

SOUTH CAROLINA

Transformation

2016/2017 ANNUAL REPORT



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MISSION: *The South Carolina SmartState® Program serves the public interest by creating incentives for the state's research universities, in cooperation with other institutions of higher education in the state, to raise capital from non-state sources to fund endowments for specialized research professorships. These professorships in turn serve as the nucleus for unique, university based research centers which cultivate critical, public-private industrial partnerships, expand the state's knowledge base, create well-paying jobs, enhance economic opportunities, and improve the quality of life for the people of South Carolina.*



WELCOME FROM THE SmartState Review Board

The SmartState Review Board consists of eleven members who serve three-year terms. Three are appointed by the Governor, three are appointed by the President Pro Tempore of the Senate, three are appointed by the Speaker of the House of Representatives, one by the Senate Finance Committee, and one by the Chairperson of the House Ways and Means Committee. The Review Board oversees operations of the SmartState® Program. The presidents of South Carolina's three research universities serve as ex officio, non-voting members.



KAROLY "CHARLES" KEREKES
VICE CHAIR
Appointed by the Governor

To My Fellow South Carolinians,

It is with pleasure that the SmartState Review Board shares the program's 2016-2017 annual report, Transforming South Carolina. This report showcases the progress this novel program has made in transforming South Carolina's economy through research centers of excellence and the world-renowned scientists, engineers, and educators who serve as SmartState Endowed Chairs. Currently, 71 of the 85 approved endowed chairs are filled.

The report features profiles of six SmartState Endowed Chairs who are working to transform our state in the areas of automotive manufacturing, energy, health informatics, cancer drug discovery, cancer health disparities, and neurotherapeutics. These are areas important not just to South Carolina, but to our nation and the world at large. I personally enjoy the profiles as they provide a personal glimpse into the chairs' labs and lives. It's enlightening and enjoyable!

I'm also pleased to report that South Carolina State University (SCSU) now has its first SmartState Endowed Chair, Dr. Marvella Ford, an expert in health disparities. Dr. Ford serves on the faculty of both the Medical University of South

Carolina (MUSC) and SCSU. Dr. Ford and her colleagues at MUSC and SCSU were recently awarded \$12.6 million in federal grants for prostate cancer disparities research, education and community outreach. The goal is to transform the health of men who currently experience poor outcomes from this all-too-common cancer.

Lastly, I would like to thank the vision of South Carolina's General Assembly for creating the SmartState® Program, the many businesses and private foundations that have invested in endowed chairs and centers, the universities for fulfilling the promise, and the many community advocates who have tirelessly supported this very worthy program. The SmartState® Program has played a major role in transforming our state.

KAROLY "CHARLES" KEREKES, VICE CHAIR
SmartState Review Board
Appointed by the Governor



JASON P. PREMO
CHAIR
Appointed by the Governor



CHARLES W. GARNETT
Appointed by the Governor



LISA D. MAIN
*Appointed by the Speaker,
House of Representatives*



ROBERT W. PEARCE, JR.
*Appointed by the Speaker,
House of Representatives*



REGAN VOIT
*Appointed by the Chairman,
Senate Finance Committee*



MELVIN C. WILLIAMS
*Appointed by the President
Pro Tempore, Senate*



ROBERTA BANKHEAD WOOD
*Appointed by the Chairman,
House Ways & Means Committee*

SOUTH CAROLINA'S Research Universities

The SmartState® Program funds Centers of Economic Excellence at South Carolina's three senior research universities: Clemson University, the Medical University of South Carolina (MUSC), and the University of South Carolina (USC). Other state universities such as South Carolina State University and the College of Charleston are included as collaborative research partners.

In 2002, members of the South Carolina General Assembly recognized the critical role research universities have in advancing innovation, creating economic and educational opportunities, and improving overall quality of life for the state's citizens when it acted by the enabling legislation of the SmartState® Program. Today, other states look to South Carolina's SmartState® Program as the model for university-based public-private partnerships that foster innovation, launch companies and create jobs.

Ranked #23 among national public universities, **Clemson** is a major land grant, science- and engineering-oriented research university that is an inclusive, student-centered community characterized by high academic standards, a culture of collaboration, school spirit, and a competitive drive to excel. With agricultural and forestry research centers and innovation campuses located from Greenville to Charleston, and a presence in every county, Clemson's campus is truly the entire state of South Carolina. This year, Clemson was classified among universities with the highest level of research activity by the Carnegie Classification for Institutions of Higher Education.

Clemson has launched a new strategic plan, **ClemsonForward**, which emphasizes high-impact engagement opportunities to prepare students for a knowledge-based global economy, and growing research and doctoral education to help find solutions to real world problems. The plan also supports economic development and creates jobs, enhances quality of life and builds the university's national academic reputation. The plan identifies six innovation clusters to support development of multi-disciplinary teams and large research projects: Health Innovation, Sustainable Environment, Human Resilience, Big Data Science, Complex Engineered Systems, and Advanced Materials.

MUSC has served the citizens of our state since 1824. MUSC has expanded from a small, private college to a comprehensive academic health sciences center, with more than 1,700 faculty members educating and training more

than 3,000 students, residents, and biomedical scientists in six colleges (Dental Medicine, Graduate Studies, Health Professions, Medicine, Nursing, and Pharmacy). As the largest non-federal employer in Charleston, the university and its affiliates have collective annual budgets in excess of \$2.3 billion, with an annual economic impact of more than \$3.8 billion and research funding in excess of \$250 million annually. MUSC Health operates one of the state's largest and most innovative health systems, which includes a nationally recognized Children's Hospital, the Ashley River Tower (cardiovascular, digestive disease, and surgical oncology), Hollings Cancer Center (a National Cancer Institute-designated center), Level I Trauma Center, Institute of Psychiatry, and the state's only transplant center.

Since opening in 1805 with an initial enrollment of nine students, the University of South Carolina (USC) has grown its student body to more than 50,000 across eight campuses statewide. USC, the fourth fastest growing flagship university in the nation boasts 47 nationally ranked programs by *U.S. News & World Report*. The main campus in Columbia offers more than 300 degree programs through its 14 colleges and schools, which include the Darla Moore School of Business, the School of Law, the Arnold School of Public Health, and the nation's top-ranked public university honors college. USC is also one of only 32 public universities to receive the top-tier research designation and the top-tier community engagement designation from the Carnegie Foundation. As a leader in health sciences, USC offers the most comprehensive suite of health science academic programs (100) in South Carolina, including medical schools in Columbia and Greenville. That diversity of offerings allows for expansive research opportunities as well as exemplary student experiences, which have made the South Carolina the state's top global university. The university's strength in leading-edge research has led to recent public/private partnerships with Fortune 500 companies like Fluor, IBM, Siemens and Boeing. And, USC's 19 locations and its alumni throughout South Carolina pump \$5.5 billion into the state's economy annually, making Carolina an indispensable contributor to the state's prosperity. ●



"The SmartState® Program truly represents the power of public-private partnerships to make a positive difference for the State of South Carolina. It also continues to have a tremendous impact on Clemson University and our ability to recruit and retain top faculty and students, which ultimately makes the university and state more attractive to industry partners"

JAMES P. CLEMENTS, Ph.D.
President
Clemson University



"Fifteen years after the inception of South Carolina's SmartState® Program, is a stellar example of what's needed to transform and grow our state through the establishment of a knowledge-based economy. This aligns with MUSC's vision, to lead health innovation for the lives we touch, which embraces collaboration, drives innovation, and ultimately is fueled by the ability to recruit and retain world-class investigators."

DAVID J. COLE, M.D., FACS
President
Medical University of South Carolina



"The SmartState® Program was established with high expectations of transforming the quality of life in our state through innovation, collaboration and workforce preparation. In the past year alone, USC hired three additional world-renown SmartState chairs. Today, our students work side-by-side with these outstanding professors. Tomorrow, these students will be South Carolina's most sought after employees and will continue to transform and shape the Palmetto State's knowledge-based economy."

HARRIS PASTIDES, Ph.D.
President
University of South Carolina



GUEST PROFILE

Every Transformation Begins with an Idea

As a child growing up in Savannah, Georgia, Sam Tenenbaum appreciated the power of knowledge. By the third grade, he'd read the entire encyclopedia. A graduate of Emory University, he was pursuing a master's degree at the University of Minnesota when he was called home by his mother's illness. The family business brought him to Columbia, S.C. in the 1960s. His opportunistic mind came with him.

Tenenbaum smiles at the memory. "Throughout my life, when my brain pops out wild ideas, I go with them."

In the late 1990s, South Carolina was in an economic slump due to the collapse of the U.S. textile industry. The state was debating whether or not to start a state lottery to fund public education. Tenenbaum liked the idea and began to build support and debate naysayers. In the end, the General Assembly established the South Carolina Education Lottery.

Fresh off that success, Tenenbaum came up with an innovative idea. "I went to (then) University of South Carolina (USC) President John Palms and made the argument that the only way to recruit the best professors to our universities was through endowed chairs. An endowment funded by the South Carolina Education Lottery would pay for research-oriented chairs and lower university operating costs. President Palms loved it."

Although the Medical University of South Carolina (MUSC) did not have any state lottery funds allocated to graduate education, this did not prevent Tenenbaum from discussing his endowed chairs idea with their leadership. MUSC also loved the idea of endowed chairs. Tenenbaum knew then he had a great idea.

Tenenbaum talked to Governor Jim Hodges, state legislators, business people, and many others. He referenced a similar program in Kentucky, Bucks for Brains Endowment Match Program, funded by their state government to encourage research and strengthen key programs at their universities. Tenenbaum wanted South Carolina to contribute \$30 million to fund endowed chairs at the three research universities. By this time, he'd succeeded in getting Clemson University President Jim Barker, MUSC President Ray Greenberg and USC President Andrew Sorensen onboard.

To make the offer more attractive, Tenenbaum suggested the universities ask corporations to match every dollar invested by the state to double the total investment in research chairs

to \$60 million. This became an integral part of the SmartState® Program.

The General Assembly passed legislation in 2002 to use South Carolina Education Lottery funds to create Centers of Economic Excellence—today's SmartState® Program—in research areas that would advance the state's economy.

Even with this victory Tenenbaum continued pursuing support for the program. He made a trip to the Upstate to call on Bobby Hitt at BMW. (Hitt is now S.C. Secretary of Commerce.) BMW became the first SmartState corporate partner, investing \$10 million dollars in two endowed chairs at Clemson. These global experts in automotive manufacturing and systems integration became the nucleus of CU-ICAR, Clemson's international center for automotive research, which to date has attracted \$250 million in capital investment and made South Carolina a leader in the global automotive industry.

Since then, the SmartState® Program has created 85 endowed chairs, attracted corporate sponsors that include AT&T Foundation, BASF, Fluor, and Michelin North America; and generated a total return on investment of \$2.4 billion. Not bad for a wild idea!

As the SmartState® Program enters its fifteenth year, Tenenbaum remains one of its biggest supporters. On his frequent trips to Washington D.C., he makes a point of taking the annual report to Senator Lindsey Graham with the idea of establishing a version of the SmartState® Program called "SmartNation" to ensure America's global competitiveness. Back in South Carolina, he's pushing an idea to establish an international innovation center at USC with Israel.

Asked what keeps the ideas flowing, the man who earned the nickname "Tenaciousbaum" shares his philosophy. "If I am not for myself, who will be for me? If I am not for others, what am I? And if not now, when?" ●



SAM TENENBAUM

President, Palmetto Health Foundation
South Carolina Visionary and Activist

SMARTSTATE PROFILE

Dr. Johan Enslin



Dr. Johan Enslin's reputation as a renewable energy expert is the result of a 35-year career that includes leadership positions at more than 90 power utilities, governments, corporations, and universities in the United States, Europe, Asia, and South Africa. In addition to his SmartState Chair, Enslin is the founding executive of the Energy Systems Program at the Zucker Family Graduate Education Center and a professor in SmartGrid at Clemson University's campus in North Charleston. He holds more than 25 provisional and final patents related to power grid technology.

A month after Hurricane Maria devastated Puerto Rico, 80 percent of the island's residents were still without power. It was not for a lack of relief efforts. Puerto Rico's energy grid was in disrepair before the hurricane and required a total re-build.

Dr. Johan Enslin warns that Puerto Rico's plight is not unique; most of the world's power grids are vulnerable to severe weather and something even more insidious: cyber attacks. Diversification in power generation, greater resilience of power grids, and better control and storage technology are needed to secure power delivery and availability.

Enslin is an expert in power system planning, power electronics, and the integration of large-scale solar and wind power to the electric grid. In August 2016, he was named the Duke Energy Smart Grid Chair for Clemson University, charged with leading the development and growth of research and education initiatives in emerging electric grid technologies. His research is focused mainly in the area of building smarter, modern power grids. He also is evaluating the role and optimization of energy storage technologies in grid modernization. Priority is given to technologies and approaches that support large-scale renewable energy integration and improve energy efficiency that demonstrates positive business cases.

Enslin's research builds upon Clemson's unique facilities at the Clemson University Restoration Institute in North Charleston, which include a wind-turbine drivetrain testing and research facility and the Duke Energy eGRID grid emulation facility. These two facilities form the cornerstone of the SCE&G Energy Innovation Center and are the largest such facilities in the world, representing more than \$110 million in public and private investment.

With these resources, Clemson stands poised to transform not just South Carolina's energy industry, but the global industry at large as companies and nations seek to increase the use of sustainable energy, integrate multiple generation sources

into newer, more advanced grids, and secure these grids from disasters. Energy security is a huge task; Enslin is a realist.

"States, nations, and companies can no longer rely on one source of power generation; it's too risky. The answer is to diversify—wind, solar, hydro, coal, natural gas, nuclear. Diversity is also critical because solar and wind generate power intermittently, while demand is constant. Renewable energy sources are not as easy to integrate into power grids and require costly energy storage," he explains.

Enslin also advocates a move to smaller, distributed generators, a notion that runs counter to traditional thinking that relies on power plants. Not only are these large generators risky when they fail, they need extensive power grids and force markets to subscribe to them over a long time rather than meeting market demands. Lastly, generators should be located closer to customers where power is needed, improving system resiliency.

"Power generation needs to be nimble and distributed," Enslin says. "If there is an issue such as a hurricane, the entire grid does not collapse. Life and businesses can continue."

Enslin is also leading the growth of Clemson's graduate research and education programs at the Zucker Family Graduate Education Center, located at Clemson's North Charleston site. The program includes master's and doctoral degrees in areas that include computer science, electrical engineering, materials science, and mechanical engineering. All courses are online enabling Clemson to attract students from around the world. The programs are attracting industry working professionals as well as traditional full-time students. There are plans to hire a dozen new faculty members for the new power program over the next few years.

"Getting master's and Ph.D. degrees may be very expensive; our approach is flexible and affordable and will attract more energy industry professionals to South Carolina," Enslin says. ●



JOHAN ENSLIN, PH.D.

Duke Energy Smart Grid Chair
SmartState Center for Smart Grid Technology

SMARTSTATE PROFILE

Dr. Mitzi Nagarkatti



Since joining the University of South Carolina in 2005, Dr. Mitzi Nagarkatti has secured more than \$45 million in grants from the National Institutes of Health (NIH) and the Veterans Administration in areas that include cancer immunology and immunotherapy, inflammation, immunopharmacology, and complementary and alternative medicine. She was recently awarded a \$10 million NIH COBRE grant to study dietary supplements and inflammation, creating new jobs for junior faculty.

Since an early age, Dr. Mitzi Nagarkatti has felt a driving ambition to do something to benefit humanity and treat and prevent disease. As the University of South Carolina (USC) SmartState Chair in Cancer Drug Discovery with far-ranging research interests and a lab humming with nearly 25 researchers, she is busy achieving her life goals.

Nagarkatti's research is focused on the underlying mechanisms of inflammation and how the immune system responds. Inflammation is the body's attempt to protect itself and remove harmful stimuli and begin the healing process. Infections, wounds, and other damage to tissue would not heal without an inflammatory response. The problem lies when inflammation becomes chronic, a condition that can turn colitis into colon cancer or hepatitis into liver cancer.

Her challenge, says Nagarkatti, is to find drugs that lead to an anti-inflammatory response. Today, patients have few options as drugs currently on the market have side effects toxic to the cardiovascular and gastrointestinal systems. As her drug discovery efforts are focused on plant-based products, the

USC has purchased a library of 800 plant-based products, which Nagarkatti is testing for anti-inflammatory and anti-cancer properties.

"Some of the most common drugs are plant based," explains Nagarkatti. "Aspirin, made from willow tree leaves, has been used to treat pain and inflammation for at least 2,400 years. A more recent example is Taxol, an anti-cancer drug made from the bark of yew trees. Plants offer great opportunities."

Among her interests is the French paradox: how is it that the French eat red meat, butter their baguettes, drink

red wine, and don't have an issue with heart disease? The answer is a plant compound called resveratrol with high antioxidant properties that is found in grapes and red wine. Would this same compound soothe colitis and reduce the risk of colon cancer?

Nagarkatti says the next colon cancer drug might also be found in broccoli, Brussels sprouts, cabbage, and kale. While it would be next to impossible to eat enough of these cruciferous cancer fighters to make a difference, a pharmacological dose derived from them would have the desired anti-inflammatory effect.

But don't expect a broccoli pill anytime soon. Nagarkatti explains researchers must first look at epigenetic mechanisms that underlie cancer development and determine how to impact them with foods. The answers to an individual's response to specific drugs and diseases lie outside of genes but within DNA.

Answers may also reside in an individual's stomach where billions of bacteria, called microbiome, reside. Microbiome are sometimes called a person's genetic footprint since they help determine DNA, hereditary factors and predisposition to diseases, including cancer. Nagarkatti and her team are working on sequencing microbiome, which will ultimately play an important role in precision medicine and drug discovery.

Nagarkatti credits the SmartState® Program for helping her realize her dream of helping others. "It is a wonderful opportunity to lead translational research studies, to attract research funding to South Carolina, train the next generation of researchers, and commercialize new drugs." ●



MITZI NAGARKATTI, PH.D.

SmartState Chair in Cancer Drug Discovery
SmartState Center for Cancer Drug Discovery

SMARTSTATE® PROGRAM: Return on Investment

The primary mission of the SmartState® Program is to elevate the state's knowledge economy by generating high-skilled, high-wage jobs in South Carolina.

The SmartState® Program's established research centers help elevate the state's knowledge economy by creating public-private partnerships, supporting start-up firms, and helping to retain highly skilled workers. Each of these efforts results in the creation of jobs that are among the highest paid in South Carolina.

Following the 2008 recession, geographic regions with the highest rates of economic growth have typically had higher shares of their workforce employed in the knowledge economy. The skills associated with these jobs often include more advanced training in the fields of mathematics and science, complex problem solving, and creative and technological innovation. The commercialization of new technologies leads to economic growth and significant knowledge spillover effects.

As of 2017, the SmartState® Program is responsible for helping to create and support approximately 13,923 jobs in South Carolina, which are associated with \$2.8 billion in economic activity and \$755 million in labor income for South Carolinians that would not exist otherwise. Approximately 5,052 of these positions are knowledge economy jobs created directly through the SmartState® Program, with the 8,871 arising from additional spending activity generated through the economic multiplier effect.

The specific employment multiplier associated with these estimates is 2.5—for every ten knowledge economy jobs created through the SmartState® Program, an additional 15 jobs are created elsewhere in South Carolina. This multiplier effect is larger than the state average. Each new job created through the SmartState® Program increased total South Carolina employment by more than it would if that job had been created in another industry of comparable size.


The average annual salary associated with a SmartState job is \$74,815, roughly 82 percent higher than the average annual salary among all jobs in South Carolina. When examining the salaries of all jobs associated with the SmartState® Program, including those created through the economic multiplier effect, the average annual salary is estimated at \$53,610. This dollar amount is approximately 34 percent higher than the average annual salary among all South Carolina jobs. ●

“One of the driving forces behind regions in the United States that have experienced high-wage job creation in the 21st century is the presence of a strong and vibrant knowledge economy. Since 2002, the SmartState® Program has helped facilitate the development of South Carolina's knowledge economy, and in the process, has generated nearly 14,000 jobs with annual salaries that pay significantly above the state average. As of 2017, the SmartState® Program is responsible for helping to create and support approximately 13,923 jobs in South Carolina, which is associated with nearly \$2.8 billion in economic activity and \$755 million in labor income for South Carolinians that would not exist otherwise.”

DR. JOSEPH VON NESSEN

Research Economist
Darla Moore School of Business,
University of South Carolina

3



Research Universities
Clemson, MUSC, USC

6



Industry Clusters¹

51



SmartState® Centers of
Economic Excellence

71



SmartState Endowed
Chairs appointed
(of the 85 created)

\$197.6_M


State Funds Invested²

\$2.8_B


Return on Investment³

13,923



Total Employment (All jobs)³

\$74,815



Average Salary of a Knowledge Economy Job³

79



Start-ups and Corporate Relocations⁴

¹ Industry-focused research is conducted in six areas of global importance: Advanced Materials and Nanotechnology, Automotive and Transportation, Biomedical, Energy, Information Science, and Pharmaceutical.

² Includes \$180 million from the State Education Lottery appropriations and \$17.6 million accrued interest from SmartState® Program endowment.

³ The figures reported are from the November 2017 Economic Impact of the SmartState® Program analysis conducted by the Darla Moore School of Business. Of the total 13,923 jobs, 5,052 are knowledge economy jobs created directly through the SmartState® Program, including 624 SmartState personnel, 1,287 start-up company and corporate relocation personnel, 30 alumni placed with in-state employers, and 3,141 employed through Extramural Research Funding. The remaining 8,871 jobs are indirect employment arising from the economic multiplier effect. For more information about the return on investment, see page 12.

⁴ See page 14 for a listing of investors, start-ups and corporate relocations.

Investors, Start-ups, and Corporate Relocations in SC

CORPORATE AND ORGANIZATIONAL INVESTORS

More than three dozen companies have invested \$500,000 or more in the SmartState® Program.

- Abney Foundation
- BASF
- Bank of America Foundation
- Biomass Gas & Electric
- BlueCross BlueShield Foundation of SC
- BMW
- Comporium Group
- Daniel Island Company
- Dialysis Clinics, Inc.
- Duke Energy Foundation
- Electric Cooperatives of South Carolina
- Fluor Corporation
- Force Protection Industries
- General Atomics
- George B. Sibert Annuity
- GlaxoSmithKline
- Greenville Hospital System
- Health Sciences South Carolina
- J.E. Sirrine Foundation
- Kellogg Foundation
- Kentwool
- Michelin
- Okuma
- Palmetto Health
- PalmettoNet
- Research to Prevent Blindness
- Robert Wood Johnson Foundation
- Samuel Freeman / Donaldson Charitable Trust
- Santee Cooper
- Smith & Nephew
- Spartanburg Regional Healthcare System
- The Duke Endowment
- The Spaulding Paolozzi Foundation
- Timken
- Toyota
- Volvo
- Westinghouse
- ZF

START-UP COMPANIES

Start-up companies founded as a result of research at USC, MUSC, and Clemson University:

- Advanced Photonic Crystals
- Career Care Solutions
- Cephos
- Cicadia
- Clinacuity
- Closing the Gap in Healthcare, Inc.
- Coastal Focus Market
- DF Werke, LLC
- Doxy.me
- eCom
- Fibro Therapeutics, Inc.
- First String Research
- GeoMat, LLC
- Hydrogen Hybrid Mobility, LLC
- ImmoMod, Inc.
- Inquisatex Epitherapeutics, LLC
- IntrusinMyFamily.com
- MagAssemble, LLC
- MicroVide
- MitoChem Therapeutics, LLC
- MitoHealth
- Neuroene Therapeutics
- NextGenEn
- NXT
- Oncology Analytics
- Palmetto Fuel Cell Technologies, LLC
- Parallel Permeation, Inc.
- Patient Guided Health Solutions, LLC
- Perfect Mixing, LLC
- Protara, LLC
- SAGE Energy Solutions
- Schnellgen, Inc.
- SemiAllogen, Inc
- SimTunes, LLC
- Smart Innovations, LLC
- South Carolina Science Solutions, LLC
- Specialty & Custom Fibers, Inc.
- Tetramer Technologies
- Vortex Biotechnology
- Zeriscope, Inc.
- 52 Inc.

CORPORATE RELOCATIONS

Companies that have relocated to South Carolina to benefit from the expertise, resources, and graduates in the SmartState® Program:

- American Titanium Works (ATW) Manufacturing
- American Titanium Works (ATW) Technology Center
- BMW Information Technology Research Center (ITRC)
- CADFEM U.S.*
- Charge2Target
- CleanEnergy
- COE Optics
- Computech*
- Cooliemon Technologies*
- DreamWeaver*
- EHD Tech
- Environment and Health Inc. (EHG)
- Esys Automation
- Fields Group, LLC.*
- Focus Chemicals*
- FSI - Advanced Research
- Greenway Energy, LLC
- In-tech
- Innoventure
- IndySoft
- Intec U.S. Inc.
- International Mold Co.
- JTEKT Technology Center
- Mallet Technology*
- Michelin
- Michelin Incubator
- Mumford Industries*
- OmniSource
- Proterra, Inc.
- Roding*
- Sage Automotive Interiors*
- SCRA
- Senex Biotechnonology, Inc.
- Simpack, Inc.
- ThermoPur Technologies*
- Tigges*
- Toho Tenax*
- Trulite

* In May 2012, CU-ICAR (Clemson University International Center for Automotive Research) opened the doors to the Center for Emerging Technologies (CET) facility, its first multi-tenant building. CET provides office, administrative, and laboratory space for transportation, technology, and energy sectors. These companies have positioned themselves on the CU-ICAR campus to be close to the SmartState Endowed Chairs and their research teams.

Ten SC Universities and Colleges Receive Record \$20 Million Grant to Enhance Advanced Materials and Manufacturing Research

The SmartState® Program will be well represented by the three top research universities and SmartState Endowed Chairs.

In September, the National Science Foundation (NSF) made its highest ever sponsored award to South Carolina institutions of higher learning, presenting a \$20 million, five-year grant to a statewide consortium of advanced materials researchers and educators. The grant, from the NSF's Established Program to Stimulate Competitive Research (EPSCoR), will establish a new initiative called Materials Assembly and Design Excellence in South Carolina, or MADE in SC.

This unique collaboration unites 10 South Carolina institutions of higher education to lead the way in advanced materials research and development, build capacity of existing South Carolina industries and attract new companies. Dr. Prakash Nagarkatti, University of South Carolina Vice President for Research, is serving as the principal investigator and project director on the award. MADE in SC partners include:

- Claflin University
- Clemson University
- College of Charleston
- Florence-Darlington Technical College
- Furman University
- Medical University of South Carolina
- South Carolina State University
- University of South Carolina
- USC Beaufort
- Winthrop University

The MADE in SC consortium will engage in advanced materials research and development (R&D), create a pipeline of highly trained workers to enter South Carolina's advanced manufacturing industry and increase the capacity for economic growth and vitality in the state.

The R&D component will focus on materials discovery and optimization with researchers concentrating on three types of high demand materials: optical and magnetic materials, stimuli-responsive polymers and interactive biomaterials. This effort will be bolstered by recruitment of 17 new research faculty members in key roles at Clemson, MUSC, USC, USC Beaufort and SCSU. The grant will enable investment in new research infrastructure at these institutions that will be available to students and faculty researchers from all South Carolina colleges and universities.

The workforce development portion of the award involves development of new undergraduate degree programs at USC Beaufort and the College of Charleston, and expanded curricula at Claflin, Furman, Winthrop, and USC to create a new pipeline of highly skilled workers from colleges and universities to industry. The grant also provides funding for summer programs to train high school teachers to better prepare students for a future in advanced materials and manufacturing. ●

SmartState Endowed Chairs Participating in the MADE in SC Grant

DR. BRIAN BENICEWICZ, USC

SmartState Center for Polymer Nanocomposites

DR. WOLFGANG DAHMEN, USC

SmartState Center for Data Analysis, Simulation, Imaging and Visualization

DR. STEPHEN A. DUNCAN, MUSC

SmartState Center for Regenerative Medicine

DR. BRUCE GAO, CLEMSON

SmartState Center for Advanced Tissue Biofabrication

DR. JOCHEN LAUTERBACH, USC

SmartState Center for Strategic Approach to the Generation of Electricity

DR. MAREK URBAN, CLEMSON

SmartState Center for Advanced Fiber-Based Materials

"Advanced materials are crucial to industry in every corner of South Carolina. Growing our talent pipeline, and ramping up our ability to invent new components that will help companies create faster, lighter, more durable products that consumers want is smart business. By building capacity in a network of ten colleges and universities throughout South Carolina, our communities will become even more attractive to businesses looking for a new location with sustainable growth potential."

BOBBY HITT

Secretary

South Carolina Department of Commerce

SMARTSTATE PROFILE

Dr. Marvella Ford



Founded in 1896, South Carolina State University (SCSU) has played a key role in the education of African-Americans in the state and nation. With Dr. Marvella Ford's appointment as the SmartState Chair in Cancer Disparities, SCSU's first endowed chair; and the award of a \$6.2 million grant from the National Institutes of Health—the Medical University of South Carolina received \$6.3 million as part of the same grant—SCSU is poised to become a national leader in cancer health disparities research and transformer of health in the black community. The prospect makes Ford very proud.

Dr. Marvella Ford never knew her grandparents; all four had passed before she was born. When she asked about their deaths, her parents had no answers. "The Depression was very difficult for rural African-Americans. If you had a doctor, communications weren't great. African-American families often didn't know why loved ones died," explains Ford.

By her 40th birthday, Ford had lost both parents to heart disease. She was diagnosed with breast cancer twice. Rather than be defeated, Ford took these experiences as a challenge, saying, "I can't change the past, but I can change the future."

Recognized as an expert in health disparities and cancer prevention research, in July 2017 Ford was named the SmartState Endowed Chair in Cancer Disparities at South Carolina State University. She is the first endowed chair in the historically black university's history. Ford retained her faculty appointment at the Medical University of South Carolina (MUSC), where she also serves as associate director of population sciences and cancer disparities at the Hollings Cancer Center.

Ford sees her new role as an honor and opportunity to lead research that addresses prostate cancer disparities in South Carolina, where African-American men are three times more likely to die from this disease compared to their white counterparts. "These disparities likely include social, economic and biological factors. I will be developing and testing interventions, based on these factors, to improve prostate cancer outcomes for African-American men."

Ford began collaborating with SCSU in 2010, when she and Dr.

Judith Salley-Guydon, chair of SCSU's Department of Biological and Physical Sciences, submitted a proposal to create the South Carolina Cancer Disparities and Research Center (SC CaDRe) to facilitate collaboration between SCSU, MUSC and the University of South Carolina. The proposal received funding in 2011. Other federal funding has since been received by MUSC, in collaboration with SCSU and two other South Carolina historically black colleges, Claflin University and Voorhees College.

In late September 2017, the National Institutes of Health/National Cancer Institute awarded additional funds for SC CaDRe: a \$6.3 million grant to MUSC and a \$6.3 million grant to SCSU. The new grants will support three cores focused on addressing prostate cancer disparities: research and education, planning and evaluation, and community outreach. The SC CaDRe is now recruiting participants from the Hollings Cancer Center and Mabry Cancer Center at the Regional Medical Center in Orangeburg for three research and pilot programs looking at novel prostate cancer interventions that include exercise and drugs.

With her new chair, Ford believes she is well positioned to transform South Carolina. "The SmartState® Program is all about changing the present and the future. Our work will impact generations to come. I want families to enjoy each other longer."

Since her recruitment to MUSC in 2005, Ford has been awarded more than \$27.5 million in grants from the National Cancer Institute, National Institute on Minority Health and Health Disparities, Department of Defense, and Centers for Disease Control and Prevention. ●



MARVELLA FORD, PH.D.

SmartState Chair in Cancer Disparities
SmartState Center for Prostate Cancer Disparities

SMARTSTATE PROFILE

Dr. Laine Mears



Advanced manufacturing is one of the anchors of South Carolina's economy, the source of high-paying careers. Keeping up with the demand for employees with the knowledge required by today's manufacturing environments is one of the issues being addressed by Dr. Laine Mears, the BMW Endowed Chair in Automotive Manufacturing at Clemson University. With more than ten years of experience in the global automotive industry, Mears is an expert in how manufacturers use sensors and the tremendous amount of data generated to optimize operations, including how robots and people interact. He is working closely with BMW and other South Carolina Manufacturers to solve current and future challenges, including educating the workforce of the future.

Since being named the BMW SmartState Chair in Advanced Manufacturing in 2016, Dr. Laine Mears has operated under the mantra to "think big." He points to former Governor Carroll Campbell, BMW, and Clemson University whose big idea led to the creation of CU-ICAR, Clemson's internationally recognized automotive research campus, as his inspiration. Says Mears, "If you're not thinking big, go back to your office. You can spend as much time on a small project as you can on a big idea that can change the world. And that's what we're doing at Clemson, thinking big!"

Mears certainly has the opportunity to change the world thanks to the support of BMW, a global automotive leader known for cutting edge technology. He is in talks with BMW Global on a number of projects and routinely meets with BMW leaders of manufacturing and engineering on collaborative projects, some involving rapid response solutions to issues on BMW's production floor and others involving multi-year, ongoing research. Mears credits his position as an endowed chair for the opportunity to impact the global automotive industry. "The SmartState® Program has opened doors for Clemson, our students and myself."

Among the issues Mears is addressing for BMW is the balance of automation and people. The trend in manufacturing is to replace people with robots to improve efficiency and create foolproof processes. But as robots appear on the factory floor, employees can become unsure about their jobs. Mears says people remain very important in manufacturing. For example, experienced industrial maintenance workers can diagnose problems with a machine based on sounds or vibrations. "This knowledge is not easily replaced with a sensor and artificial intelligence is still far from what an experienced technician can achieve," says Mears.

BMW is now looking at collaborative robotics where humans and robots work side by side. This requires workers with higher cognitive skills such as problem solving and decision-making as well as experience in data analysis. Such skills are needed among workers programming robots as well as those in industrial maintenance.

According to Mears, this shift in workforce requirements has created huge opportunities for people with the right skills and led to a shortage of workers. He says that by 2025 the United States will lack the workforce to fill two million open manufacturing jobs. However, attracting students to manufacturing is challenging, largely because they are not aware of the sophistication of today's plants and the high salary potential. To counter this, Mears is overseeing a new program between Clemson and the Greenville Tech Center for Manufacturing Innovation (CMI).

"What we're doing is setting up a prototype vehicle manufacturing line at Greenville Tech that teams Clemson researchers with technical college students. As we develop new manufacturing processes, we will vet them with the Tech students. Once our innovations are proven, they become part of the curriculum, which prepares students for high-tech careers in manufacturing."

The program is a win for everyone, Mears says. "The CMI Advanced Manufacturing Program will graduate 40 students a year, but each manufacturer like BMW may need ten times that. Growing innovative, collaborative education programs like this will help South Carolina meet companies' demands for workers with the technical knowledge required of advanced manufacturing. I thank the SmartState® Program for driving big ideas like this into success stories." ●



LAINE MEARS, PH.D.

BMW Endowed Chair in Automotive Manufacturing
SmartState Center for Automotive Manufacturing

SMARTSTATE® PROGRAM

Centers And Endowed Chairs

The work of South Carolina's SmartState Centers is exciting, groundbreaking, and of critical importance to the state, nation and world. These Centers, which align with industries in South Carolina, help elevate the state's economy and quality of life. What follows is an overview of each Center.

Program totals reported as of November 2017. In cases of joint proposals, Centers awarded by an institution are tallied by the fiscal agent. Endowed chairs are tallied based on the assigned institution. USC's assigned endowed chairs include one joint appointment with MUSC and Clemson. On the pages that follow, information about each SmartState Center includes the date the center was approved, the institution(s) awarded, the state award

amount that must be matched with an equal amount of non-state investment, the appointed endowed chair(s) as of November 2017, reported extramural research funding (federal and private awards) above the match, and a brief description of the research focus. Centers are grouped by industry cluster. For updated information on centers and program totals, contact the S.C. Commission on Higher Education or visit SmartStateSC.org.

51	SmartState® Program Centers Awarded
85	SmartState Endowed Chairs Created
71	SmartState Endowed Chairs Appointed
14	SmartState Endowed Chairs Remaining to be Appointed

		
13	18	20
Awarded	Awarded	Awarded
16	28	41
Created	Created	Created
13	25	33
Appointed	Appointed	Appointed
3	3	8
Remaining	Remaining	Remaining



Advanced Materials & Nanotechnology

ADVANCED FIBER-BASED MATERIALS*

Award Date: 2006

State Award Amount: \$4 million

University: Clemson

Endowed Chair(s):

Dr. Marek Urban
*J.E. Sirrinc Foundation Endowed Chair in
Advanced Fiber-Based Materials*

Corporate Partner(s):

J.E. Sirrinc Textile Foundation

External Funding Above Match:

\$14.7 million

Research Focus: To provide the vehicle for repositioning existing research and manufacturing resources to support new industrial and entrepreneurial opportunities based on advanced polymeric-based materials.

ENVIRONMENTAL NANOSCIENCE AND RISK*

Award Date: 2008

State Award Amount: \$3 million

University: USC

Endowed Chair(s):

Dr. Jamie Lead

External Funding Above Match:

\$4.5 million

Research Focus: Understand the fundamental properties of nanomaterials and nanomaterials-environment interaction and use these principles to understand and help reduce impacts of nanomaterials as used as well as develop and innovate nanotechnological applications.

EXPERIMENTAL NANOSCALE PHYSICS*

Award Date: 2003

State Award Amount: \$4 million

University: USC

Endowed Chair(s):

USC is recruiting one endowed chair.

External Funding Above Match:

\$6 million

Research Focus: Perform basic and applied research of potential spintronic optoelectronic and nanoelectronic devices and/or materials for future applications in information processing, high-speed, high-density electronics, and bio, chemical and radiation sensing.

MULTIFUNCTIONAL MATERIALS & STRUCTURES (MFMS)*

Award Date: 2013

State Award Amount: \$2 million

University: USC

Endowed Chair(s):

Dr. Michel van Tooren

External Funding Above Match:

\$6 million

Research Focus: The development and supply of engineered materials for high technology industries such as aerospace by providing a foundation of research and development that will enable and enhance growth in the engineered materials field. Specific examples of research and development include: Lightning strike and EMF management, structural integrity, energy storage, essential power for commercial aircraft, and multi-physics-based micro/nano mechanics of dielectric materials.

OPTICAL MATERIALS/PHOTONICS*

Award Date: 2004

State Award Amount: \$5 million

University: Clemson

Endowed Chair(s):

Dr. John Ballato
*J. E. Sirrinc Textile Foundation Endowed Chair
in Optical Fiber*

Corporate Partner(s):

J.E. Sirrinc Textile Foundation

External Funding Above Match:

\$24.9 million

Research Focus: Conduct optical and photonic materials research, particularly as relates to advanced optical fibers and fiber-based devices, and recruit and mentor graduate students with a focus on domestic scholars. Identify and foster the latest technologies and initiate partnerships with top national research universities and laboratories, aid South Carolina industry and economic development partners in the transfer of technology from Clemson to the public sector, and participate in the recruitment of optical technology firms to South Carolina.

POLYMER NANOCOMPOSITES*

Award Date: 2004

State Award Amount: \$3.5 million

University: USC

Endowed Chair(s):

Dr. Brian Benicewicz
Materials Science & Engineering

Corporate Partner(s):

Michelin North American, BASF, U.S. Navy, PBI Performance Products

External Funding Above Match:

\$17.3 million

Research Focus: Development of synthetic tools needed to precisely control the environment or interface between nanoparticles and polymer matrix applicable to optics, electronics, biological, medical, and structural material applications.

* Graduated Center

Once a center has reached a point of full operability, the SmartState Review Board has the authority to graduate SmartState centers. A center must meet the requirements in the following key areas to be considered graduated: non-state match; all draw downs; endowed chairs and key personnel; initiatory programmatic activities have been achieved; the most recent annual report cites demonstrable programmatic activity; and match certification. Once a center is graduated, the majority of fiscal and administrative oversight responsibilities are transferred to the center's lead fiscal institution. Certain accountability and reporting obligations are retained by the graduated center.

Automotive & Transportation

AUTOMOTIVE DESIGN AND DEVELOPMENT*

Award Date: 2004

State Award Amount: \$5 million

University: Clemson

Endowed Chair(s):

Dr. Zoran Filipi
Timken Endowed Chair in Automotive Design & Development

Corporate Partner(s):

Hertz Corporation, Duke Energy

External Funding Above Match:

\$10 million

Research Focus: Focuses on the research and design of advanced powertrains for internal combustion engines and hybrid and electric vehicles, along with lightweight design and materials, functional integration and structural dynamics for vehicles.

AUTOMOTIVE MANUFACTURING*

Award Date: 2003

State Award Amount: \$5 million

University: Clemson

Endowed Chair(s):

Dr. Laine Mears
BMW Endowed Chair in Automotive Manufacturing

Corporate Partner(s):

BMW

External Funding Above Match:

\$15.9 million

Research Focus: Seeks to reinvent the vehicle production system through developing processes inspired by car designs (transitioning from Design-for-Manufacturing thinking to Manufacturing-for-Design), and augmenting existing process capital through smarter model-based control and applying energy fields to overcome material limitations. The guiding goals of this research are to improve productivity, reduce downtime, enhance quality, and more effectively integrate the human to the emerging digital information network.

AUTOMOTIVE SYSTEMS INTEGRATION*

Award Date: 2003

State Award Amount: \$5 million

University: Clemson

Endowed Chair(s):

Dr. Christiaan Paredis, Clemson
BMW Endowed Chair in Automotive Systems Integration

Corporate Partner(s): BMW, Mazda,

GM and others

External Funding Above Match:

\$5 million

Research Focus: Automotive diagnostics and prognostics, sustainable mobility, concepts, methods and tools. Deriving a simple, flexible energy management control strategy for plug-in hybrid electric vehicles.

SUPPLY CHAIN OPTIMIZATION AND LOGISTICS*

Award Date: 2006

State Award Amount: \$2 million

University: Clemson

Endowed Chair(s):

Dr. Scott Mason
Fluor Endowed Chair in Supply Chain Optimization & Logistics

Corporate Partner(s): Fluor

External Funding Above Match:

\$11.2 million

Research Focus: Interdisciplinary research addressing the multifaceted problems associated with supply chains. Deliver tangible supply chain optimization and logistics products and services through theoretical and applied research.

VEHICLE ELECTRONIC SYSTEMS INTEGRATION*

Award Date: 2004

State Award Amount: \$3 million

University: Clemson

Endowed Chair(s):

Dr. Venkat Krovi
Michelin Endowed Chair in Vehicle Electronic Systems Integration

Corporate Partner(s):

Michelin

External Funding Above Match:

\$3.9 million

Research Focus: Research to enable intra-vehicle and V2X automation, at subsystem, system, and system-of-systems levels, for automotive and vehicular applications.





Biomedical

ADVANCED TISSUE BIOFABRICATION

Award Date: 2008

State Award Amount: \$5 million

Universities: MUSC, USC, Clemson

Endowed Chair(s):

Dr. Bruce Gao, Clemson

Endowed Chair in Biofabrication Engineering

MUSC and USC are recruiting Endowed Chairs in *Biofabrication Biology*.

Research Focus: Develop innovative technologies and approaches that will enable repair, replacement, or restoration of diseased cells, tissues and organs.

BRAIN IMAGING

Award Date: 2003

State Award Amount: \$5 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Chris Rorden, USC

Dr. Joseph Helpert, MUSC

MUSC is recruiting one additional endowed chair.

External Funding Above Match:
\$38.9 million

Research Focus: Creating a world-class brain imaging center. Initiated the first study using transcranial magnetic stimulation (TMS). Combined with functional MRI, TMS provides a short strong magnetic field useful for studying how the brain works. Specific studies include stroke-related brain injury and MRI physics techniques for clinical and neuroscience research.

CHILDHOOD NEUROTHERAPEUTICS

Award Date: 2006

State Award Amount: \$5 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Jeffery Twiss, USC

Child and Adolescent Neurochemistry

Dr. Manuel Casanova, USC

Translational Clinical Research

MUSC is recruiting one endowed chair in *Neurodevelopmental Disorders*.

External Funding Above Match:
\$12 million

Research Focus: Prevention of brain damage in premature infants and curing infant brain diseases through cellular engineering. Also working on cognitive behavioral tasks in transgenic mice to determine if therapeutics can improve functional development outcomes, which may someday help children with ADHD.

CLINICAL EFFECTIVENESS AND PATIENT SAFETY*

Award Date: 2006

State Award Amount: \$5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. John Schaefer, MUSC

Lewis Blackman Endowed Chair for Patient Simulation & Research for Health Sciences South Carolina

Dr. Jihad Obeid, MUSC

Biomedical Informatics

Dr. Cynthia Corbett, USC

Endowed Chair in Chronic Care Management

External Funding Above Match:
\$12.1 million

Research Focus: Quality and safety of patient care, and improving the medical informatics aspects of data acquisition and the evaluation of health information technology on the quality and safety of clinical care processes and outcomes. The Center also focuses on developing South Carolina as

a training center for physicians and other health professions using human simulators and sophisticated software-based training scenarios.

EFFECTIVENESS RESEARCH IN ORTHOPEDICS (CERotho)

Award Date: 2007

State Award Amount: \$5 million

University: USC

Endowed Chair(s):

Dr. John Brooks

Corporate Partner(s):

Smith & Nephew

External Funding Above Match:
\$16.2 million

Research Focus: Medical health needs in orthopaedic disorders, exercise and sports-related injury prevention, treatment, and rehabilitation. The Center investigates the biologics of tissue-engineered materials and implantable devices to find solutions to musculoskeletal maladies.



Biomedical

HEALTHCARE QUALITY*

Award Date: 2007

State Award Amount: \$5 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Les Lenert, MUSC
Medical Bioinformatics

Dr. Xiaoming Li, USC
Translational Clinical Research

Corporate Partner(s):

The Duke Endowment

External Funding Above Match:

\$18.3 million

Research Focus: Creating a unique and comprehensive clinical data store that collects data from providers, enhances data usability, and makes it available in an easily accessible form for participants to use for clinical improvement and research purposes.

HEALTH FACILITIES DESIGN AND TESTING

Award Date: 2007

State Award Amount: \$2 million

University: Clemson, MUSC

Endowed Chair(s):

Dr. Anjali Joseph, Clemson
Architecture & Health Research

Dr. Kenneth Catchpole, MUSC
Clinical Practice and Human Factors

External Funding Above Match:

\$4.1 million

Research Focus: The impact of the built environment on health and healthcare delivery and the creation of architectural settings that promote health, safety, and the wellbeing of all users.

INFLAMMATION AND FIBROSIS RESEARCH*

Award Date: 2010

State Award Amount: \$5 million

University: MUSC

Endowed Chair(s):

Dr. Carol Feghali-Bostwick
Kitty Trask Holt Endowed Chair for Scleroderma Diseases

Dr. Betty Tsao
Inflammation Research

External Funding Above Match:

\$28.8 million

Research Focus: Develop new therapies and education programs for inflammatory and fibrosing rheumatic diseases such as lupus, scleroderma, and rheumatoid arthritis.

MARINE GENOMICS*

Award Date: 2003

State Award Amount: \$4 million

Universities: MUSC, College of Charleston

Endowed Chair(s):

Dr. Gavin Naylor, MUSC
Bioinformatics

MUSC is recruiting one endowed chair.

External Funding Above Match:

\$9.5 million

Research Focus: Monitoring and predicting the impact of environmental changes on marine biosystems, which can, in turn, affect human health. Specific areas of study include environmental causation in wildlife, human disease and susceptibility, and mapping variability in genomes and populations; as well as research of shark and ray species.

MOLECULAR PROTEOMICS IN CARDIOVASCULAR DISEASE AND PREVENTION*

Award Date: 2006

State Award Amount: \$5 million

University: MUSC

Endowed Chair(s):

Dr. Sheldon E. Litwin
Countess Alicia Spaulding Palozzi Chair in Cardiovascular Imaging

Dr. Thomas G. DiSalvo
Volpe SmartState Endowed Chair in Cardiovascular Biomarker Development for Diagnosis & Prevention

External Funding Above Match:

\$7.6 million

Research Focus: Translation advances in basic bench science to clinical bedside care to improve the health care of the citizens of South Carolina. Priorities include diagnostic techniques, therapeutic management strategies, relations of protein signatures to clinical outcomes for risk assessment, and treatment of disease manifestation.

NEUROSCIENCES

Award Date: 2003

State Award Amount: \$3 million

University: MUSC

Endowed Chair(s):

Dr. Christopher Cowan
William E. Murray Endowed Chair in Neuroscience

MUSC is recruiting the *Josephine Tucker Morse Endowed Chair in Parkinson's Disease*.

External Funding Above Match:

\$17.8 million

Research Focus: Brain neuromodulatory systems and their roles in cognitive performance, drug abuse, sleep and affective disorders. Other areas of research are movement disorders such as Ataxia, Choro, Bradykinesia and multiple system atrophy.



Biomedical

PROSTATE CANCER DISPARITIES

Award Date: 2008

State Award Amount: \$3.6 million

University: MUSC, USC, SCSU

Endowed Chair(s):

Dr. Chanita Hughes-Halbert, MUSC
AT&T Distinguished Endowed Chair in Cancer Equity in Cancer Disparities

Dr. Marvella Ford, MUSC/SCSU
Cancer Disparities

USC is recruiting an endowed chair in *Cancer Disparities*.

Corporate Partner(s): AT&T Foundation

External Funding Above Match:
\$44.9 million

Research Focus: Facilitate statewide partnerships in cancer prevention and control research, clinical trials, and training to significantly decrease disparities in prostate cancer incidence and mortality in South Carolina.

PROTEOMICS*

Award Date: 2003

State Award Amount: \$4 million

University: MUSC

Endowed Chair(s):

Dr. Richard Drake

Dr. Anand S. Mehta

External Funding Above Match:
\$22.5 million

Research Focus: Develop and use high-end analytical technologies to understand the biologic profile of protein expression in health and disease. Developing enzyme-based analytical methods to effectively detect biomolecules in tissues and tissue microarray platforms.

REGENERATIVE MEDICINE*

Award Date: 2004

State Award Amount: \$5 million

Universities: MUSC, USC, Clemson

Endowed Chair(s):

Dr. Martin Morad, USC
BlueCross BlueShield of SC Foundation Chair in Cardiovascular Health

Dr. Stephen Duncan, MUSC
Regenerative Medicine and Cell Biology

Dr. Jeremy Gilbert, Clemson
Hansjörg Wyss Endowed Chair in Bioengineering

External Funding Above Match:
\$43.5 million

Research Focus: Regenerative medicine approach for cardiovascular applications and provide expertise in clinical trials, statistics and/or assay development. Application of regenerative medicine and tissue engineering approaches to orthopaedic and neural diseases. Regeneration of tissue and organs for repairing, replacing, and maintaining organ function.

RENAL DISEASE BIOMARKERS

Award Date: 2008

State Award Amount: \$5 million

University: MUSC

Endowed Chair(s):

Dr. Deepak Nihalani
Renal Biomarkers

MUSC is recruiting one endowed chair in *Translational Nephrology Research*.

External Funding Above Match:
\$7.1 million

Research Focus: Identifying biomarkers that identify or predict prognosis for acute kidney injury, diabetic neuropathy, lupus nephritis, and focal segmental glomerulosclerosis.

SENIORSMART®

Award Date: 2007

State Award Amount: \$5 million

Universities: USC, Clemson

Endowed Chair(s):

Dr. Sue Levkoff, USC
SmartHOME®

Dr. Julius Fridriksson, USC
SmartBRAIN™

Clemson is recruiting one endowed chair in *SmartWHEELS™*.

External Funding Above Match:
\$14.6 million

Research Focus: Three areas of research include: *SmartBRAIN™* (maintaining intellectual activity), *SmartWHEELS™* (independent mobility outside the home) and *SmartHOME®* (independent mobility inside the home) to foster independent living among seniors.



Biomedical

STROKE*

Award Date: 2007

State Award Amount: \$5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. Robert Adams, MUSC
Stroke

Dr. Mark Chimowitz, MUSC
Countess Alicia Paolozzi Endowed Chair in Translational Neurology

Dr. Souvik Sen, USC
Clinical Neurology

External Funding Above Match:
\$29.3 million

Research Focus: Enhancing stroke treatment, prevention, and recovery. This Center is developing new stroke-related therapeutics, drug discovery, and biotechnology, and is a leader in stroke telemedicine.

TECHNOLOGY CENTER TO ENHANCE HEALTHFUL LIFESTYLES*

Award Date: 2009

State Award Amount: \$3 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Frank Trieber, MUSC
Technology Applications for Disease Prevention, Management, and Risk Reduction

Dr. Delia West, USC
Technology Application for Health Behavior Change

External Funding Above Match:
\$18.5 million

Research Focus: Develop and test lifestyle interventions for improving health, preventing illness and managing chronic health problems caused by physical inactivity, poor diets, and other lifestyle behaviors.

TOBACCO-RELATED MALIGNANCY

Award Date: 2007

State Award Amount: \$5 million

University: MUSC

Endowed Chair(s):

Dr. Nancy DeMore
BMW Chair in Cancer Research

MUSC is recruiting the *Burtschy Family Distinguished Endowed Chair in Lung Cancer Research*.

Corporate Partner(s):
BMW

External Funding Above Match:
\$56.4 million

Research Focus: Devoted to discovering tobacco-related malignancy biomarkers via clinical trials with a specific focus on tobacco-related cancers. Additionally, the Center is evaluating the specificity and sensitivity of novel biomarkers by molecular epidemiologic techniques across the diverse populations of South Carolina.

TRANSLATIONAL BIOMEDICAL INFORMATICS

Award Date: 2013

State Award Amount: \$2 million

University: MUSC

Endowed Chair(s):

Dr. Stephane Meystre

Research Focus: The new Center will provide expertise in translational biomedical informatics essential for cutting-edge, innovative methodologies to link genetic/genomic data with vast amounts of clinical data. The contributions of the center to data sharing/analysis will decrease cost and increase efficiency in research and healthcare delivery and provide a robust IT platform for industry partnerships and new company formation.

VISION SCIENCE

Award Date: 2005

State Award Amount: \$4.5 million

Universities: MUSC

Endowed Chair(s):

Dr. Baerbel Rohrer
Chair in Gene and Pharmaceutical treatment of Retinal Degenerative Diseases

MUSC is recruiting one endowed chair.

Corporate Partner(s):

Alcon Labs, Taligen, Alexion
Pharmaceuticals

External Funding Above Match:
\$26.2 million

Research Focus: New treatments for macular degeneration, development of new anti-glaucoma agents and innovations in cataract surgery. The Center also focuses on using advances in bioengineering and material sciences to improve the diagnosis, treatment, and prevention of eye diseases.



Energy & Alternative Fuels

CATALYSIS FOR RENEWABLE FUELS*

Award Date: 2005

State Award Amount: \$3 million

University: USC

Endowed Chair(s):
Dr. John Regalbuto

External Funding Above Match:
\$13.6 million

Research Focus: Developing catalysts that allow production of alternative fuels from renewable sources, thereby reducing dependence on imported oil and carbon fuel. The Center focuses on synthesizing inorganic catalysts for converting biomass to biofuels and synthesizing electrocatalysts for solar fuels and fuel cells.

GENERAL ATOMICS CENTER FOR THE DEVELOPMENT OF TRANSLATIONAL NUCLEAR TECHNOLOGY

Award Date: 2009

State Award Amount: \$3 million

University: USC

Endowed Chair(s):
Dr. Theodore Besmann
Energy and Nuclear Security

Corporate Partner(s):
General Atomics

External Funding Above Match:
\$22.1 million

Research Focus: The production of biofuels and coal to liquid fuels using nuclear process heat for more efficient production and the reduction of wastes associated with recycling of used fuel, seeking more long term strategies to manage used fuel, recovery of energy value in used fuel, and eliminating concerns over proliferation associated with recycling used fuel.

NUCLEAR SCIENCE AND ENERGY

Award Date: 2008

State Award Amount: \$3 million

University: USC

Endowed Chair(s):
Dr. Dan Gabriel Cacuci
Nuclear Power and Advanced Materials

Corporate Partner(s):
Duke Energy, Progress Energy, SCANA, Westinghouse

External Funding Above Match:
\$7.3 million

Research Focus: Performance, efficiency, and maintenance issues at existing and future nuclear power plants using expertise modeling and simulation related to nuclear fuels and materials.

SMART GRID TECHNOLOGY

Award Date: 2013

State Award Amount: \$5 million

University: Clemson

Endowed Chair(s):
Dr. Johan Enslin
Duke Energy Smart Grid Technology Chair

Corporate Partner(s):
Duke Energy

External Funding Above Match:
\$4.7 million

Research Focus: Develop technology to better plan and operate electric power systems.

SOLID OXIDE FUEL CELLS*

Award Date: 2006

State Award Amount: \$3 million

University: USC

Endowed Chair(s):
Dr. Kevin Huang, USC
Solid Oxide Fuel Cells

External Funding Above Match:
\$60.1 million

Research Focus: Develop solid oxide fuel cells for use in large, high-power systems such as industrial sites and electricity generating stations as well as for mobile power for computers, cell phones, and other electronics.

STRATEGIC APPROACHES TO THE GENERATION OF ELECTRICITY (SAGE)*

Award Date: 2007

State Award Amount: \$5 million

University: USC

Endowed Chair(s):
Dr. Jochen Lauterbach

External Funding Above Match:
\$12.7 million

Research Focus: Developing, improving, and advancing technologies to enhance the environmental performance of electricity production. Other work focuses on converting CO₂ to chemicals, fuel cell and hydrogen storage-related research, and chemical production from coal to biomass.



Information Science

CYBERINSTITUTE**Award Date:** 2008**State Award Amount:** \$2 million**University:** Clemson**Endowed Chair(s):**

Clemson is recruiting the *C. Tycho Howle Endowed Chair in Collaborative Computing Environments*.

Corporate Partner(s):

Omnibond Systems, LLC

External Funding Above Match:

\$7.6 million

Research Focus: Connecting research and scholarship, particularly in interdisciplinary aspects of high-performance computing, networking, and data storage; the security of information systems and networks; human-computer interactions; interpretation; and visualization to the commercial sector via strategic industrial partnerships. Conduct research in conjunction with the Clemson University Cyber-Institute.

DATA ANALYSIS, SIMULATION, IMAGING, AND VISUALIZATION**Award Date:** 2010**State Award Amount:** \$2 million**University:** USC**Endowed Chair(s):**

Dr. Wolfgang Dahmen
Williams-Hedberg-Hedberg Chair of Mathematics

External Funding Above Match:

\$2.8 million

Research Focus: Develop technology for transforming data into knowledge concentrating on inline data processing, multi-sensor data acquisition, tissue modeling, atomic scale modeling, and bioimaging.

INNOVATION AND COMMERCIALIZATION**Award Date:** 2004**State Award Amount:** \$5 million**University:** USC**Endowed Chair(s):**

Dr. Laura B. Cardinal
Discovery and Innovation

Corporate Partner(s):

Fluor Foundation and Savannah River
Nuclear Solutions LLC

External Funding Above Match:

\$19.8 million

Research Focus: The innovation, commercialization, and new venture development of research in the SmartState Centers, leading to technology commercialization and transfer activities in collaboration with business organizations and public sector stakeholders.

OPTOELECTRONICS***Award Date:** 2008**State Award Amount:** \$2 million**University:** Clemson**Endowed Chair(s):**

Dr. Eric Johnson
PalmettoNet Endowed Chair in Optoelectronics

Corporate Partner(s):

Advanced Photonic Crystal, Tetramer
Technologies

External Funding Above Match:

\$11 million

Research Focus: Improving devices, systems, and protocols used in high-speed optical communications networks.

SUSTAINABLE DEVELOPMENT***Award Date:** 2010**State Award Amount:** \$4 million**University:** Clemson**Endowed Chair(s):**

Clemson is recruiting the *Thomas F. Hash '69 Endowed Chair in Sustainable Development*.

External Funding Above Match:

\$5.8 million

Research Focus: Developing new technologies to support real-time monitoring and management of natural and built environments through the Intelligent River® Project. The Center has created wireless sensor networks that can reliably monitor and transmit environmental data in near real time.

TOURISM AND ECONOMIC DEVELOPMENT***Award Date:** 2005**State Award Amount:** \$2 million**University:** USC**Endowed Chair(s):**

Dr. Simon Hudson

Corporate Partner(s):

Rawle Murdy
US Travel Association (USTA)

External Funding Above Match:

\$500,998

Research Focus: Tourism is a \$17 billion industry in South Carolina. The Center conducts cutting-edge tourism and hospitality research initiatives that will improve South Carolina's competitiveness as a tourism destination.

URBAN ECOLOGY AND RESTORATION***Award Date:** 2006**State Award Amount:** \$2 million**University:** Clemson**Endowed Chair(s):**

Dr. Robert F. Baldwin
Margaret H. Lloyd SmartState Chair in Urban Ecology

External Funding Above Match:

\$6.8 million

Research Focus: Generating scholarship by building collaborations in applied ecology and environmental science, habitat ecology and restoration, wetland and watershed management; conservation biology; private-public networks for conservation; payments for ecosystem services; urban ecology; environmental education; and by developing careers of young scientists and educators.



Pharmaceutical

CANCER DRUG DISCOVERY***Award Date:** 2005**State Award Amount:** \$5 million**Universities:** MUSC, USC**Endowed Chair(s):**

Dr. John LeMasters, MUSC
*GlaxoSmithKline Distinguished
 Endowed Chair*

Dr. Patrick Woster, MUSC
Medicinal Chemistry

Dr. Mark Hamann, MUSC
Charles & Carol Cooper Chair in Pharmacy

Dr. Mitzi Nagarkatti, USC
Structural Biology and Pharmacy

Corporate Partner(s):

GlaxoSmithKline

External Funding Above Match:

\$20.1 million

Research Focus: Advanced biomedical screening technologies to identify disease mechanisms and targets, and also screening drug candidates. Structural biology for target analysis, chemical biology for designing drug candidates, and advanced biomedical screening technologies.

CANCER STEM CELL BIOLOGY AND THERAPY***Award Date:** 2008**State Award Amount:** \$5 million**Universities:** MUSC, Clemson**Endowed Chair(s):**

Dr. Zihai Li, MUSC
*Abney Endowed Chair Remembering Sally
 Abney Rose*

Dr. Xue Zhong Yu, MUSC
Biomedical Engineering

External Funding Above Match:

\$22 million

Research Focus: Developing new technologies for isolating, growing, and manipulating cancer stem cells. This will enable the Center to find ways to use adult stem cells from bone marrow or organs to treat cancer.

GASTROINTESTINAL CANCER DIAGNOSTICS**Award Date:** 2005**State Award Amount:** \$5 million**University:** MUSC**Endowed Chair(s):**

Dr. Carolyn Britten
*Charles Westerfield Coker Distinguished Chair
 in Gastrointestinal Malignancy*

Dr. Gustavo Leone, MUSC
*Grace DeWolff Endowed Chair
 in Medical Oncology*

Corporate Partner(s):

Roche Carolina, Bank of America

External Funding Above Match:

\$17 million

Research Focus: Clinical and translational gastrointestinal oncology and biomarker development and gastrointestinal (GI) malignancies. Bringing state-of-the-art translational medicine to all GI cancer patients in South Carolina, thereby decreasing the overall impact of cancer mortality and morbidity and closing disparity gaps throughout the state.

LIPIDOMICS, PATHOBIOLOGY AND THERAPY***Award Date:** 2009**State Award Amount:** \$5 million**University:** MUSC**Endowed Chair(s):**

Dr. J. Alan Diehl
Lipidomics & Pathobiology

Dr. Besim Ogretmen
Lipidomics Drug Discovery

External Funding Above Match:

\$36.3 million

Research Focus: Develop models for translational research and study of lipidomics and their pathobiology with an emphasis on cancer and inflammation.

MEDICATION SAFETY AND EFFICACY**Award Date:** 2008**State Award Amount:** \$2 million**Universities:** MUSC, USC**Endowed Chair(s):**

Dr. Charles Bennett, USC
*Frank P. and Josie M. Fletcher Professor
 of Pharmacy*

External Funding Above Match:

\$6.1 million

Research Focus: Increasing drug safety and effectiveness, as well as decreasing medication errors by identifying the incidence and significance of adverse drug events.

TRANSLATIONAL CANCER THERAPEUTICS***Award Date:** 2004**State Award Amount:** \$5 million**Universities:** MUSC, USC**Endowed Chair(s):**

Dr. Kenneth Tew, MUSC
*John C. West Endowed Chair
 in Cancer Research*

Dr. Igor Roninson, USC
Drug Efficacy

External Funding Above Match:

\$31.8 million

Research Focus: Development of new approaches in cancer treatment, including the discovery and development of new drugs. Research also focuses on utilizing mouse models predisposed to cancer to study the impact of gene misregulation and therapeutic agents on tumor development, and the identification and inhibition of new cancer drug targets.

SMARTSTATE PROFILE

Dr. Jeffery Twiss



The University of South Carolina (USC) SmartState Chair in Childhood Neurotherapeutics, Dr. Jeffery Twiss, helped organize the inaugural South Carolina Autism and Neurodevelopmental Disorders (SCAND) Consortium held October 9, 2017 at the USC Alumni Center. Composed of members from USC, the Medical University of South Carolina, Clemson University, Palmetto Health, the USC School of Medicine Greenville, and Greenwood Genetics Center, the consortium is working to understand neurodevelopmental and autism disorders and support South Carolina families affected by these conditions. Twiss' research in neural development could bring a better understanding of autism and possibly restore neural function.

Much like a finely tuned automobile or airliner, the human body is governed by sophisticated circuitry that keeps it running smoothly. Connections between neurons within the brain and central nervous system are needed for every thought, movement and sensation. These connections form as the brain and spinal cord develop, establishing neural circuits. In infants, this circuitry is fairly simple, gaining in complexity with age and experiences.

When these circuits are disrupted by disease or trauma, brain and spinal cord functions are lost. Neurodevelopmental disorders similarly disrupt neural circuits. Autism is one of the conditions where disrupted neural circuits cause difficulty communicating, forming relationships with other people, and a tendency toward restricted interests and repetitive behaviors. With the number of diagnosed autism cases on the rise, the question arises: can these circuits be reestablished and normal brain function returned?

Twiss has invested 20 years in researching neural development and the brain's ability to regenerate and neurons to reconnect in cases of spinal cord or traumatic brain injury. "What we've found is that children's nervous systems are more "plastic"—able to change—than adults' and thus are better able repair and regenerate," he says.

Part of his research focuses on neural repair mechanisms, specifically on how to use these mechanisms to improve recovery after an injury of the nervous system. Long-range communication in the nervous system is provided through

axon processes that connect neurons with their targets. Disruption of this communication pathway, either through injury or disease, often results in permanent loss of function unless neural connections can be restored. Twiss' work seeks to restore neural function by finding the means to improve regeneration of axons. These general mechanisms also impact neural function, synaptic plasticity affecting memory and learning, and development.

"At one time we thought that neural regeneration was hopeless, but we kept at it. We now have identified a peptide that can accelerate regeneration and are working on a drug that can mimic how this works," he explains. "It's possible such a drug could help children with issues such as autism, as well as adults."

The other portion of his research focuses on how neural connections are formed during development of the brain. Of particular interest are interactions between gene products that help establish neural circuits and how changes in gene expression can be impacted by developmental disorders like autism. Twiss hopes to accelerate his lab's findings and to support that, has added two new faculty researchers.

"Parents of children with autism, the healthcare community, and educators are all very interested in our research as our findings could lead to a very different life for these children. That is what inspires us," Twiss says. The National Institutes of Health and the Dr. Miriam and Sheldon G. Adelson Medical Research Foundation are the major funders of Twiss' research. ●



JEFFERY TWISS, M.D., PH.D.

SmartState Chair in Childhood Neurotherapeutics
SmartState Center for Childhood Neurotherapeutics

SMARTSTATE® PROGRAM Endowed Chairs

The role of SmartState® Program Endowed Chairs is to serve as catalysts for the state's knowledge economy. Seventy-one chairs of 85 approved chairs have been filled at Clemson University, the Medical University of South Carolina, and the University of South Carolina across 51 SmartState Centers. The SmartState® Program welcomed six new endowed chairs this year: Dr. Cynthia Corbett, Dr. Marvella Ford, Dr. Bruce Gao, Dr. Gustavo Leone, Dr. Christiaan Paredis, and Dr. Kevin Huang.



ROBERT ADAMS
Stroke
MUSC



ROBERT F. BALDWIN
Urban Ecology and Restoration
Clemson



JOHN BALLATO
Optical Materials/Photonics
Clemson



BRIAN BENICEWICZ
Polymer Nanocomposites
USC



CHARLES BENNETT
Medication Safety and Efficacy
USC



THEODORE BESMANN
General Atomics
USC



CAROLYN BRITTEN
Gastrointestinal Cancer
Diagnostics
MUSC



JOHN BROOKS
Effectiveness Research
in Orthopedics
USC



DAN GABRIEL CACUCI
Nuclear Science and Energy
USC



LAURA B. CARDINAL
Innovation and
Commercialization
USC



MANUEL CASANOVA
Childhood Neurotherapeutics
USC



KENNETH CATCHPOLE
Health Facilities Design and Testing
MUSC



MARK CHIMOWITZ
Stroke
MUSC



CHRISTOPHER COWAN
Neurosciences
MUSC



WOLFGANG DAHMEN
Data Analysis Simulation Imaging
and Visualization
USC



NANCY DEMORE
Tobacco-related Malignancies
MUSC



J. ALAN DIEHL
Lipidomics Pathobiology and
Therapy
MUSC



THOMAS DISALVO
Molecular Proteomics in
Cardiovascular Disease and
Prevention
MUSC



RICHARD DRAKE
Proteomics
MUSC



STEPHEN A. DUNCAN
Regenerative Medicine
MUSC



JOHAN ENSLIN
Smart Grid Technology
Clemson



CAROL FEGHALI-BOSTWICK
Inflammation & Fibrosis Research
MUSC



ZORAN FILIPI
Automotive Design and
Development
Clemson



MARVELLA FORD
Prostate Cancer Disparities
MUSC/SCTU



JULIUS FRIDRIKSSON
SeniorSMART®
USC



BRUCE GAO
Advanced Tissue Biofabrication
Clemson



JEREMY GILBERT
Regenerative Medicine
Clemson



MARK HAMANN
Cancer Drug Discovery
MUSC



JOSEPH HELPERN
Brain Imaging
MUSC



SIMON HUDSON
Tourism and Economic
Development
USC



CHANITA HUGHES-HALPERT
Prostate Cancer Disparities
MUSC



ERIC JOHNSON
Optoelectronics
Clemson



ANJALI JOSEPH
Health Facilities Design and Testing
Clemson



VENKAT KROVI
Vehicle Electronic Systems Integration
Clemson



JOCHEN LAUTERBACH
Strategic Approaches to the Generation of Electricity (SAGE)
USC



JAMIE LEAD
Environmental Nanoscience and Risk
USC



JOHN LEMASTERS
Cancer Drug Discovery
MUSC



GUSTAVO LEONE
Gastrointestinal Diagnostics
MUSC



LES LENERT
Healthcare Quality
MUSC



SUE LEVKOFF
SeniorSMART®
USC



XIAOMING LI
Healthcare Quality
USC



ZIHAI LI
Cancer Stem Cell Biology and Therapy
MUSC



SHELDON E. LITWIN
Molecular Proteomics in Cardiovascular Disease and Prevention
MUSC



SCOTT MASON
Supply Chain Optimization and Logistics
Clemson



LAINE MEARS
Automotive Manufacturing
Clemson



ANAND S. MEHTA
Proteomics
MUSC



STEPHANE MEYSTRE
Translational Biomedical Informatics
MUSC



MARTIN MORAD
Regenerative Medicine
USC



MITZI NAGARKATTI
Cancer Drug Discovery
USC



GAVIN NAYLOR
Marine Genomics
MUSC



DEEPAK NIHALANI
Renal Disease Biomarkers
MUSC

**JIHAD OBEID**

Clinical Effectiveness and Patient Safety
MUSC

**BESIM OGRETMEN**

Lipidomics Pathobiology and Therapy
MUSC

**CHRISTIAAN PAREDIS**

Automotive Systems Integration
Clemson

**JOHN REGALBUTO**

Catalysis for Renewable Fuels
USC

**BAERBEL ROHRER**

Vision Science
MUSC

**IGOR RONINSON**

Translational Cancer Therapeutics
USC

**CHRIS RORDEN**

Brain Imaging
USC

**JOHN SCHAEFER**

Clinical Effectiveness and Patient Safety
MUSC

**SOUVIK SEN**

Stroke
USC

**KENNETH TEW**

Translational Cancer Therapeutics
MUSC

**FRANK TRIEBER**

Technology Center to Enhance Healthful Lifestyles
MUSC

**BETTY TSAO**

Inflammation and Fibrosis Research
MUSC

**JEFFERY TWISS**

Childhood Neurotherapeutics
USC

**MAREK URBAN**

Advanced Fiber Materials
Clemson

**MICHEL VAN TOOREN**

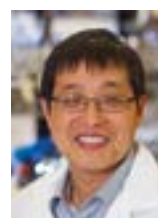
Multifunctional Materials & Structures
USC

**DELIA WEST**

Technology Center to Enhance Healthful Lifestyles
USC

**PATRICK WOSTER**

Cancer Drug Discovery
MUSC

**XUE ZHONG YU**

Cancer Stem Cell Biology and Therapy
MUSC

NOT PICTURED: Cynthia Corbett, Clinical Effectiveness & Patient Safety, USC and Dr. Kevin Huang, Solid Oxide Fuel Cells, USC.

SMARTSTATE PROFILE

Dr. Stephane Meystre



Buried within patients' electronic health records is a wealth of information that can be used to improve patient care and outcomes, fuel research, reduce health disparities, improve efficiency and the quality of care. Currently, the data exists as blocks of text, making the extraction of meaningful information tedious. Dr. Stephane Meystre is employing Natural Language Processing, a form of artificial intelligence, to transform this data dump into a treasure trove. He has founded a startup company, Clinacuity, to bring this important technology to market.

In the early 1960s, the Mayo Clinic was among the first health systems to adopt the use of electronic health records (EHR). By 2016, 96 percent of U.S. hospitals had adopted EHRs, replacing paper-based files of demographic and clinical data on patients with digital files. Biomedical informatics experts like Medical University of South Carolina's (MUSC) Dr. Stephane Meystre were pleased and overwhelmed by the near-perfect adoption rate: it didn't take long to realize difficulties with the quantity and format of data in EHRs.

"It truly was a data dump," says Meystre. "Information like patient demographics was easy to extract; however, most clinical information is in the form of unstructured text. This includes clinical notes, operative reports, pathology reports, orders, and discharge summaries. This data is extremely valuable, and health systems are mandated by the government to use the data in meaningful ways, but manually sifting through text to find important patient clinical information is highly inefficient."

Meystre's research as the SmartState Chair for the Translational Biomedical Informatics Center is focused on solving the global healthcare dilemma of unstructured data reuse. His area of expertise is Natural Language Processing (NLP), which combines the disciplines of computer science, artificial intelligence, and computational linguistics to enable computers to derive meaning from human or natural language input such as the data found in EHRs.

Meystre is developing NLP systems that make it easy to extract structured and coded information from clinical text for better patient care, improved healthcare management and effective clinical research.

"NLP can be used to extract pertinent data from the EHR in real time which gives a physician the information he needs without having to read through a patient's entire record. This is particularly useful for complex cases such as cancer patients and others who have multiple health issues," Meystre says. "It's also useful when a physician sees a patient for the first time. NLP gives the physician a summarized view of the patient's condition and treatments."

MUSC is using NLP at the Hollings Cancer Center in a pilot program that screens patients for eligibility for clinical trials at MUSC for their specific type of cancer. The oncologist is notified if there is a match. If successful, the program could lead to a large-scale pilot with the National Cancer Institute to identify trials anywhere in the world. MUSC researchers are also taking advantage of Meystre's work with pilot programs on treatment performance and quality measures assessment.

In 2012, Meystre founded a startup company, Clinacuity, to provide hospitals and physicians with the benefits of NLP technology. The company is developing an automated system for de-identifying clinical notes in EHRs and improve the availability of this text for secondary uses while protecting the confidentiality of patient data. Clinacuity, already a MedTech Innovator Top 100 company, was selected in October 2017 to participate in the National Institutes of Health's Commercialization Accelerator Program for 2017-2018.

Meystre is pleased with the progress being made through his SmartState Endowed Chair and Clinacuity. "We must have systems that make it easy for physicians and health systems to use data. We are scratching the surface of the potential of EHRs." ●



STEPHANE MEYSTRE, M.D., PH.D., FACMI

SmartState Chair

SmartState Center in Translational Biomedical Informatics

IN CLOSING

South Carolina Transformation



“First comes thought; then organization of that thought into ideas and plans; then transformation of those plans into reality. The beginning, as you will observe, is in your imagination.”

NAPOLEON HILL

The SmartState Endowed Chairs' ideas have the power to transform South Carolina's fortunes through research and education, partnerships and investment from corporations, and the attraction of federal research dollars. The endowed chairs have seized the SmartState® Program's vision and run with it. And in creating this report, they have invited us into their labs and lives to experience a little of their world.

The endowed chairs agree that the SmartState® Program has opened doors for them. Their counsel is valued by corporations, energy companies, healthcare institutions, and policymakers. Students seek out their labs, hoping to become part of something greater that only can be found in South Carolina.

Clemson University's Dr. Laine Mears, the BMW Endowed Chair in Automotive Manufacturing, commented that the SmartState® Program inspires him to “think big.” He marveled at how he is now a trusted advisor to South Carolina manufacturers and is tasked with helping to solve a variety of issues. Such great expectations have led Mears to think big in his research, but equally important, to lead

an effort to transform technical education. What began as an idea is now a unique collaboration between Clemson and University of South Carolina Greenville Technical College that promises to elevate the knowledge base of South Carolina workers and keep the state's manufacturing businesses powered by qualified people.

The SmartState® Program has a legacy rich in big thinkers, from early advocates like Sam Tenenbaum (featured in this report) who worked tirelessly to bring supporters to the table, to university presidents: Jim Barker and James Clements of Clemson University; Ray Greenberg and David Cole of the Medical University of South Carolina; and John Palms, Andrew Sorensen and Harris Pastides of the University of South Carolina. These individuals and many too numerous to list here believed in the big idea of the SmartState® Program and used it to transform South Carolina for our citizens, our businesses community and our students.

The SmartState® Program would like to thank everyone who has dared to dream big and worked tirelessly to make those dreams reality. Let us continue to transform South Carolina for the better. ●

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