results.

ACTIONS TAKEN

Communication about innovation at Carolina has played a key role in making progress toward the Roadmap goals. The Vice Chancellor's Office for IEED and communication offices across campus have worked together in this regard, cross-pollinating innovation messages and disseminating them by many means: through newsletters, social media, placement of stories in mainstream news outlets, and campus media outlets such as the *University Gazette* and the UNC-Chapel Hill website. (For example, the homepage carried a year-long series of lead stories about notable innovators).

The Vice Chancellor's Office for IEED has driven and encouraged face-to-face communication as well.

- The special assistant for innovation and entrepreneurship (now the Vice Chancellor) and the chair of the Innovation Circle fulfilled hundreds of speaking engagements with deans, chairs, standing committees, faculty, employees, parents, alumni and external groups in Chapel Hill, regionally and nationally.

- UNC-Chapel Hill's Global Entrepreneurship Week is part of an annual international celebration of entrepreneurship originated and supported by the Kauffman Foundation.

- The provost, senior administrators and faculty leaders have been active in explaining and promoting the Roadmap goals among the faculty.

- The Innovate Carolina Student Leadership Team has done much to help spread the word among students.

- Senior administrators and campus leaders have been active in explaining the innovation goals and soliciting involvement. They have also included innovation messages in presentations to key audiences.

- The Vice Chancellor's Office hosted annual Chancellor's Innovation Summits, bringing entrepreneurs, investors, alumni, faculty and students together from across the country to explore UNC-Chapel Hill's innovation work and strategize for the future.

WHAT WE'VE LEARNED

Consistent messages, networks, individual relationships, credibility, resources and a combination of one-on-one conversations with outreach through electronic media are all key elements in building an innovation ecosystem. All must continue in order to fully infuse innovation and entrepreneurship into the fabric of campus life at Carolina.

NEXT STEPS

Communication efforts need to be continued and expanded in every respect. Areas for significant concentration going forward include the following:

- Ensure that the Innovate Carolina brand reflects a well-connected, informed and mobilized network of people and programs, and that brand exposure at Carolina is maximized so that people can find the support they need.

- Work with the Admissions Office to include messages about innovation and entrepreneurship at Carolina throughout the recruiting process.

- Continue to disseminate information about UNC-Chapel Hill's I&E resources to incoming students at resource fairs, panels and networking opportunities during the Week of Welcome.

- Continue to work with key individuals in departments and programs to build a network of super-connectors around innovation and entrepreneurship.

- Mobilize other student groups in conjunction with the Innovate Carolina Student Leadership Team.

Finally, in communication as in all other I&E efforts, significant attention must be paid to two aspects: securing resources to support the work and measuring impact.

GRADUATE STUDENT INVOLVEMENT

The Startup Consulting Program, part of KickStart Venture Services, assists University faculty with the development of a commercialization strategy for moving novel technologies toward the market. Teams of MBA students serve as consultants to both early-stage startups and faculty members interested in evaluating a startup as a vehicle for commercializing their technology. Many graduate students are supported by their faculty advisors to work on startups based on their work or research. Oakkar Oakkar, MSIS '13 (above) and Jared Mustafa (above) in the School of Information and Library Science worked together to start Keona Health while Oakkar was a graduate student.

In 2012, UNC-Chapel Hill's School of Medicine and the Kenan-Flagler Business School partnered to form a joint MD/MBA program that brings together expertise from both schools. This unique dual-degree program offers medical students, particularly those interested in opening their own practices, an opportunity to earn both a doctor of medicine and a master of business administration in five years. Unlike most MD/MBA programs, Carolina's goes beyond offering healthcare management courses by also integrating leadership, innovation and entrepreneurship into the curriculum.

Sam Lai (right), an assistant professor at the School of Pharmacy, helped pioneer the breakthrough development of mucus-penetrating particle technology. Lai established a rigorous research program at the interface of engineering, immunology, biophysics and biomaterials. His lab recently spun out Mucommune LLC, a startup focused on harnessing antibody-mucin interactions to prevent or treat infectious diseases at mucosal surfaces. Taking the initiative to promote entrepreneurship and innovation among graduate students, professional students and postdocs, Lai secured funding from VentureWell to create the E(I) Lab program, an eight-month long experiential education program that brings together graduate students from diverse disciplines across UNC-Chapel Hill to conceive, develop and test innovative solutions to unmet needs in healthcare.

DEANS INTEGRATING I&E *into* STRATEGY

A few notable examples of innovation support from the deans.

Dean Kevin Guskiewicz, previously Karen Gill, College of Arts and Sciences—Expanded and strengthened the Minor in Entrepreneurship. E-minor teaches undergraduate students the necessary skills to start successful ventures in nine areas: artistic, commercial, media, scientific, social, sports, public health, design and computer science. Created new department of Applied Physical Sciences and opened the BeAM maker network with a 3,000 square foot space in the heart of campus.

Dean Susan King, previously Jean Folkert, School of Media and Journalism—Converted the school's Reese Felts Digital Newsroom to the Reese News Lab — now an experimental media and research project that focuses on developing and testing new ideas for the media industry. Developed and expanded Workroom, an entrepreneurial advertising design track incubator. Started a virtual reality lab and adopted 360-degree video technology for experimental storytelling. Established the Center for Innovation and Sustainability in Local Media to support news organizations through applied research on economic sustainability and entrepreneurship as well as innovative news and digital product solutions.

Dean Barbara Rimer, Gillings School of Global Public Health—Established the Office of Research and Innovation Solutions, which supports research teams that include both faculty and students, giving students the opportunity to work on real-world problems in which they can apply the approaches that they have learned in the classroom. Also, funded by the $50 million Gillings gift, the Gillings Innovation Labs offer research awards to accelerate public health solutions.

Dean Robert Blouin, Eshelman School of Pharmacy—Received $100 million to launch the Eshelman Institute for Innovation. The Institute helps fuel innovation, create jobs and spur economic development in the state, while enabling the school to pursue new ways to enhance its position as a national and international leader. The Institute will fund student and faculty innovations and fellowships, and will connect industry and government with UNC scientists and technologies to establish research collaborations with the goal of developing and commercializing innovation.

Dean William Roper, School of Medicine—Established the Center for Health Innovation, which promotes the development of patient-centered innovations. These are designed to address the current challenges facing the nation's healthcare delivery system related to cost efficiency, quality of care, innovative health care delivery, and alignment of incentives among industry participants. The School of Medicine also grants the Innovation Pilot Awards, to fund employees for their innovations across a spectrum of areas including care delivery, new technology and advanced analytics.

Dean Martin Brinkley, previously Jack Boger, School of Law—Established the Community Development Law Clinic for social entrepreneurs, which engages third-year law students in providing corporate and transactional counsel to North Carolina nonprofit organizations and social enterprises. Also created the Intellectual Property Clinic, which trains and engages students to use their intellectual property skills to serve the public interest.

Dean Fouad Abd-El-Khalick, previously Bill McDiarmid, School of Education—Launched the country's first and only educational entrepreneurship Master's degree, UNC's MA in Educational Technology, Innovation and Entrepreneurship (MEITE) and partnered with the Campus Y to develop a social entrepreneur-in-residence program themed around education from 2014-2015.

Dean Gary Bowen, previously Jack Richman, School of Social Work—Launched the Social Entrepreneurship and Innovation Clinic at Durham's American Underground to provide consultation for community programs engaged in social entrepreneurship and innovation. Also received a $350,000 gift in 2015 to fund new innovation initiatives that align with the school's strategic goals.

Dean Michael Smith, School of Government—Started the Local Government Managers Innovation Lab, a one-day event that provides hands-on training on design thinking as a method to develop innovative solutions to community issues and/or to improve service delivery. In 2015, the School received the Public Service Innovation Award from the Consortium of University Public Service Organizations (CUPSO) for a local government budget simulation, Budgetopolis. Budgetopolis and Bottom Line! are tools, designed as board games, that help newly elected city and county officials (and others) learn to work as a governing board, agree upon common goals and values and make budgetary decisions as a group.

Dean Douglas Shackelford, previously Jim Dean, Kenan-Flagler Business School—The Center for Entrepreneurial Studies leads the Carolina Challenge, an annual University-wide venture competition; Launching the Venture, a course series designed to teach, empower, and inspire entrepreneurship; Launch Chapel Hill, an accelerator for high-growth companies; 1789 Venture Lab, a place for students and recent alumni to work on their startup ideas; the Adam Apprenticeship, a year-long coaching process with UNC's leading entrepreneurial alumni; the Entrepreneurs Lab, a marketplace for entrepreneurs and venture capitalists, and also offers both an undergraduate and an MBA concentration in Entrepreneurship.

Dean Scott DeRossi, previously Ken May, School of Dentistry—Established research and innovation programs including the Center for Pain Research and Innovation, which enables faculty, students, research fellows and visiting scholars from multiple disciplines with common interests to work together to study chronic pain in a unified manner.

Dean Gary Marchionini, School of Information and Library Science—Collaborated to establish the Digital Innovation Lab, which supports digital humanities projects for the public good. Faculty co-led the Working Group on Data Literacy, which called for graduating all students data literate commensurate with level in school and majors and minors. The IRODS Consortium has many corporate partners, is run out of RENCI and came from SILS' strategy of recruiting Reagan Moore and Arcot Rajaekar to SILS seven years ago. This is an academic-corporate partnership that continues to bear fruit.

Dean Nilda Peragallo Montano, previously Donna Havens, School of Nursing— Launched the Education-Innovation-Simulation Learning Environment to optimally prepare Carolina nursing graduates; cultivated a partnership with a leading home healthcare provider in North Carolina to collaborate on creative approaches for building this workforce; launched an annual Symposium on Healthcare Solutions, a forum to discuss complex issues and solutions that translate to providers; established the Hillman Scholars Program in Nursing Innovation to align resources, processes, students and faculty toward a culture of innovation; fostered a thriving mobile healthcare program to catalyze innovation as a site where faculty and students team up to help diverse populations; and established research infrastructures through the Office of Research Support and Consultation to foster innovative, collaborative research among faculty, students, research fellows and visiting scholars.

Dean Steve Matson, Graduate School—Supported graduate student involvement in innovation activities across the University, supporting pilot innovation fellowships and providing guidance as students navigate the complex environments within their individual departments.

Dean Jan Yopp, Summer School—Supported the adoption of innovation tools by providing funding to integrate teaching in the BeAM makerspaces into the summer school curriculum.

Sarah Michalak, University Libraries—Established Research Hub service and technology-enabled group workspaces, including a makerspace offering 3D printing and scanning. Instituted competitive Innovation Grant program for staff. Improved facilities to support innovation, including the Carolina Health Informatics Program offices and collaboratory in the Health Sciences Library, huddle and co-working spaces in the Kenan Science Library and collaboration spaces in Davis Library. Supported innovation and entrepreneurship through technology consultations, research partnerships, access to research resources and workshops that are open to the entire campus.

■ *Closing Thoughts*

The Bar is High

The Innovate Carolina Roadmap, laid the groundwork for the next chapter in the University's commitment to applying its resources toward creating solutions for the most pressing problems facing North Carolina and the world. The Roadmap, created in 2010 by faculty, staff, students and external partners, had an audacious goal: Make Carolina the place where people can unleash their creative potential and turn ideas into practical value. Succinctly stated, the vision is: Put important ideas to use for the public good. With a mission of: Be a place where innovators thrive.

The first phase of this work is now behind us, and it is time to enter a new creative process to design the future together. It is time to create Roadmap 2.0. There are many more people today who are aware, engaged and passionate about what that future might be as a result of the work done to date. The UNC-Chapel Hill Board of Trustees, Chancellor Carol Folt, Provost Jim Dean, administrators and deans have just completed a strategic framework for the University, with innovation and entrepreneurship firmly integrated. What an exciting time for the Carolina community, and what a responsibility to do whatever it takes as an institution to address the serious issues facing the world.

The University has set a high bar. The goal is to have the University, the Triangle region and the State of North Carolina become world leaders in innovation and entrepreneurship. We want as many as possible—from members of the University community to citizens of the state, the nation and world—to benefit fully from the social and economic impacts of the University's work.

To that end, the University will continue to strengthen and integrate all areas of activity in the burgeoning Innovate Carolina ecosystem. The following are core functions of the ecosystem. After each are listed key questions and issues to be addressed with fresh eyes by the Carolina community:

- **Teach the skills and build the mindset**—How will we continue to elevate UNC-Chapel Hill's formal and informal teaching of the skills and mindset necessary in the 21st-century innovation economy and reach even more people?

- **Build the foundational elements**—How can we support and expand areas of activity that serve as the building blocks of innovation? At present, this includes research and education in Applied Physical Sciences, Biomedical Engineering, Data Studies, Computer Science and other academic fields, along with work in the new BeAM makerspace network.

- **Translate ideas to impact**—What is needed to optimally guide and support people as they move ideas to impact? How can this be done in the realms of both for-profit and not-for-profit enterprises?

- **Provide spaces for Innovate Carolina people and programs**—Where can we expand existing spaces and create new ones on or adjacent to campus, to support the full innovation process?

- **Fund high-potential ideas and the work of the Innovate Carolina network**—What funding do we need to accelerate the translation of ideas into impact and sustain the work of the distributed network? How can we raise these funds from a growing variety of sources?

- **Communicate the impact and measure the results**—How can we integrate I&E into the overall UNC-Chapel Hill brand, to more effectively convey its importance and continue to share the collective story of I&E impact both on campus and beyond?

The work ahead is about alignment with the University's framework. It is about the Carolina community envisioning a world-class translational approach to important problems and preparing students for the future. This imagined state can only be achieved if all members of the community work together with key strategic partners to develop, fund, execute, measure and tell the story. Together, we create the future.

APPENDICES

Innovate Carolina Network Members

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Carolina Center for Public Service

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Carolina Center for Public Service

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Professor, Applied Physical Sciences
Faculty Director, BeAM Maker Network
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Food for All
Majors: Interdisciplinary Studies, Global Studies

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VCIC
Major: Business Administration

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Minor: Entrepreneurship

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Minor: Religions Studies

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Minor: Chemistry

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Minor: Entrepreneurship

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Minor: Chemistry

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Minor: French

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Minor: Music

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Minor: Entrepreneurship

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Minor: Business Administration

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Campus Y
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Minor: Entrepreneurship

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Minor: Social and Economic Justice

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Minor: Entrepreneurship

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Luke Soliman '18
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Minor: Entrepreneurship

Graham Treasure '17
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UNC-Chapel Hill Startups

908 Devices

908 Devices is bringing the powerful capabilities of mass spectrometry out of the confines of centralized laboratories. 908 Devices' products range from rugged, handheld chemical detection tools to compact, dedicated analyzers for researchers, serving a range of industries including safety and security, life science research, biotechnology, food safety and clinical diagnostics.

Algynomics, Inc.

Algynomics developed a diagnostic platform to identify individuals at risk for the development of chronic pain to improve targeted prevention and clinical trial patient stratification. Algynomics was acquired by Proove Biosciences in 2016.

AngleFix Tech

AngleFix Tech develops novel screw technology for orthopedic plates.

Aquagenx

Aquagenx provides portable water-quality testing products that detect E. coli bacteria. The Compartment Bag Test is simple to use and does not require complex equipment or electricity, making it ideal for places with fewer resources including developing countries and emergency/disaster areas.

Asklêpios BioPharmaceutical, Inc. (AskBio)

AskBio is advancing gene therapy technologies developed in the Gene Therapy Center at UNC-CH. AskBio is pursuing development and delivery of novel protein and cellular based therapies through the design of proprietary Biological Nano Particles (BNPs).

BioDeptronix

BioDeptronix develops instruments to sense and monitor toxic chemicals and gasses in outdoor and indoor air, as well as in lab-created air samples, using changes in the metabolism and gene expression of human cells.

Bivarus, Inc.

Bivarus develops improved patient satisfaction and experience survey tools. The Bivarus analytics platform utilizes a proprietary statistical framework to generate scientifically valid, real-time data using electronically delivered patient experience surveys. Comprehensive reporting/tracking tools and workspace features facilitate active data management and continuous improvement, resulting in safer, more efficient and profitable healthcare environments.

Blue Current, Inc.

Blue Current is developing novel materials for improved battery performance.

Cell Microsystems, Inc.

Cell Microsystems develops cell separation and isolation tools. The CellRaft™ technology permits rapid and efficient separation and isolation of single cells.

ChemoGLO

ChemoGLO develops technologies that detect and remove chemotherapy drug contamination in hospitals, pharmacies and laboratories through its ChemoGLO Wipe Kit and the Hazardous Drug Clean (HDClean) towelette cleaning system.

Clinical Sensors, Inc.

Clinical Sensors is developing novel sensing technologies for use in hospital point-of-care devices. Among these are nitric oxide sensors for the early detection of sepsis to save lives, reduce complications in intensive care units (ICUs) and decrease health care costs related to the treatment of sepsis.

Cortical Metrics, Inc.

Cortical Metrics develops quantitative, noninvasive measures of brain health that can address a broad spectrum of neurological disorders.

DeltaSphere, Inc.

DeltaSphere develops advanced 2-D imaging and 3-D computer graphics products for law enforcement and security firms. It specializes in creating accurate, photorealistic representations of the real world. The company's integrated hardware and software solutions are widely used to capture and present 2-D and 3-D visual crime-scene reconstruction.

Dualogics

Dualogics is a biotechnology company using proprietary technology to develop bispecific antibodies with superior properties to those generated using other methods.

Enci Therapeutics, Inc.

Enci Therapeutics is developing a monoclonal antibody to block the activity of SFRP2: a newly-discovered protein expressed in a wide number of human tumors that promotes angiogenesis and tumor progression in animal models.

Entegrion

Entegrion develops biological and medical-device technologies to enhance the safety and availability of the human blood supply. Entegrion has developed a lyophilized blood substitute product which is far more stable than stored human platelets and effective at stopping bleeding.

Enzerna Biosciences

Enzerna Biosciences has developed a proprietary platform technology to engineer sequence-specific RNA endonucleases.

EpiCypher

EpiCypher develops and manufactures novel tools and reagents for epigenetics drug development and chromatin biology research.

Epizyme, Inc.

Epizyme is a clinical stage epigenetics company that is developing small molecule inhibitors of histone methyltransferases for multiple oncology indications.

Eppin Pharma, Inc.

Eppin Pharma is developing an oral, non-hormonal male contraceptive.

Ercole Biotech, Inc.

Ercole developed oligonucleotide-based RNA therapeutics that directed alternative splicing of mRNA. These splice-switching drugs represent a new class of drug with the potential to modify gene-encoded proteins and their production. Ercole Biotech was acquired by AVI BioPharma in 2008 and AVI BioPharma changed its name to Sarepta Therapeutics in 2012.

G1 Therapeutics

G1 Therapeutics is a clinical-stage pharmaceutical company developing small-molecule therapeutic agents to protect patient bone marrow and the immune system from chemotherapy-induced damage.

GeneCentric Diagnostics

GeneCentric Diagnostics' proprietary platform utilizes tumor genomic information to enable oncologists and their patients to make informed decisions through clinical trial design, prediction of drug response, drug development target selection and improved therapeutic results.

Global Vaccines

Global Vaccines is a not-for-profit company that develops vaccines against diseases such as HIV/AIDS, polio, dengue fever, malaria and viral diarrhea (rotavirus), common in developing countries.

Glycan Therapeutics, Inc.

Glycan Therapeutics has developed a chemo-enzymatic method for producing synthetic heparan sulfate, rather than sourcing from animal tissues. This method can also be used to generate a multitude of glycans for research use.

Hibernaid, Inc.

Hibernaid is a pharmaceutical company dedicated to development of medications to treat acute brain injury and other ischemia-reperfusion injuries. Company co-founder Dr. Lawrence Katz studies hypothermia mechanisms and their ability to improve outcomes for critical patients, and the company's current lead induces clinically-relevant hypothermia to increase survival and prevent damage in acute critical care conditions. Hibernaid's goal is to find therapeutic agents that can be administered to patients more broadly, quickly and easily with fewer side effects.

Impulsonic, Inc.

Impulsonic uses high-performance computer graphics techniques and the latest research in acoustics simulation to develop high-performance and accurate acoustics-simulation algorithms for game and virtual reality applications, architects, acoustics consultants, and government and national defense applications. Impulsonic was acquired by Valve Corporation in 2017.

Initos Pharmaceuticals

Initos Pharmaceuticals has identified small molecules that enhance the pharmacological effects of oligonucleotide-based therapeutics.

InnerOptic Technology, Inc.

InnerOptic Technology develops 3D navigation and guidance software for use in minimally invasive image-guided surgical procedures.

Inspire Pharmaceuticals, Inc.

Inspire Pharmaceuticals focused on researching, developing and commercializing prescription pharmaceutical products for ophthalmic and pulmonary diseases. Inspire Pharmaceuticals was acquired by Merck & Co. in 2011.

KindHeart, Inc.

KindHeart is a medical-simulation company specializing in surgery simulation systems that use real animal tissue, fully animated surgical simulators.

KinoDyn, Inc.

KinoDyn is a cancer drug discovery company using a proprietary multiplexed inhibitor bead/mass spectroscopy platform that simultaneously maps and quantifies important cellular enzymes and kinases to discover new drugs and drug combinations. KinoDyn is focused on difficult-to-manage cancers including triple negative breast cancer (TNBC), pancreatic cancer, drug-resistant leukemias and glioblastoma.

KXTbio, Inc.

KXTbio is a biotechnology company focusing on the development and application of reagents, assays and drug screening platforms for the study of G proteins and GTPases with the goal of developing small molecule therapeutics targeting protein-protein interactions.

Liquidia Technologies

Liquidia Technologies develops precision-engineered drug particles that have the potential to dramatically improve the performance of medicines. The ability to modify nanoparticle attributes allows Liquidia to develop more optimized safe and effective vaccines and therapies for a wide variety of diseases.

Meryx, Inc.

Meryx is a biotechnology company developing inhibitors of Mer Receptor Tyrosine Kinase for the treatment of hematologic and solid tumors including leukemia, lung cancer and melanoma.

Mission3, Inc.

Mission3 is an educational nonprofit company distributing an educational software application that tracks medical resident behaviors and skills linked to the ACGME milestones.

Morphmics

Morphmics developed and delivered medical-imaging software systems to dramatically increase efficiency and success rate in image-guided medical treatment planning, intervention and diagnosis. Proprietary image analysis methods were developed that recognized and extracted anatomical structures from 3D and 2D medical images. Morphmics was acquired by Accuray in 2012.

NanoCor Therapeutics, Inc.

NanoCor Therapeutics is a biotechnology company developing a gene therapy for chronic heart failure based upon delivery of protein phosphatase 1 inhibitor using the company's proprietary Biological NanoParticle (BNP) technology. NanoCor Therapeutics was spun off from Asklêpios BioPharmaceutical, Inc.

Nanosonic Bioreagents

Nanosonic Bioreagents has developed proprietary reagents for efficient DNA fragmentation in preparation for sequencing applications and for use as microbubble contrast agents in ultrasound imaging.

Novan, Inc.

Novan is a clinical-stage pharmaceutical company harnessing the power of nitric oxide. The company's proprietary platform technology enables the stable storage and delivery of nitric oxide in a variety of dosage forms. Novan is currently developing innovative, first-in-class therapies for the field of dermatology.

Nutrigene Sciences

Nutrigene Sciences offers genetic testing and gene-guided medical foods for multiple medical conditions including fatty liver disease and male infertility.

Oriel Therapeutics, Inc.

Oriel Therapeutics develops technology for drug delivery to the lungs to better treat respiratory and pulmonary disease. As of 2010, Oriel Therapeutics was acquired by Sandoz.

Parion Sciences

Parion Sciences develops therapies to treat defects of the innate mucosal defense system in respiratory and ocular diseases.

Path BioAnalytics

Path BioAnalytics develops cloud-based, software-enabled drug development tools for R&D and clinical trial enhancement. Assays include high-throughput organoid-based assays for CFTR and ENaC modulator response, sputum and bronchial alveolar lavage viscoelasticity, and measurement of mucolytic agent effectiveness.

UNC-Chapel Hill Startups *(continued)*

PharmatrophiX

PharmatrophiX is focused on developing small-molecule drugs targeting neurotrophin receptors for the treatment of neurodegenerative disorders.

PhoenixSongs Biologicals

PhoenixSongs is a global life science company dedicated to developing and providing novel stem cell-derived model systems for research and drug discovery. Stem cell sources include iPS cells and stem cells isolated from donor tissues such as liver, brain, biliary tree and umbilical cords.

Premirr Plastics

Premirr Plastics has developed a catalyst system for recycling PET plastic, commonly found in water bottles and other commercial products, in an eco-friendly manner.

Qualiber, Inc.

Qualiber is a nanomedicine company with an innovative drug-delivery technology platform to enable targeted delivery of siRNA, small-molecule therapeutic agents, and genes for the treatment of cancer and liver diseases.

Qualyst Transporter Solutions

Qualyst Transporter Solutions is a biotechnology company providing hepatic drug transporter models, products and contract research services for accelerating the process of screening drug candidates.

RedBud Labs

RedBud Labs is a MEMS and microfluidics technology company that manufactures actuated surface-attached posts (ASAP) for used in microfluidics applications. These posts bend in the presence of a magnetic field and enable small volume sample collection, mixing, processing and analysis.

Renaissance Cell Technologies

Renaissance Cell Technologies was developing a liver progenitor cell therapy for treatment of liver failure. The company name was changed to Incara Pharmaceuticals and was later sold to Vesta Therapeutics.

Renovion, Inc.

Renovion is a pre-clinical stage pharmaceutical company with a therapy for chronic inflammatory airway diseases.

Ribometrix

Ribometrix has developed a proprietary platform for discovering and characterizing the interactions of small molecule drugs that target RNA.

Sandbar Oyster Company

Sandbar Oyster Company has developed substrates that improve the colonization of oysters. The results are improved native oyster production, habitat restoration and shoreline protection.

SonoVol

SonoVol has developed a fully-automated benchtop ultrasound platform for researchers as an alternative to expensive imaging equipment.

Spyryx Biosciences, Inc.

Spyryx Biosciences is developing therapies for treatment of cystic fibrosis. The lead candidate is a peptide that reduces sodium absorption through a natural, biological mechanism.

Symberix, Inc.

Symberix is developing pharmaceuticals that selectively target bacteria within the human microbiome to improve health. The lead program is focused on alleviating the GI toxicity of chemotherapeutic agents and NSAIDs. Compounds are being developed that inhibit beta-glucuronidase, an enzyme that reactivates drug metabolites in the GI tract and causes toxicity.

Synereca Pharmaceuticals

Synereca Pharmaceuticals is developing orally-active drugs that restore or potentiate the effectiveness of existing antibiotics. The company's initial program focuses on inhibiting RecA, a key enzyme in bacterial DNA repair, as well as in the development and transmission of antibiotic resistance.

Syzygy Optics

Syzygy Optics manufactures high-performance diffraction gratings for astronomy application.

TheraLogics

TheraLogics develops biopharmaceuticals to control and treat inflammatory diseases through the modulation of NF-kB activity. Diseases targeted by the company include chronic inflammatory arthritis, muscular dystrophy and Parkinson's disease.

Vascular Pharmaceuticals

Vascular Pharmaceuticals is a clinical-stage pharmaceutical company developing therapeutics for diabetic nephropathy.

Viamet Pharmaceuticals

Viamet Pharmaceuticals is a clinical-stage pharmaceutical company discovering and developing small-molecule compounds that target metalloenzymes, with applications in fungal infection, oncology and certain orphan diseases.

XinNano Materials, Inc.

XinNano Materials, a joint venture of Xintek, Inc. and TECO Nanotech Col, Ltd., is a world leader in producing high-quality carbon nanotubes for field emission, thermal and electrical conducting applications. XinNano Materials has also developed carbon nanotube ink that can be easily applied to substrates to produce transparent conducting film and anti-static film used for touch panel, flexible display and EMI shielding applications.

XinRay Systems

XinRay Systems is a joint venture between Siemens Medical Solutions and Xintek that develops and manufactures distributed x-ray sources for a broad range of applications including diagnostic medical imaging, homeland security and industrial inspection.

Xintek, Inc.

Xintek develops nanomaterial-based field emission technologies and products for a broad range of industries such as x-ray imaging, information display, telecommunication, aerospace and oil detection. Xintek's major products include: carbon nanotube (CNT)-based field emission electron source, field emission grade CNT material, field emission x-ray source and CNT AFM probes.

ZeroPoint Dynamics

ZeroPoint Dynamics develops computer and network security products. Their cybersecurity products rapidly analyze e-mail, documents and web content to prevent data breaches and loss.

At-A-Glance Roadmap Recommendations

■ *Recommendation 1*

Prepare faculty, graduate and undergraduate students, staff and the broader Carolina community with the knowledge, skills and connections necessary to translate new ideas into innovations.

■ *Goal 1.1: Ensure that faculty, students, staff and the broader Carolina community understand the University's commitment to innovation and the resources available to help them reach their related goals.*

■ *Goal 1.2 Learn the skills of innovation and entrepreneurship.*

■ *Recommendation 2*

Collaborate with diverse groups internally and externally to explore issues, options and creative approaches that may lead to innovations.

■ *Goal 2.1: Enhance robust interdisciplinary collaboration among physical and social scientists, humanistic scholars and those in hybrid disciplines, such as bioengineering and applied sciences, to address the great challenges of our times.*

■ *Goal 2.2: Collaborate and coordinate around key themes of local, national and global significance to mobilize the University toward new understanding of issues and solutions.*

■ *Goal 2.3: Improve industry collaborations and increase industry funding.*

■ *Goal 2.4: Extend collaborations with state and regional partners to help North Carolina further develop into a leading competitive, global, entrepreneurial, knowledge and innovation economy.*

■ *Goal 2.5: Strengthen collaborations with Carolina's strategic international partners.*

■ *Recommendation 3*

Translate important ideas more expediently and at an increased volume into innovations that improve society.

■ *Goal 3.1: Support faculty, students and staff as they develop understanding of issues and contribute solutions to complex social and environmental problems through social entrepreneurship.*

■ *Goal 3.2: Effectively organize and manage the University's commercialization services to maximize the quality and volume of potentially important innovations for society. Return revenue from these innovations to the University to support this work.*

■ *Goal 3.3: Measure the impact of innovations and innovators launched at Carolina.*

■ *Recommendation 4*

Align people, incentives, resources and processes to strengthen an intentional culture of innovation at Carolina.

■ *Goal 4.1: Encourage leaders from across the University to support and promote innovation in their schools, departments, institutes, and offices.*

■ *Goal 4.2 Recruit, retain and reward faculty, students and staff who show promise, aptitude and/or achievement in innovation.*

■ *Goal 4.3 Align the University's internal methods and processes to foster innovation, especially in working across schools.*

■ *Goal 4.4: Provide the necessary funds to support nascent and promising innovations on campus.*

■ *Recommendation 5*

Catalyze innovation at Carolina by facilitating the work of faculty, staff and students as they put important ideas to use for the public good.

■ *Goal 5.1: Leverage the talents of leaders across campus to prepare, collaborate, translate and align resources and processes to strengthen an intentional culture of innovation at Carolina.*

■ *Goal 5.2: Create the Chancellor's Catalyze Group to facilitate the implementation of this Roadmap.*

"We are developing and inspiring the next generation of innovators and entrepreneurs who will create new jobs and fields of endeavor that capture imaginations, create new opportunities and help change our state, nation and world."

- Carol L. Folt
Chancellor
The University of North Carolina at Chapel Hill