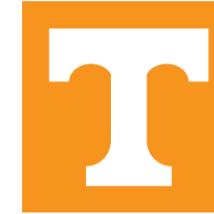


THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

COLLEGE OF ENGINEERING

Annual Report 2015



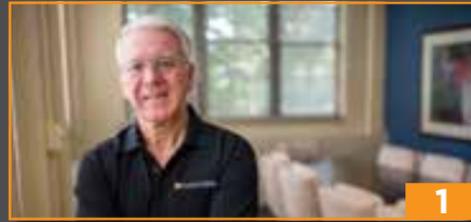
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KNOXVILLE

COLLEGE OF ENGINEERING

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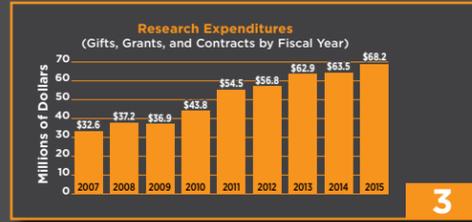
The University of Tennessee College of Engineering

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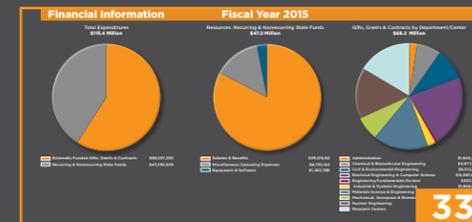
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Mission Statement

The mission of the University of Tennessee College of Engineering is:

To provide high quality education in the major engineering disciplines from the undergraduate through doctoral levels through a creative balance of academic, professional, and extracurricular programs;

To foster and maintain mutually beneficial partnerships with our alumni, friends, industry, and local, state, and federal governments through public services assistance and collaborative research; and

To be a major contributor to our nation's technology base through scholarship and research.

College of Engineering Annual Report 2015

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The information in this report reflects the time period from June 30, 2014 through July 1, 2015. The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services. All qualified applicants will receive equal consideration for employment without regard to race, color, national origin, religion, sex, pregnancy or marital status, sexual orientation, gender identity, age, physical or mental disability, or covered veteran status. E01-1301-013-012-16 DOP: 10/15



ENGINEERING

Dean's Message

Fiscal year 2015, which ended in June, was an excellent year for our college! Our faculty, staff, and graduate teaching assistants were engaged in providing the best education to an increasingly larger number of undergraduate and graduate students. We graduated eighty-five PhD students and our freshman class was the largest ever. All indications are that Fall 2015 will see a continuation of that trend—thanks to the recently added Volunteer Scholarships for both in-state and out-of-state students announced by the university. The great news is that those entering students are highly engaged in their education, participating at increasing numbers in our world-class Engineering Co-op program, in undergraduate research experiences led by our faculty, and in international exchange programs. Many of these experiences are being augmented by the very strong support of our donors and friends of the college as well as from corporations. An excellent example of the corporate support was the opening of the new Eastman Unit Operations Laboratory in April. This was also a year in which our college's *US News & World Report* rankings as a doctoral granting public college of engineering increased to 36th and 32nd, respectively at the graduate and undergraduate levels and our Department of Nuclear Engineering moved up to being a 4th ranked public program.

This year saw a substantial increase in our development of partnerships with companies across the US. In January, President Obama announced the award to the University of Tennessee of the fifth of the nation's planned institutes under the National Network of Manufacturing Institutes (NNMI). The Institute for Advanced Composites Manufacturing Innovation—IACMI—will be operated as a 501(c)3 under the University of Tennessee Research Foundation. It provides opportunity for ORNL and UT and its faculty and students to engage with the one hundred and twenty-two partner members, including numerous companies, universities, and state and federal agencies on

development of next generation advanced composite materials. We already have partnerships and relationships with many of the partners, but IACMI will enhance those and provide opportunities for us to create even stronger relationships with all participants. In the end, our faculty and students will have opportunities to engage in research and training and to become better positioned to make an impact on the future manufacturing and innovation that are needed for our state and nation to be competitive worldwide. It is exciting to be at the center of this national initiative that involves partners in thirty-seven states.

IACMI is one of many of our initiatives in which the college is engaged and comes on the tail of other successes, such as the college's recent inclusion as a research partner in the NNMI on American Light Metals Manufacturing Innovation Institute or Light-Weighting innovation for Tomorrow (ALMMII-LIFT). These all enhance our existing programs such as the NSF-DOE Engineering Research Center—CURENT, our Reliability and Maintainability Center, and our co-op programs. Couple these with the activities that our alumni are involved in worldwide and our college and its graduates are making a huge impact globally (and even outside of the world as we had two MS graduates who consecutively commanded the International Space Station in 2015!). It is a great time to be a Vol and we hope that you enjoy reading in this year's annual report about some of the exciting things in which our faculty, students and alumni are engaged!

Wayne Davis

Wayne T. Davis Endowed Dean's Chair in Engineering

College Profile

Board of Advisors for Fiscal Year 2015 (July 1, 2014– June 30, 2015)

Mr. Todd A. Apple
BS/ChE '87, JD '00
(Nashville School of Law)
Director, Channel Marketing–NA
Residential, Masonite International
Garnet Valley, Pennsylvania

Mr. Terry K. Begley
BS/ChE '69, MS/EA '74
Vice President, Global Supply Chain,
Chief Procurement Officer (retired)
Eastman Chemical Company
Kingsport, Tennessee

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BS/IE '76, Graduate, Owner/Pres/
Mgmt '95 (Harvard Business School)
Chairman and CEO
Bryce Corporation
Memphis, Tennessee

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BS/NE '63, MS/NE '64, PhD/NE '67
President/CEO, EnergyX LLC
Oak Ridge, Tennessee

Mr. Howard E. Chambers
BS/ME '64
Consultant to BCA Program
Management for Boeing
Rancho Palos Verdes, California

Dr. Wayne A. Coleman
BS/NE '63, MS/NE '65, PhD/NE '69
Corporate Vice President (retired)
Science Applications International
Corporation (SAIC) (retired)
Solana Beach, California

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BS/IE '65
Founder and Principal, Mountain
Group Capital, LLC
Nashville, Tennessee

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BS/EE '73, MS/EE '75, MBA '87
President, Crabtree Ventures, LLC
Franklin, Tennessee

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Riddle Aeronautical University)
President, Military Engines,
Pratt & Whitney
East Hartford, Connecticut

Mr. Jim Downing
BS/CE '69, MS/EE '74
Chairman Emeritus (retired), Barge,
Waggoner Sumner and Cannon, Inc.
Martinez, Georgia

Dr. William L. Eversole
BS/EE '73, PhD/EE (Southern
Methodist University)
CEO and President, Bandspeed, Inc.
Austin, Texas

Mr. Jim K. Flood
BS/CE '80
Vice President, Artic/Eastern Canada,
ExxonMobil Development Company
Houston, Texas

Ms. Kimberly S. Greene
BS/ES '88, MS/BioM '90
(University of Alabama-Birmingham),
MBA '96 (Samford))
Executive Vice President and
Chief Operating Officer,
Southern Company Services, Inc.
Atlanta, Georgia

Ms. Sharon S. Habibi
BS/Arch '75, MS/CE '77,
EMBA '89
CEO/President,
Syscom Technologies, Inc.
Marietta, Georgia

Mr. Ralph D. Heath
BS/EE '70, MBA '75
Executive Vice President,
Lockheed Martin (retired)
Aledo, Texas

Mr. Pete Hoffman
BS/ME '82 (University of Tennessee-
Martin), MS/ME '84 (University
of Tennessee Space Insitute),
MS/Manufacturing Engineering
(Washington University-St. Louis),
Master of International Business (St.
Louis University)
Vice President of Intellectual Property
Management
The Boeing Company
Hazlewood, Missouri

Mr. John Howanitz
BS/Psychology/Criminal Justice
(Dual Major) '81 (King's College,
Wilkes-Barre)
General Manager, Nuclear Security &
Operations
Bechtel National, Inc.
Reston, Virginia

Mr. Burkhard J. Huhnke
PhD '99 (Technical University of
Braunschweig, Germany)
General Manager, Board Member
Volkswagen GoA
Chattanooga, Tennessee

Mr. Kenneth (Ken) Huntsman
BS/CompSci '74 (Pennsylvania State
University), MS/CompSci '77
Co-Founder, America Online (retired)
Clifton, Virginia

Mr. Kenneth (Ken) Huntsman
BS/CompSci '74 (Pennsylvania State
University), MS/CompSci '77
Co-Founder, America Online (retired)
Clifton, Virginia

Ms. Misty D. Mayes
BS/IE '88
President, Management Solutions, LLC
Knoxville, Tennessee

Mr. Cavanaugh Mims
BS/CE '86
President, Visionary Solutions, LLC
Knoxville, Tennessee

Mr. Ronald (Ron) T. Morris
BS/EE '69
Senior Consultant (Contractor)
DuPont
Eads, Tennessee

Dr. Jeff Nichols
BA/Math '78, BA/Chem '78 (Malone
College), PhD '83 (Texas A & M
University)
Associate Laboratory Director,
Computing & Computer Science
Division, ORNL
Oak Ridge, Tennessee

Mr. J. Parker Smith
BS/ME (North Carolina State
University)
Vice President and
General Manager
Worldwide Manufacturing Support
Eastman
Kingsport, Tennessee

Mr. J.D. "Spike" Tickle II
BS/IE '87, MBA '98 (University of
North Carolina-Chapel Hill)
Director, Strongwell Corporation,
Three Horse Investments LLC
Bristol, Virginia

Mr. Ronald L. Turner
BS/Aero '68, MS/Aero '72 (University
of Florida); MS/Mgmt (MIT-Sloan
Fellow) '77
Managing Director, Turner Aero, LLC
Jet Charter (retired)
Amelia Island, Florida

Mr. Steven Welsh
BS/EE '87
Vice President for Strategic Services
for Distribution Sector, IBM
Raleigh, North Carolina

Mr. Eric L. Zeanah
BS/IE '84
President/Owner American
Accessories International
Knoxville, Tennessee

Leadership Team

Dr. Wayne T. Davis
Dean of Engineering

Dr. William Dunne
Associate Dean for Research
and Technology

Dr. Yearie Keppens
Associate Dean for Faculty
Affairs

Dr. Masood Parang
Associate Dean for Academic
and Student Affairs

Dr. Richard Bennett
Director of the Engineering
Fundamentals Division

Dorothy Barkley Bryson
Executive Director of
Engineering Development

Kim Cowart
Director of Engineering
Communications

Travis Griffin
Director of Engineering
Diversity Programs

Kimberly McCulloch
Director of Finance and
Administrative Affairs

Dr. J. Roger Parsons
Director Engineering Outreach

Dr. Kevin Kit
Director of Engineering
Honors Program

Todd Reeves
Director of Engineering
Professional Practice

Margie Russell
Director of Engineering
Advising Services

Departments

**Biosystems Engineering and
Soil Science****
Dr. Eric C. Drumm
Department Head

**Chemical and Biomolecular
Engineering**
Dr. Bamin Khomami
Department Head

**Civil and Environmental
Engineering**
**Dr. Greg Reed (interim)/
Dr. Chris Cox (5/01/15)**
Department Head

**Electrical Engineering and
Computer Science**
Dr. Leon Tolbert
Department Head

**Industrial and Systems
Engineering**
Dr. John E. Kobza
Department Head

**Materials Science and
Engineering**
**Dr. Kurt Sickafus/Dr. Yearie
Keppens (5/01/15)**
Department Head

**Mechanical, Aerospace, and
Biomedical Engineering**
Dr. Matthew M. Mench
Department Head

Nuclear Engineering
Dr. J. Wesley Hines
Department Head

**University of Tennessee Space
Institute**
Dr. Robert Moore
Executive Director

Degrees Offered

Bachelor of Science

Aerospace
Biomedical
****Biosystems**
Chemical
Civil
Computer Engineering
Computer Science
Electrical
Industrial
Materials Science
Mechanical
Nuclear

Master of Science

Aerospace
Biomedical
****Biosystems**
Chemical
Computer Engineering
Computer Science
Electrical
Engineering Science
Environmental
Industrial
Materials Science
Mechanical
Dual MS-MBA program
Nuclear
**Reliability and
Maintainability**

Doctor of Philosophy

Aerospace
Biomedical
****Biosystems**
Chemical
Civil
Computer Engineering
Computer Science
Electrical
Engineering Science
Industrial
Materials Science
Mechanical
Nuclear

****Note:** Degrees in
Biosystems Engineering
are offered in conjunction
with the College of
Agricultural Sciences and
Natural Resources.

Academic Support Programs and Diversity Initiatives

Distance Education Degrees and
Certificates in Engineering

The Jerry E. Stoneking *engage*™
Freshman Engineering Program

Engineering Advising Services

Engineering Diversity Programs

Engineering Honors Program

Engineering Outreach Office

Engineering Professional Practice

Tennessee Louis Stokes Alliance
for Minority Participation

Enrollment Figures

The origins of the College of
Engineering at the University of
Tennessee date back to 1838.

Total Enrollment Full-Time Programs Academic Year 2014

Undergraduate:	2,907
Graduate - MS:	346
Graduate - PhD:	650
Total:	3,903

Degrees Granted Academic Year 2014-2015

Bachelor of Science:	495
Master of Science:	161
Doctor of Philosophy:	85
Total:	741

Faculty - Fiscal Year 2013- 2014

Professors:	87
Associate Professors:	52
Assistant Professors:	45
Total:	*184

*Including Biosystems Engineering
and UTSI

Accreditation

All engineering programs at
the University of Tennessee are
accredited by the Engineering
Accreditation Commission of
ABET, <http://www.abet.org>. The
computer science program at
the University of Tennessee is
accredited by the Computing
Accreditation commission of
ABET.

Student/Faculty Ratio

21.2:1

For FY 2015
(July 1, 2014 – June 30, 2015)

The college has Five National Academy of Engineering Members

Dr. Mark Dean, John Fisher
Distinguished Professor,
Department of Electrical
Engineering and Computer
Science

Dr. Robert Dodds, Research
Professor, Department of Civil and
Environmental Engineering

Dr. Jack Dongarra, Distinguished
Professor, Department of
Electrical Engineering and
Computer Science

Dr. George Pharr, Director of
the Joint Institute for Advanced
Materials, Department of Materials
Science and Engineering

Dr. Steven Zinkle, Governor's
Chair for Nuclear Materials,
Department of Nuclear
Engineering

One Distinguished Scientist

Dr. Takeshi Egami, Department of
Materials Science and Engineering

Two University Distinguished Professors

Dr. Jack Dongarra, Department
of Electrical Engineering and
Computer Science

Dr. Bamin Khomami, Department
of Chemical and Biomolecular
Engineering

Dr. Suresh Babu, Governor's Chair
in Advanced Manufacturing

Dr. Howard Ball, Governor's Chair
in Global Nuclear Security

Dr. Terry Hazen, Governor's Chair
in Environmental Biotechnology

Dr. Yili Liu, Governor's Chair in
Power Electronics

Dr. Frank Loeffler, Governor's
Chair in Microbiology and Civil
and Environmental Engineering

Dr. Arthur Raganathan, Governor's
Chair for Biorefining, Department
of Chemical and Biomedical
Engineering

Dr. Uday Vaidys, Governor's
Chair in Advanced Composites
Manufacturing, Department of
Mechanical, Aerospace, and
Biomedical Engineering

Dr. William Weber, Governor's
Chair in Radiation Effects on
Materials

Dr. Brian Wirth, Governor's
Chair in Computational Nuclear
Engineering

Dr. Thomas Zawodzinski,
Governor's Chair in Electrical
Energy Storage

Dr. Steven Zinkle, Governor's Chair
in Nuclear Materials

Eleven Endowed Chairs

**H. H. Arnold Chair of Excellence in
Computational Fluid
Dynamics**

**Edward and Carolyn Boling Chair
of Excellence in Space Propulsion
Vacant**

**Robert M. Condra Chair of
Excellence in Computer Integrated
Engineering and Manufacturing
Vacant**

Robert M. Condra Professors
Dr. Edwin G. Burdette Professor
Dr. Baoshan Huang, Department
of Civil and Environmental
Engineering

**Robert M. Condra Chair of
Excellence in Power Electronics
Applications**
Dr. Fred Wang, Department
of Electrical Engineering and
Computer Science

**CTI Chair in Electrical and
Computer Engineering**
Dr. Kevin Tomovic, Department
of Electrical Engineering and
Computer Science

**Wayne T. Davis Endowed Dean's
Chair in Engineering**
Dr. Wayne T. Davis, Dean of
Engineering

**Ericsson-Harlan D. Mills Chair of
Software Engineering**
Dr. Audris Mockus, Department
of Electrical Engineering and
Computer Science

Gibson Chair
Dr. Stephen Paddock, Department
of Chemical and Biomolecular
Engineering

**Henry Goodrich Chair of
Excellence in Civil and
Environmental Engineering**
Dr. Thanos Papanicolaou,
Department of Civil and
Environmental Engineering

Leonard Garfield Penland Chair
Dr. Philip Rack, Department of
Materials Science and Engineering

**Ivan Racheff Chair in Materials
Science and Engineering**
Dr. Peter Liaw, Department of
Materials Science and Engineering

**Twenty-seven Endowed
Professorships and Faculty
Fellows**

Alvin and Sally Beaman Professors
Dr. Assad Khattak, Department
of Civil and Environmental
Engineering

**Blalock, Kennedy, Pierce Analog
Electronics Professor**
Dr. Ben Blalock, Department
of Electrical Engineering and
Computer Science

James McConnell Professor
Dr. Aly Fathy, Department
of Electrical Engineering and
Computer Science

**John and Dorothy McKamey
Professor**
Dr. George Pharr, Department
of Materials Science and Engineering

Fred N. Peebles Professors
Dr. Edwin Burdette, Department
of Civil and Environmental
Engineering

**Charles P. Postelle Distinguished
Professor in Nuclear Engineering**
Dr. Wesley Hines, Department
of Nuclear Engineering

**Dr. John Prados Chemical and
Biomedical Engineering Professor
Vacant**

**Richard Rosenberg Endowed
Professor
Vacant**

Fred Mason Roddy Professor
Dr. Rick Komistek, Department
of Mechanical, Aerospace, and
Biomedical Engineering

**Dr. Jack Whitfeld Professor
Vacant**

**Min H. Kao Electrical and
Computer Engineering Professor**
Dr. Leon Tolbert, Department
of Electrical Engineering and
Computer Science

**Blalock, Kennedy, Pierce Analog
Electronics Professor**
Dr. Ben Blalock, Department
of Electrical Engineering and
Computer Science

**Gonzalez Family Endowed
Professor**
Dr. Haihong Qi, Department
of Electrical Engineering and
Computer Science

**Armour T. Granger Memorial
Professor**
Dr. Bamin Khomami, Department
of Chemical and Biomolecular
Engineering

Jerry and Kay Henry Professor
Dr. David Mandrus, Department of
Materials Science and Engineering

**Min H. Kao Electrical and
Computer Engineering Professor**
Dr. Leon Tolbert, Department
of Electrical Engineering and
Computer Science

James McConnell Professor
Dr. Aly Fathy, Department
of Electrical Engineering and
Computer Science

**John and Dorothy McKamey
Professor**
Dr. George Pharr, Department
of Materials Science and Engineering

Fred N. Peebles Professors
Dr. Edwin Burdette, Department
of Civil and Environmental
Engineering

**Charles P. Postelle Distinguished
Professor in Nuclear Engineering**
Dr. Wesley Hines, Department
of Nuclear Engineering

**Dr. John Prados Chemical and
Biomedical Engineering Professor
Vacant**

**Richard Rosenberg Endowed
Professor
Vacant**

Fred Mason Roddy Professor
Dr. Rick Komistek, Department
of Mechanical, Aerospace, and
Biomedical Engineering

**Dr. Jack Whitfeld Professor
Vacant**

**Min H. Kao Electrical and
Computer Engineering Professor**
Dr. Leon Tolbert, Department
of Electrical Engineering and
Computer Science

**Blalock, Kennedy, Pierce Analog
Electronics Professor**
Dr. Ben Blalock, Department
of Electrical Engineering and
Computer Science

James McConnell Professor
Dr. Aly Fathy, Department
of Electrical Engineering and
Computer Science

**John and Dorothy McKamey
Professor**
Dr. George Pharr, Department
of Materials Science and Engineering

Three Faculty Fellows

**Ferguson Faculty Fellow
Vacant**

**Heath Fellow in Business and
Engineering**
Dr. Rupy Sawhney, Department
of Industrial and Systems
Engineering

**UCOR Faculty Fellow in Nuclear
Engineering**
Dr. Jason Hayward, Department
of Nuclear Engineering

Four Professors of Practice

**Eastman Professor of Practice in
Chemical Engineering**
Dr. Sankar Raghavan, Department
of Chemical and Biomolecular
Engineering

**Eastman Professor of Practice in
Electrical Engineering**
Dr. Yan Xu, Department of
Electrical Engineering and
Computer Science

**Eastman Professor of Practice in
Mechanical Engineering**
Dr. Matthew Young, Department
of Mechanical, Aerospace, and
Biomedical Engineering

**Underwriters Laboratory
Professor of Practice**
Dr. David Iscoe, Department
of Electrical Engineering and
Computer Science

**Additional Faculty
Professorships**

**Two COE CAREER Development
Professors**
Dr. Eric Boder, Department
of Chemical and Biomolecular
Engineering

Dr. Mohamed Mafouz, Department
of Mechanical, Aerospace, and
Biomedical Engineering

Two Chancellor's Professors
Dr. George Pharr, Department
of Materials Science and Engineering

Dr. Lawrence Townsend,
Department of Nuclear
Engineering

Dr. George Pharr, Department
of Materials Science and Engineering

Dr. Lawrence Townsend,
Department of Nuclear
Engineering

**Dr. Jack Whitfeld Professor
Vacant**

**Dr. Jack Whitfeld Professor
Vacant**

**THE UNIVERSITY OF
TENNESSEE
KNOXVILLE**
COLLEGE OF ENGINEERING

Outstanding Undergraduate Student: Duncan Greeley

Knoxville native Duncan Greeley grew up hearing stories of collaborations between the University of Tennessee and Oak Ridge National Laboratory (ORNL). Coupled with his parents' encouragement to seek an education in a technical field, he was intrigued by the possibility of getting involved with groundbreaking research.

"While I have been interested in engineering ever since high school, narrowing in on a major had always seemed a daunting task," said Greeley. "I was fascinated by a wide variety of industries—aerospace, marine, and renewable energy to name a few."

A summer pre-college program offered by the College of Engineering (COE) helped him focus his interests.

"I attended an American Society for Metals (ASM) International Materials Camp hosted by the Department of Materials Science and Engineering (MSE)," he said. "During that week, I was introduced to the unique and interdisciplinary field of MSE, and found that it matched my interests in a way that I would have never expected."

This match has helped Greeley, now a senior, thrive as an undergraduate student in MSE. He is a member of both the Chancellors Honors Program and the Tennessee Student Assistance Corporation Ned McWherter Scholars Program. He's also in the engineering honors society Tau Beta Pi, and is a COE Ambassador (chair for 2014-2015).

He earned the Best Poster award for "Modeling Oxygen Permeability in Biodegradable Polymer Films" in the UT Center for Materials Processing Summer Research Poster Competition in July 2013, and also a Best Undergraduate Poster award in the Oak Ridge Chapter of ASM International Student Poster Competition in November 2013. His studies have benefitted from a series of scholarships: the Herbert and Lillian Duggan Engineering Scholarship; the Jerry E. Stoneking Memorial Scholarship; the Thomas D. Dunlap Scholarship; the Shek Hong Scholarship; and the Racheff Scholarship and Fellowship in Metals.

He credits the Honors Engineering Fundamentals faculty—Drs. Chris Pionke, Roger Parsons, and Kevin Kit—for giving him the foundation and motivation to properly pursue opportunities.

"They challenged our class to work as a team and think critically to solve problems, and were always willing to sit down individually and offer guidance," he said. "Chris Wetteland, the coordinator of the MSE undergraduate laboratory

courses, has also been significantly influential. He constantly promotes innovation as a key tool in research, and above all encourages us to never be afraid to ask why."

Greeley's favorite aspect of his studies has been the opportunity to learn in hands-on laboratory projects as an undergraduate. One of his most beneficial projects involved using molecular dynamics to model oxygen permeability in biodegradable chitosan films, for which he won the two poster awards, under supervision of Dr. David Keffer.

"As this was my first research project I had ever participated in, Dr. Keffer offered not only technical mentorship but also advice on research skills such as literature review, data analysis and interpretation, and technical communication," he said.

Greeley balances his studies with activities that take advantage of the natural beauty of his hometown and region: running, hiking, mountain biking, and sometimes relaxing on the lake with the UT Sailing Club.

"I also enjoy volunteering with the Chancellors Honors Program Community Service Committee," said Greeley. "And I am a member of the UT Model United Nations Club."

Greeley has also enjoyed the benefits of the internship program offered through the COE Office of Engineering Professional Practice.

"I was a research intern at ORNL in the Science Undergraduate Laboratory Internship (SULI) program, investigating the use of the bio-derived polymer lignin in chopped-carbon-fiber-reinforced polymer composites," he said. "For my second internship, I worked at the Boeing Company in process development and optimization for environmental stress rupture testing of materials in the Boeing Research and Technology Huntsville Laboratories."

These internship, project, and course experiences gave Greeley exposure to the wide range specialties and sub-disciplines within materials science, as well as varying work environments in academic research, government research, and industry. He is investing this know-how into his own research projects.

"Based off of interest arising from a course on metallic materials, I plan on starting a new research project involving metal additive manufacturing," said Greeley. "After graduation I plan to pursue a PhD in MSE and continue to work in industry."





Outstanding Graduate Student: Caroline Black

Caroline Black, a doctoral student in biomedical engineering, stayed on the move throughout 2015. She planned her dissertation proposal while maintaining her excellent surgical robotics research, earning her notice as the College of Engineering's Outstanding Graduate Student for the year 2015. Along the way, she married a fellow engineer and also organized an event designed to inspire pre-college students to become engineers.

Black has long shown this type of drive. She forged her own path as an undergraduate at the University of Alabama at Huntsville, near her hometown of Madison, Alabama.

"I was interested in engineering and in the medical field," said Black, who found that the availability of biomedical courses was limited. "So I invented my own approach—I got a double degree in nursing and engineering."

This curricular combination gave her a dual viewpoint in problem solving, and helped her to win several awards in her undergraduate time.

"Several of those competitions were oriented to making the world a better place by using engineering to improve healthcare, the delivery of disaster aid, and the education system," said Black.

Dr. Caleb Rucker, assistant professor in the Department of Mechanical, Aerospace, and Biomedical Engineering (MABE), noticed Black's work and encouraged her to consider UT for her graduate studies.

"The tours that I had here and the people that I met let me know that this is where I need to be in order to take the next step in blending my two passions," she said. "Once I saw the campus and met with the professors, I realized how the university was committed to, not just research, but outcomes. I realized that UT had a mission to benefit the world and that is what I wanted to do as well."

Black was welcomed to UT with the Chancellor's Fellowship, which included full tuition and a stipend.

"I was honored to have received the award and very grateful for the benefits it gave me," she said. Black later received a National Science Foundation (NSF) Graduate Research Fellowship.

In her first semester at UT, Black built an initial design of a parallel continuum robot. She and Rucker co-authored a paper on the project, titled "Toward Parallel Continuum Manipulators," which earned the "Best Manipulator" award at the 2014 IEEE Conference on Robotics and

Automation (ICRA), held in Hong Kong. Her research continues to focus on robotics, specifically surgical robots that could improve techniques in prenatal surgery.

"The long-term impact of this research will reduce human suffering by lowering the risk and cost of treatment for one of the most vulnerable patient demographics: the unborn child," she said. "My research is also relevant to natural orifice surgical intervention and endoscopic procedures.

Black credits Rucker's "infectious" thirst for knowledge and Dr. William Hamel's experience and enthusiasm for robotics with influencing her academic success. Working with Rucker gave Black the opportunity to assist with several grant applications, an aspect of research she had been unfamiliar with.

"In working through the many requirements for these types of applications, I have realized that it is simply not enough to have good science—you have to also be able to communicate that to others," she said.

Black showed off more communication skills in organizing the "STEMpunk" reverse science fair for the College of Engineering's 2015 Middle School Introduction to Engineering Systems (MITES) summer camp. Her event gave visiting pre-college students hands-on experience with science, technology, engineering, and mathematics (STEM) projects. To add some fun to the activities, she themed the event around "Steampunk"—a literary and pop culture movement in which Victorian attire and materials are used to make modern machinery and equipment.

"My work at UT has found me on several different teams," said Black. "I have worked not only with engineers but also with mathematicians, physicists, biologists, psychologists, educators, and even artists. I have also been given the opportunity to work with the younger generation. The things I have enjoyed the most are learning from all these different groups, not only about science and engineering but how we learn the things we learn."

Black enjoys learning in all aspects of life, especially if it keeps her moving forward—or upward. Her husband, Justin Black, has been teaching her to rock climb.

"I love climbing and hiking," she said. "I am also a novice ballroom dancer. I can foxtrot, waltz, and swing."

Outreach Update

Faculty-led study abroad courses and alternative student-break trips have established a strong presence for international education and experience within the College of Engineering (COE). Five years ago, if a COE student wanted to study abroad, they went to the UT Programs Abroad Office to see what the university had to offer. Students were mostly restricted to finding general education courses that could fit into their curriculum. It could be difficult for students to find technical courses that let them stay on track for graduation. About fifteen COE students a year studied abroad.

Now, the COE offers three to five faculty-led, study abroad engineering course programs—organized by the Office of Engineering Outreach—every summer, and runs short-term, non-credit, alternative break service trips—organized by the Global Initiatives program—four times a year.

For the second year in a row, more than 100 COE students participated in global experiences, with fifty-eight receiving technical course credit as part of their experience. Another thirty students participated in other study abroad classes, and twenty-four participated in alternative-break trips.

Faculty-Led Study Abroad



COE students examine an Enigma Machine at Bletchley Park in England. Researchers at the facility broke the World War II German codes created with this device.

“I took two classes dealing with water resources engineering,” said civil engineering major Kelly Grissom. “The first course focused on the calculations of glacier volume loss found in Dr. Tootle’s research. The second course focused on the study of ice in the environment that reflects the past and present climate changes.”

Also offered this summer as a faculty-led program was Nuclear Engineering in Prague, sponsored by the Department of Nuclear Engineering and led by Dr. Ondrej Chvala. Twelve students received credit for a junior level nuclear engineering laboratory course for participating in a reactor physics training course associated with the Czech Technical University (CTU) of Prague. The students also visited several nuclear-related sites in the region, and composed a report on the experience as a group.

“It was very interesting to see the differences between the nuclear power plants from the US and those in the Czech Republic, but there were many similarities as well,” nuclear engineering students reported.



Dr. Ondrej Chvala, third from right, led UT nuclear engineering students on study-abroad courses in Prague, Czech Republic.

Global Initiatives

COE’s Global Initiatives program continued to offer international experiences to students in late 2014 and throughout 2015. Judith Mallory, COE International Coordinator, arranged and led the trips.

An Alternative Winter Break took eight students to the city of Quetzaltenango, Guatemala, in December 2014. The group constructed safe cook stoves for six indigenous families, replacing older open-flame stoves that are health and safety hazards.

“The new stove is more efficient, contains the fire, and uses less wood,” said Mallory. “This is an environmental bonus, as Guatemala suffers from deforestation.”

Side activities included a visit to the town square, horseback riding in the country, and a visit to Las Calientes Georginas, a volcanic hot spring in the mountains. The group also took a short trip to the Pacific coastal town of Tulate.

“The most rewarding part of the experience was being able to see the spark of joy in the homeowners’ eyes once we completed our project,” said Chirag Tailor, electrical engineering and computer science major. “I also really enjoyed the opportunity to explore a country and culture in an entirely new fashion.”

The Alternative Spring Break for 2015 took place in March in the town of El Jaz, Costa Rica, marking Global Initiatives’ third trip to this country. A local family had an old and improperly installed septic system, which had failed. Five COE students and a microbiology major helped replace the system, under the guidance of the homeowner.

“The system we installed more closely resembled the system used in many American homes,” said aerospace engineering major Emily Beckman.

In addition to the project, the group toured the Orosi Valley, including a look at the Cachi Dam, which generates hydroelectric power. Later, they observed the ruins at Ujarras, the Iglesia de Nuestra Señora de la Limpia Concepcion, dating from 1693, mostly destroyed by a flood in the 1800s. They toured the city of Cartago, the first city of Costa Rica and the original Colonial capital.

The Alternative Summer Break for 2015 took six COE students to San Ignacio, Belize, in May. The service project involved the construction of a large root cellar located on a sustainable farm, which is scheduled to become a home for girls aging out of the foster care system.

“We managed to make a great deal of progress in the few days we had to work,” said Rosemary Dabbs, a chemical engineering major. “By our last workday, we really were a team and we had fun with the task at hand, even though it was hard work.”

Side activities included a trip to the Green Iguana Conservation Project; a tour of a thriving Mennonite community; canoeing on the Macal River; a tour of the local produce and crafts market; and a horseback trip to the Maya archaeological site of Xunantunich.

The Alternative Fall Break took place in August, in Quito, Ecuador, with four COE students. A day care center funded by the government and private donations, Semillas Esperanza, or Seeds of Hope, was the project location. About 100 children, ages four and below, use the center while their parents are at work.

Students installed protective netting along the stairways, so that children would not fall off while going up and down. Repairs were also made on playground equipment, and rooms were given new curtains, paint, and shelves. Landscaping surrounding the play area was tidied. The group also assisted the staff in moving one of the classrooms to another floor.

“Students had two conversational Spanish classes, as well as a Salsa dance class, all provided by local instructors,” said Mallory.

Field trips included a visit to an art museum devoted to the works of Ecuadorian artist Oswaldo Guayasamin; the town of Otavalo, home of Ecuador’s largest indigenous market; Cascada Peguche, a waterfall and park; and the Cruz Loma Mountain.

Upcoming planned Global Initiatives trips will be to Peru in December 2015 and a return to Belize in March 2016.



COE students visit the Zugspitze, the highest point in Germany, while studying water resources and climate in Austria.



COE students mix cement to build new cooking facilities for a Guatemalan family.

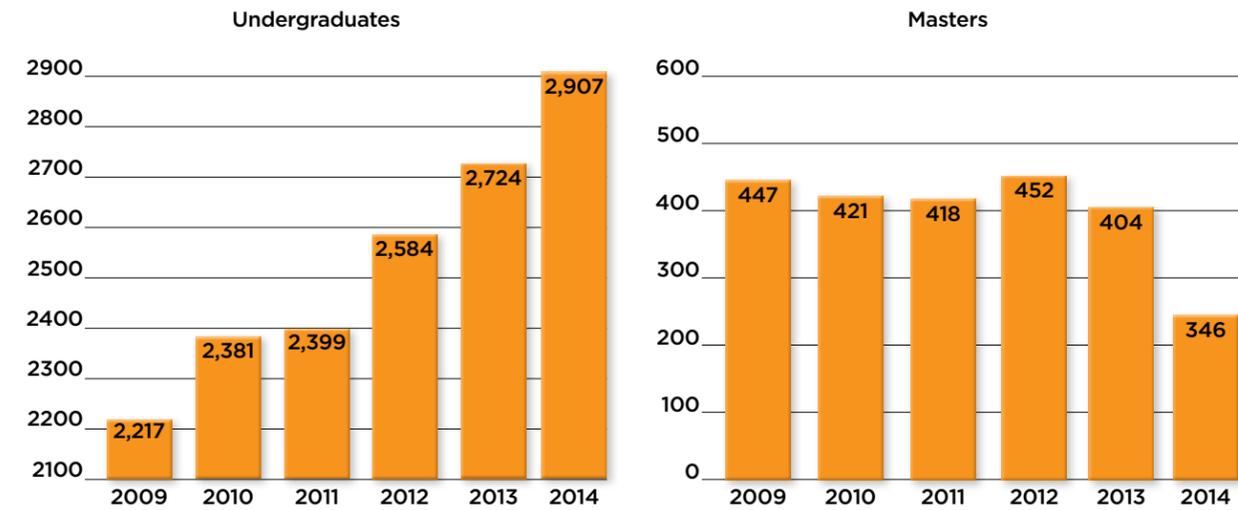


COE students help build a root cellar for a future home for young women in Belize.



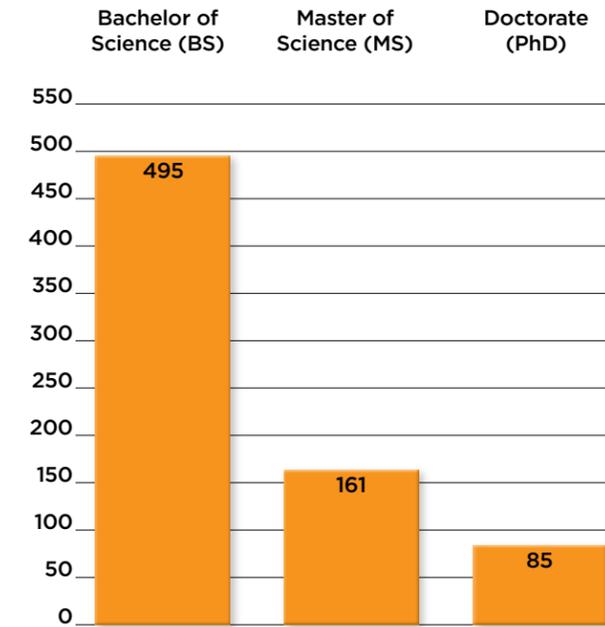
The 2015 Engineering Ambassadors (front row, left to right): Tina Anjonrin-Ohu (sitting), Samira Ibrahim, Mary McBride, Katie Roth, Haley Whitaker, Kristen Miranda, Abby Link, Sierra Ellis, Katelyn Luthi, Sarah Davis, Brooke McMurrer, Melanie Smith, Amanda Randolph; (back row, left to right): Greg Tate, Steven Shuman, Duncan Greeley, Parker Tooley, Jarrod Edwards, Braxton Brakefield, Jermaine Cheairs, Will Fredebeil, Austin Fullbright, Liam Weaver, Amany Alshibi, Rob Tennille. Not pictured: Elliot Greenlee, Stephen Kwan.

Engineering Enrollment Trends by Academic Year



Student Body 2014-2015

Degrees Granted 2014-2015



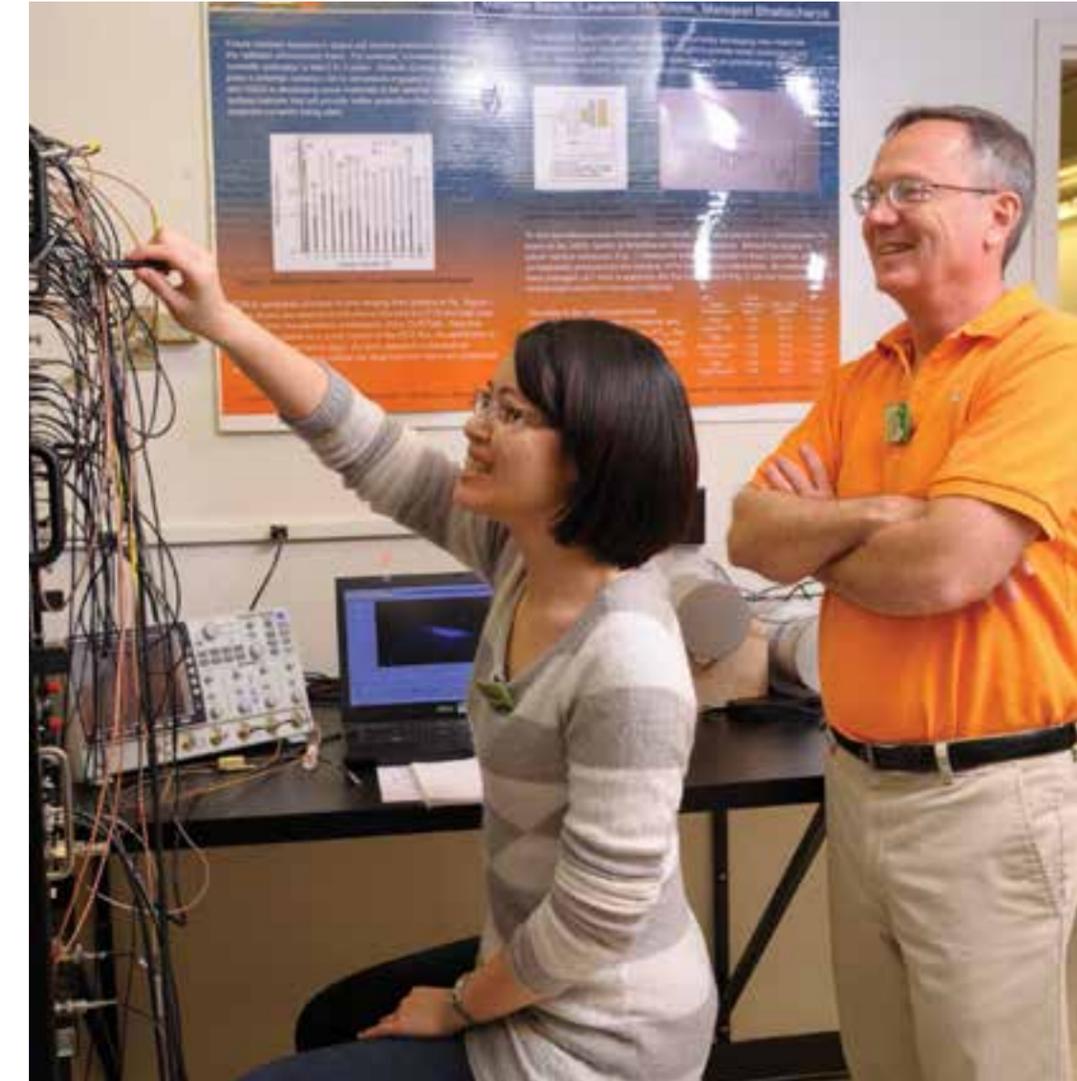
Dr. Jeffrey Reinbolt (center), Department of Mechanical, Aerospace, and Biomedical Engineering



Dr. Mingzhou Jin (center), Department of Industrial Engineering

College of Engineering 2015 Teaching Fellows

The COE Teaching Fellow Award is presented to faculty members who possess an exceptional record of graduate and undergraduate teaching and a strong performance in teaching-related service activities, and whose efforts clearly contribute to the overall mission of the college. The awards were established to award superior teaching.



Dr. Lawrence Heilbronn (right), Department of Nuclear Engineering

College of Engineering 2015 Professional Promise in Research Award



COE Dean Wayne Davis (far left) and Associate Dean for Research and Technology William Dunne (far right) present the COE Professional Promise in Research Awards to (left to right): Dr. Fangxing (Fran) Li; Dr. Lawrence Heilbronn; and Dr. Gong Gu. Not pictured: Dr. Yanfei Gao.

The COE Professional Promise in Research Award was established to award young faculty who are making significant contributions to the college's research mission. The 2015 award recipients include:

Dr. Yanfei Gao, Associate Professor, Materials Science & Engineering

Dr. Gao's research interests are mostly focused on small scale mechanical behavior, micromechanics of failure of advanced structural materials, and thin film growth in advanced functional materials. He has teamed with fellow MSE colleague Dr. George Pharr and Oak Ridge National Laboratory colleagues and made significant contributions to dislocation plasticity. He also worked with another MSE professor, Dr. Peter Liaw, to solve failure mechanisms in high temperature alloys by using neutron and synchrotron x-ray diffraction techniques.

Dr. Gong Gu, Associate Professor, Electrical Engineering & Computer Science

Driven by both intellectual curiosity and application potentials, Gu's primary research interest is in the novel physics and electronic device applications of two-dimensional (2D) materials. In the last century, heteroepitaxy, or seamless growth of a crystal on a different one, of conventional 3D semiconductors led to important devices such as lasers and high-speed bipolar transistors. Gu's research has demonstrated that the concept of heteroepitaxy can be expanded (or actually reduced) to two dimensions, resulting in a seamless 1D interface. This landmark work was published in *Science*. Follow-on works, also published in high-profile journals, further proved

that the in-plane heteroepitaxy is indeed of a 2D nature, not mediated by any factors in the third dimension, and also captured the electronic states of the interface. Gu's research is interdisciplinary, and he leads multi-institutional, international teams to accomplish scientific goals.

Dr. Lawrence Heilbronn, Associate Professor, Nuclear Engineering

Since joining the faculty at UT Knoxville, Dr. Heilbronn has received national and international recognition in the field of nuclear measurements related to space radiation research. He is a leading expert on secondary neutron production in space, a key component of the radiation environment in space craft and planetary habitats. He is the principle spokesman for the measurements group that will conduct a series of experiments at the NASA Space Radiation Laboratory at Brookhaven National Laboratory over the next four years. The experiments, which are designed to measure the components of the radiation field created by galactic cosmic ray interactions in shielding materials, have the potential to save NASA hundreds of millions of dollars in mission costs over the next generation of missions, as well as provide better estimates of the risk to astronauts from the harsh radiation environment in space. In addition to his NASA related research, Heilbronn also conducts research in isotope production, cross section measurements of short lived isotopes, detector development and testing,

accelerator target design and shielding, and medical physics. Heilbronn is a member of the UT Institute for Nuclear Security and is one of the principle investigators in UT's Radiochemistry Center of Excellence, where he conducts basic research on cross section measurements of actinides and lanthanides. His research involves collaborations with scientists and engineers from several DOE national labs, NASA Centers, universities, corporations, as well as international collaborators from Sweden, Japan, and Taiwan.

Dr. Fangxing Li, Associate Professor, Electrical Engineering & Computer Science

Dr. Li serves as the campus director of the Center for Ultra-wide-area Resilient Electric Energy Transmissions Networks (CURENT) research center, one of the largest electric power research centers in the US. His current research interests include renewable energy integration, smart grid, power markets, and distributed energy resources. He has published nearly seventy journal papers and one hundred conference papers and holds a US patent. He is an editor of IEEE Transactions on Sustainable Energy, IEEE Power and Energy Society Letters, the vice chair of the IEEE PES Power System Planning and Implementation (PSPI) committee, the president of North America Chinese Power Professional Association (NACPPA) and a Fellow of IET.

College of Engineering Research Achievement Awards



COE Dean Wayne Davis (third from left) and Associate Dean for Research and Technology William Dunne (far right) present the COE 2015 Research Achievement Awards to (left to right): Dr. Ben Blalock; Dr. George Pharr; Dr. Lawrence Townsend; Dr. John Schwartz; Dr. Dayakar Penumadu; and Dr. Kevin Tomsovic.

The COE Research Achievement Award was established to reward senior faculty members whose work is recognized nationally and internationally and who make notable contributions to the college's research mission. The 2015 award recipients include:

Dr. Ben Blalock, Blalock-Kennedy-Pierce Professor, Electrical Engineering & Computer Science

Dr. Blalock directs the Integrated Circuits and Systems Laboratory (ICASL). His research focus at UT includes analog/mixed-signal integrated circuit design for extreme environments (both wide temperature and radiation) across multiple semiconductor technologies, multi-channel monolithic instrumentation systems, mixed-signal/mixed-voltage circuit design for systems-on-a-chip, and gate drive integrated circuits for wide bandgap (SiC and GaN) power electronics. One highlight of his research team's extreme environment electronics research is their design and development of the Mars Quad Operational Amplifier (QOA) microchip currently in use on NASA's Mars Science Laboratory (MSL) exploration rover Curiosity. Over ninety copies of the QOA microchip are in use on the MSL Mars rover, distributed on the periphery of the Curiosity, enduring the harsh Martian surface environment.

Dr. Dayakar Penumadu, Fred N. Peebles Professor, Civil & Environmental Engineering

Dr. Penumadu is a Fred N. Peebles professor in the Department of Civil and Environmental Engineering (CEE). Penumadu holds the Joint Institute for Advanced Materials (JIAM) Chair of Excellence. Penumadu's research on energy selective neutron imaging to map spatially resolved crystalline phases was recently featured on the cover of *Advanced Materials*, a materials science and engineering journal with an impact factor of fifteen. His ongoing research is sponsored by the Office of Naval Research, the Defense Threat Reduction Agency, the National Science Foundation, the Department of Energy, and private sector corporations.

Dr. George Pharr, John and Dorothy McKamey Professor, Chancellor's Professor, Director, Joint Institute for Advanced Materials, Materials Science & Engineering

Dr. Pharr's research focuses on the mechanisms of deformation and fracture in solid materials, with an emphasis on probing these mechanisms at the micrometer and sub-micrometer scales. One of the primary tools he uses for his work is nanoindentation, a small scale testing technique that he pioneered along with researchers at the Oak Ridge National Laboratory starting in 1985. He is currently directing a large National Science Foundation (NSF) supported research project to take these techniques to the next logical steps by designing and building

a versatile next generation nanomechanical testing that will allow for testing at very high temperatures and very high speeds in high vacuum or in various gaseous atmospheres. Pharr is a Fellow of the Materials Research Society, a Fellow of ASM International, a member of the National Academy of Engineering, and was recently elected as the University of Tennessee's 2015 Macebearer.

Dr. John Schwartz, Associate Professor, Civil & Environmental Engineering

Dr. Schwartz's research program at UT has focused on advancing the understanding of watershed adjustments in physical, chemical, and biological processes resulting from anthropogenic disturbances. Recent research has included water resource management of the Tennessee Valley Authority river system examining potential effects of climate and land use change. Over the past ten years, Schwartz's research expenditures have totaled nearly \$4 million with funding from many federal and state agencies, and he has published thirty journal articles.

Dr. Kevin Tomsovic, CTI Professor, Director, Center for Ultra-wide-area Resilient Electric Energy Transmission Networks, Electrical Engineering & Computer Science

Dr. Tomsovic's research focuses on the development of optimization and intelligent system methods for the electric power system. The power system consists of a vast array of devices that interact both through their physical connection and indirectly through communication systems. The engineering challenges are how to design and operate this extremely complex system to meet economic, reliability and social objectives. Tomsovic's most recent research efforts have been directed at developing wide area controls for the power grid to allow full integration of renewables.

Dr. Lawrence Townsend, Robert M. Condra Professor, Chancellor's Professor, Nuclear Engineering

Using quantum mechanical, multiple scattering techniques, Dr. Townsend develops models of nuclear collisions of galactic cosmic radiation for NASA's use in applications related to radiation protection and risk analyses of exposures of astronauts to the complex space radiation environment. Townsend is also the Modeling Lead for the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) instrument on the Lunar Reconnaissance Orbiter spacecraft currently in orbit around Earth's moon.

Translational Research Award. The purpose of the COE Award for Translational Research is to recognize a faculty member whose research has achieved societal benefit through the development of intellectual property via licensing agreements, patents, and/or business startups.

Dr. Jie (Jayne) Wu, Associate Professor, Electrical Engineering & Computer Science

Dr. Wu has invented, implemented, and patented several methods in the area of AC electrokinetics-based microfluidics, lab-on-a-chip and microsensors. Among them, the most noteworthy is an international patent application "Method and Apparatus for Detection of A Biomarker by Alternating Current Electrokinetics," published in August 2013, which has been licensed by Meridian Bioscience, Inc. shortly afterwards in August 2014.



Dr. Jie (Jayne) Wu (center) receives the Translational Research Award from Dean Davis (left) and Associate Dean William Dunne (right).

COE Joins University in \$259 Million National Composites Manufacturing Institute



Dr. Taylor Eighmy

On Friday, January 9, 2015, President Barack Obama and Vice President Joe Biden visited the Knoxville area to announce that the University of Tennessee will lead the Institute for Advanced Composites Manufacturing Innovation (IACMI), a \$259 million public-private partnership. The Institute reflects a \$70 million commitment from the US Department of Energy and \$189 million in commitments from IACMI's partners.

Supported by the Advanced Manufacturing Office in the DOE's Office of Energy Efficiency and Renewable Energy, IACMI joins four other institutes backed by the Obama administration in a recent push to accelerate advanced manufacturing.

The selected team, a one hundred and twenty-two-member consortium, connects the world's leading manufacturers across the supply chain with universities and national laboratories pioneering advanced composites technology research and development.

Established as a nonprofit 501(c)(3) in Tennessee by the UT Research Foundation, IACMI has received a \$15 million commitment from the Tennessee Department of Economic and Community Development as part of an effort to facilitate breakthroughs in manufacturing and materials.

IACMI includes founding partners in Tennessee (University of Tennessee and Oak Ridge National Laboratory), Colorado (National Renewable Energy Laboratory), Indiana (Purdue University), Michigan (Michigan State University), Ohio (University of Dayton Research Institute) and Kentucky (University of Kentucky).

The Institute is regionally organized around five focus areas: vehicles (Michigan); wind turbines (Colorado); compressed gas storage (Ohio); design, modeling and simulation (Indiana); and composite materials and processing technology (Tennessee supported by Kentucky).

UT has emerged as a growing force in the field of advanced manufacturing, as evidenced by the university's ongoing partnership between UT and ORNL, its long history in nonwoven composites, its extensive collaboration with the federal government on composites research and development, and the selections of Suresh Babu as UT-ORNL Governor's Chair in Advanced Manufacturing and Dr. Art Ragauskas as UT-ORNL Governor's Chair in Biopolymers and Carbon Fiber. A third Governor's Chair in Composites is presently being recruited.

Several departments within the COE in particular have focused on advancing the use of materials in manufacturing and the process itself.

Carbon fiber, additive manufacturing (3D printing) and the development of other materials are but a few of the areas where UT and ORNL have a shared wealth of knowledge.

The Institute will focus on advanced fiber-reinforced polymer composites that combine strong fibers with tough plastics to yield materials that are lighter and stronger than steel.

The Institute has received commitments from large charter corporate contributors such as those with critical connection to the automotive composites supply chain like Ford, Volkswagen, Dow Chemical Company and DowAksa; premium



Dr. Suresh Babu



Dr. Dayakar Penumadu

members with national manufacturing impact like Boeing and Lockheed Martin; and small and medium enterprises like Strongwell Corporation, the world's leading pultrusion company, and Local Motors, the world's leading 3D-printed car company, which are both innovation drivers and local to East Tennessee. More than ninety companies across the supply chain support the project.

While advanced composites are used in selected industries such as aircraft, military vehicles, satellites and luxury cars, these materials remain expensive, require large amounts of energy to manufacture and are difficult to recycle. IACMI aims to overcome these barriers by developing low-cost, high-production, energy-efficient manufacturing and recycling processes for the composites sector.

The COE has played a significant role in this initiative from the beginning. Dr. Taylor Eighmy, UT vice chancellor for research and engagement, co-chair of the Institute's board of directors, and a professor in the Department of Civil & Environmental Engineering (CEE), was the leading principal investigator for the project and Governor's Chair Babu, and Fred N. Peebles Professor Dayakar Penumadu from the CEE department were also major participants in the proposal.

"This was a very competitive call with many prominent teams nationally going hard after the award," Eighmy said. "Winning this is obviously great for the University of Tennessee, ORNL, and our core team, especially when we think about our path to becoming a Top 25 research university. More importantly, IACMI will be both a magnet and a catalyst for rapid innovation research and development with companies interest in advanced manufacturing, especially here in Tennessee, in close proximity to the university and ORNL."

Babu envisions unique research opportunities for students as well.

"Both undergraduate and graduate students will be involved in this institute for performing research, as well as interacting with industry associates during research projects at UT," Babu said. "We are also planning frequent embedding of these students within the industrial members of IACMI."

Babu has helped to further the establishment of the Manufacturing Demonstration Facility (MDF) at ORNL, and said that most of the manufacturing solutions will be housed in the MDF. The large additive manufacturing equipment will be located at MDF and UT faculty and students will use this equipment for working on research in collaboration with IACMI industry partners.

"I was involved with the IACMI core team since its formation, representing the University of Tennessee, Knoxville, and integrating our technical capabilities and unique university resources in the area of the carbon fibers and polymer composites," Penumadu said. "Working closely with the faculty, IACMI board member and Vice Chancellor Eighmy, and Dean Davis, I look forward to the opportunities with IACMI as it evolves."

Additional COE professors involved with IACMI include Dr. Gajanan Bhat, a professor in the Department of Materials Science & Engineering and the director of the UT Nonwovens Research Laboratory. COE Dean Wayne T. Davis provided ongoing support and coordination with the engineering college as the IACMI proposal progressed.



President Obama (center) and Vice President Joe Biden (far right) take a look at the 3-D printed carbon fiber replica of a Shelby Cobra at Techmer PM, a plastics fabrication company based in Clinton. The facility was the location for the official announcement of UT's leadership of IACMI. The car was printed by a team including UT engineering students Andrew Messing and Alex Roschli.

"This opportunity adds to the momentum we've already built as a leader in this field," said Davis. "This selection, along with our Governor's Chairs, our strategic focus on advanced manufacturing, and our faculty's applied research into woven composites, carbon fiber and residual stress in composites, all serve to showcase our strategic place in the field of advanced materials. We look forward to our role in advancing manufacturing innovation."

The IACMI plan dovetails with the DOE's Clean Energy Manufacturing Initiative by encouraging collaboration and moving ahead with production methods and materials that require less energy and resources.

Dr. Craig Blue, a joint UT-ORNL faculty member, will be the IACMI Chief Executive Officer.

"Having IACMI will not only help cement expertise in traditional manufacturing, but will bring together UT's expertise in design, polymer science, textiles, processing of composites, as well as testing and characterization of composites," said Babu, who is based in the COE's Department of Mechanical, Aerospace, and Biomedical Engineering as well as ORNL.

The Shelby Cobra 3D printed car, which was highlighted during Obama's visit as an example of the changing world of manufacturing, was produced with major contributions from a pair of student interns from UT's College of Engineering—Alex Roschli and Andrew Messing.

Roschli and Messing, both seniors in the Department of Electrical Engineering and Computer Science, are doing internships at ORNL, where the car was printed at the Manufacturing Demonstration Facility.

Roschli worked on printing and assembling components of the car and fitting them with the body, while Messing developed the software that tells the printer how to make various parts.

The Cobra was 3D-printed with advanced composites that cut its weight in half while improving performance and safety, with a motor powered by wide-bandgap power electronics that are more efficient and less expensive than traditional silicon technologies and can be charged wirelessly.

Amazingly, the car was developed and produced by six people in just six weeks.

For more information, visit <http://tntoday.utk.edu/2015/01/09/white-house-picks-ut-lead-national-composites-manufacturing-institute/>.

Related video: <https://www.youtube.com/watch?v=VobUKNKpCGE>.



The group gathered to cut the ribbon to dedicate the Fred D. Brown Jr. Residence Hall included (left to right) Assistant Director for Facilities and University Housing Rodney Combs; Anne Holt Blackburn; UT Trustee Spruell Driver (BS/IE '87); Fred Brown's widow, Thelma Brown; Fred Brown's son, Douglas Brown; Vice Chancellor for Student Life Vincent Carilli; Chancellor Jimmy G. Cheek; UT President Joe DiPietro; Assistant Vice Chancellor for Student Life and Executive Director of Housing Frank Cuevas; President of the United Residence Hall Council Natalie Torres; Student Government Association President Kelsey Keny; and President of the Fred D. Brown Jr. Residence Hall Sherie Smith.

Engineering Diversity Programs Celebrate Dedication of Fred Brown Jr. Residence Hall

Diversity Program Graduates Join Together to Celebrate as the University Dedicates Fred D. Brown Jr. Residence Hall

On Friday, October 10, 2014, engineering alumni gathered to celebrate the legacy of the founder of the college's Engineering Diversity Programs (EDP) during a luncheon at the former University Center ballroom and the dedication of UT's first new residence in nearly forty years, the Fred D. Brown Jr. Residence Hall. The facility is named after the first director of the college's diversity programs, established in 1973.

The day started with breakfast for a small group of volunteers in the Executive Dining Room of the University Center. Engineering alumni Dwight Hutchins (BS/ChE '86), Rodney Brooks (BS/ME '85) and Cavanaugh Mims (BS/NE '86) chaired the meeting, which focused on efforts to raise \$1 million for three specific EDP funds—the Engineering Diversity Excellence Endowment, the Fred D. Brown Jr. Minority Academic Endowment, and the James Pippin Pre-College Program Endowment (named for James Pippin, who succeeded Brown as director of diversity programs until 2010)—between December of 2011 and December of 2018. COE Dean Wayne Davis spoke enthusiastically about the progress that EDP has made in recent years and thanked the alumni volunteers for their leadership and help in communicating the fundraising initiative to their fellow alumni.

A luncheon featured heart-warming reunions between former participants in the college's diversity programs and

included remarks by UT Chancellor Jimmy J. Cheek, Dean Davis, current EDP director Travis Griffin, and Fred Brown Scholarship recipients Andre Norfleet and Tina Anjonrin-Ohu. Hutchins, Mims, and Brooks (BS/ME '85) spoke passionately about Fred Brown's impact in their lives and the importance of alumni and friends joining them in investing in the UT funds that support today's diversity efforts to continue Brown's legacy of providing access, opportunity, and student support in pursuit of a UT engineering education. Approximately sixty alumni were in attendance, including numerous members of Fred Brown's family, some from as far away as Massachusetts and California.

In the afternoon, UT President Joe DiPietro, Chancellor Cheek, Dean Davis, and Brown's family, friends and former students, joined in celebrating Brown's life and legacy in a dedication ceremony that included live music, food, and tours of the residence hall.

Brown's son, Douglas Brown, delivered one of the most poignant of the day's speeches. As he recalled memories of his father—some of which sparked laughter and some of which highlighted his impact on the hundreds of former students in attendance—the standing-room-only crowd gained insight to a man responsible for making great progress in UT's diversity efforts.

Brown, who died in 1986, was the College of Engineering's first director of what was then called the Minority Engineering Scholarship Program, which started in 1973. Renamed the Engineering Diversity Programs office in 1999, the office serves to increase the number of underrepresented—African-American, Hispanic, Native American, Pacific Islander, Alaskan Native, and female—students. The EDP now offers successful summer recruitment and education programs for pre-college students, provides support and mentoring for underrepresented students during their time on campus, and encourages and facilitates enrollment of its participants in graduate school.

Brown was the first African-American teacher at Oak Ridge High soon after it was integrated and became the first African-American member of the Alcoa Board of Education. He is credited with laying the foundation for the UT College of Engineering's diversity program, one of the most successful college-based diversity recruiting programs in the nation.

"Fred Brown was an extremely important person in the lives of his students," said Davis, who was a professor at UT when Brown arrived. "He was instrumental in making sure that students didn't just come to UT, but that they graduated."



Unveiling the plaque at the Fred D. Brown Jr. Residence Hall are (left to right) Vice Chancellor for Student Life Vincent Carilli; Assistant Vice Chancellor for Student Life and Executive Director of Housing Frank Cuevas; UT President Joe DiPietro; UT Chancellor Jimmy G. Cheek; Fred Brown's widow Thelma Brown; and Fred Brown's son Douglas Brown.

Many former students who participated in the engineering diversity programs described how Brown took a "hands-on" approach to their education.

"He would come to dorms and check to make sure you were studying and he would make a point of walking with you to class to make sure you went," said Robert McKinney (BS/ME '86). "He made it clear that you were here to learn."

Mims said Brown came to his house in Georgia to convince him to come to UT, something a number of Mims's peers echoed. Mims said that at the time he didn't even know where UT's campus was located, but something about Brown's pitch convinced him to come.

Several students echoed the sentiment that Brown's guidance was key to them not only getting through college, but thriving.

"He would come to our dorm and see if we were playing cards or studying," said Spruell Driver Jr. (BS/IE '87), who emceed the EDP luncheon and is now on UT's Board of Trustees. "He did everything he could to make sure we were prepared for success."

The two hundred and fifty thousand square-foot residence hall houses about seven hundred undergraduates.

The building includes an art gallery, two restaurants, recreation and workout facilities, Internet and conference lounges on every floor—even its own post office.

The Fred D. Brown Jr. Residence Hall is the first building at the university named for an African-American.

For more information and a look at the facility, visit: <http://housing.utk.edu/students/halls/suite/#fred-d-brown-jr>.

For more information on the fundraising campaign for Engineering Diversity Programs, visit www.engr.utk.edu/give/diversity.



Fred Brown's family and guests pose for a photo in the lobby of the Fred D. Brown Jr. Residence Hall.



Fred Brown's son Douglas Brown speaks at the dedication of the Fred D. Brown Jr. Residence Hall.



UT Board of Trustees member and luncheon emcee Spruell Driver (BS/IE '87, left) greets Dwight Hutchins (BS/ChE '86, right) at the College of Engineering Diversity Programs luncheon.



Tiffany Sithiphone, UT engineering student and regional chairperson of the National Society of Black Engineers (NSBE) (left); and Diamond Wallace, UT NSBE chapter president (right), at the Diversity Programs luncheon.

Facilities Update



The Ribbon-cutting team (left to right): J. Parker Smith; John D. Tickle; Edna Kinner; Steve Crawford; Wayne T. Davis; Bamin Khomami; Mark Cox; and Etta Clark.

College of Engineering Celebrates Opening of New Eastman Unit Operations Laboratory

Eastman in Kingsport, Tennessee, has long been a strategic partner for UT's College of Engineering.

The new Eastman Unit Operations Laboratory was officially dedicated on Thursday, April 9, 2015, in a ceremony that took place in a tent just outside the Nathan W. Dougherty Engineering Building. The ribbon-cutting team included COE Board of Advisors Member and Vice President and General Manager, Manufacturing Support and Quality, Eastman, J. Parker Smith; UT engineering alumnus and Strongwell Chairman John D. Tickle; Vice President, Human Resources, The Americas, Eastman, Edna Kinner; UT alumnus and Senior Vice President and Chief Technology Officer, Eastman, Steve Crawford; COE Dean Wayne T. Davis; Alvin and Sally Beaman Professor and CBE Department Head Bamin Khomami; UT alumnus and Senior Vice President and Chief Manufacturing and Engineering Officer, Eastman, Mark Cox; and UT alumna and Vice President, Global Public Affairs and Policy, Eastman, Etta Clark.

The event celebrated the latest example of the Eastman-College of Engineering partnership, bringing business and education together to enable students to be successful in the workforce and to allow faculty to conduct valuable innovative research.

Bamin Khomami welcomed guests. After remarks by COE and Eastman officials and dignitaries, guests enjoyed conducted tours of the laboratory.

The lab offers state-of-the-art facilities for engineering students to learn real-world practices.

Unit operations labs are designed to help chemical engineering students take theoretical knowledge from the classroom and put it to use under monitored conditions.

In particular, students can go through the process of converting raw materials into finished products, something that helps them prepare for employment after college.

For a Fortune 300 company like Eastman, being approximately one hundred miles away from UT has provided them with one of their most critical resources: people.

While funding and mentoring provided by Eastman help the college, having such a highly skilled group of graduates in their area is one of the significant ways that the COE returns the favor.

In addition to the lab itself, Eastman also has funded a commons area in Dougherty, where students study or relax; three professors of practice positions; select engineering student groups; and the HITES— High School Introduction to Engineering Systems—camp. This support is part of Eastman's most recent commitment of \$2 million to the college.



New laboratory equipment in the Eastman Unit Operations Lab.

New Landscaping Projects Enhance Engineering Campus

Students, faculty, staff, and visitors to the UT campus will have an opportunity to enjoy two new significant landscaping projects on the engineering campus that are slated to be completed this fall.

The Perkins-Ferris Courtyard

Beginning in May, the courtyard area between Perkins and Ferris Halls and the steps to the Science and Engineering Research Facility (SERF) were closed to pedestrian traffic as a construction team began demolition on the area. In addition, Middle Way Drive was also closed to motorized vehicle traffic during the project. By late September, the project had created a plaza area uniting the surrounding buildings of Ferris Hall, Perkins Hall, and the Science and Engineering Research Facility. A combination of vegetation, pavers, and concrete pathways plus outdoor furniture with the existing mature trees completed the plaza. The area is also bordered on the SERF and Ferris sides by low walls appropriate for sitting. This plaza greatly increased the amount of seating, eliminated the shaded areas where plants would not grow, and created more pleasant routes between buildings on the engineering portion of the campus.



The engineering campus landscape project as viewed from near Ferris Hall.

The new furniture includes round tables with chairs, benches, and backless seating. Additionally, a number of increased locations for parking bicycles and outdoor trash and recycling bins have been added. A new staircase with seating leads down from the courtyard area between Dougherty and Ferris to Estabrook Road, making pedestrian access easier to parking behind the two buildings. The wi-fi access in the area has been improved, allowing students, faculty, and staff the capability to work on laptops and tablets outside.



The new path that runs between Ferris and Dougherty Halls to Estabrook Road.

On Middle Way Drive, pavers were added in a decorative pattern to enhance the appearance of the road. Also, the entrance area for SERF includes a new ADA-approved path.

Dr. William Dunne, the college's associate dean for research and technology, who is representing the college for the project, added that every effort has been made to preserve the mature trees, and new plants that are indigenous to the East Tennessee climate will be planted. Pavers and shade-friendly groundcovers have been used to fill in the areas under the trees, and to allow drainage from precipitation.

Estabrook Road Improvements

A second landscaping and upgrade project is going on along the eastern boundary of campus on Estabrook Road, behind the Dougherty Engineering Building and the Min H. Kao Electrical Engineering and Computer Science Building. The old chain link fence has been torn down, and structural engineers from Barge Waggoner Sumner & Cannon, Inc. (BWSC) along with workers from UT Facilities Services are replacing deteriorating above ground infrastructure (such as the sidewalk, fencing, overhead wires, etc.) and are adding streetscape elements including trees, lighting, seating, and new paving to improve the appearance and accessibility for this end of campus.

Due to extreme damage from weather, moisture, and vehicles over the years, the infrastructure underlying the area was in very bad shape, so the project has been limited to the area between Cumberland Avenue and the stairs leading to the parking area next to Second Creek. Dunne said that this phase of the project has been completed in time for the football season, with work along the remainder of Estabrook Road up to the John D. Tickle Building continuing after the football season and academic classes have completed.

The current plan is to completely restructure the eastern side of Estabrook Road by early 2016. The university and BWSC are also working with the City of Knoxville to clear out and landscape the bank of Second Creek that is located next to the university's parking lot in order for both areas to provide a consistently attractive and convenient pedestrian area for UT students, faculty, and staff.

JIAM Building to Fully Open in 2016

The Joint Institute for Advanced Materials (JIAM) Building, located on the university's Cherokee Farm Campus on the banks of the Tennessee River, is about to open its doors officially in 2016.

Built in two phases, all areas of the building are due for completion and move-in in January-March timeframe, according to JIAM Director George Pharr.

Current plans are for most of the occupants to move into the building in January, with the rest following after final construction.

"We are currently working on a business model for JIAM, with a base staff of five—a business manager, whom I have already hired; an office manager; an information technology manager; a building manager; and a shipping and receiving manager. We will also have four technical staff to coordinate management of the primary research facilities, including the Electron Microscope and Clean Room," Pharr said.

Estabrook Residents, *engage*™ Program Move to Perkins Hall

The calm in Perkins Hall after the Department of Civil and Environmental Engineering moved to the new John D. Tickle Engineering Building two years ago has ended, replaced by the energy and excitement of several hundred students as the classrooms, offices, and laboratories of the Jerry E. Stoneking *engage*™ Freshman Engineering Program; the Engineering Honors Program; the Engineering Advising Program; and the Engineering Diversity Programs vacated long-term tenancies in aging Estabrook Hall and moved into Perkins at the beginning of the Fall 2015 semester.

The move, assisted by a \$1 million remodeling budget from the university, consolidated the programs into improved and enlarged spaces, and also makes way for an easier facilitation of the new engineering complex, which is currently scheduled to begin design in the near future. Planning for the facility, which will house all of the freshman engineering programs and the Department of Nuclear Engineering, has already been completed and partial funding is already in place.

Perkins is now also home to offices for several new Department of Mechanical, Aerospace & Biomedical Engineering faculty as well as refurbished lab space for the Reliability and Maintainability Center. The engineering administrative offices continue to be housed in Perkins, with most located on the first floor.

Renovations to Perkins included fresh paint, updated electrical and plumbing, and detailed cleaning and reorganizing. Also, old noticeboards and signage in the hallways will be replaced by updated signage, noticeboards, poster-hanging strips, and video monitors. Additionally,

Pharr is also working with UT Facilities Services on details like security cameras, bus service to and from the Cherokee Farm Campus, and moving arrangements for faculty from the Department of Materials Science & Engineering, the Departments of Physics and Chemistry, and several other departments in the College of Engineering.



The new Joint Institute for Advanced Materials Building is slated to open next year.

"This will truly be a center for multidisciplinary materials research," Pharr said.

A dedication ceremony is currently scheduled in March 2016 at the JIAM Building.

For more information, visit <http://jiam.utk.edu>.

life-safety conditions were improved in the building via the installation of new smoke detectors and fire alarm system.

Dr. William Dunne, who supervised the project for the college, said his favorite project was the renovation of the Perkins sub-basement, a notoriously dark and dingy area that has now become a brightly lit and open classroom and lab space for the freshman engineering program. The large design workroom for the students will have colorful banners for the undergraduate degree programs, is accented with orange and white columns, and has new purpose-selected workbenches.

"Everything looks great, but I was totally pleased and surprised that we created such changed environment on the sub-basement level," Dunne said. "It is a great interim space for the freshman program for now until we have the new building."



The Perkins Hall sub-basement renovation



Outstanding Faculty: Dr. Jamie Coble

Dr. Jamie Coble's ties to the East Tennessee region brought her home to become an assistant professor in the Department of Nuclear Engineering at the University of Tennessee.

Coble was born in Florence, Alabama, and grew up primarily in Johnson City, Tennessee, where her father worked for the Tennessee Valley Authority. The family lived all along the Tennessee River Valley.

Coble's interest in engineering came about via influence from family and friends and through her early interest in math and science.

"When I was growing up, I had several friends whose dads were scientists and engineers at local companies—mostly at Nuclear Fuels Services and Eastman," Coble said. "I talked with them about their work and responsibilities, and the opportunities were very exciting. I enjoyed math and science in grade school, and my AP Physics teacher (L.G. Smith) advised me to look into engineering. L.G. suggested nuclear engineering as an area with a lot of opportunities. When I was choosing a major my freshman year, the impending nuclear renaissance was all the buzz."

Coble received all four of her degrees from UT—a bachelor's degree in nuclear engineering and mathematics in 2005, a master's degree in nuclear engineering in 2006, a master's degree in reliability and maintenance engineering in 2009, and a PhD in nuclear engineering in 2010.

Coble initially went to work at Pacific Northwest National Laboratory after receiving her doctorate degree, working as a staff scientist in the Applied Physics group for two years. Although she enjoyed the work, she missed the university and the Appalachian Region. When the opportunity came up to return to UT as an assistant professor, she eagerly accepted it.

"I always hoped to be a professor eventually because I love the university environment," Coble commented. "I got a fantastic education at UT, and I am very excited to be part of the department on this side of the classroom. The department has experienced impressive growth over the last several years, in terms of student body, faculty, and research. We have excellent research labs planned for our new building, which will open even more areas of research for the department."

Coble's research falls under the broad umbrella of instrumentation and controls (I&C), specifically focused on data-driven methods for equipment condition assessment, fault detection and diagnostics, and prognostics. Coble and her research team collect data on operating components (such as pumps, valves, motors) and analyze the data to determine if there is a fault in the equipment and estimate how much longer the equipment can operate before it breaks. This work supports optimized operations and maintenance planning for nuclear power plants to reduce the cost of generating electricity while maintaining the high safety and reliability standards currently enjoyed in the US nuclear fleet.

Coble's team recently received a \$1 million grant from the Department of Energy's (DOE) Nuclear Energy University Programs for a research project headed by Pacific Northwest National Laboratory with UT as a collaborating institution.

"This project was awarded through the DOE-NE Nuclear Energy Enabling Technologies (NEET) program to a collaboration between UTK, Pacific Northwest National Laboratory, and Analysis and Measurement Services Corporation (AMS), a local company owned by UT nuclear

engineering graduate Dr. Hash Hashemian," Coble commented. "This project is focused on empirical modeling methods for sensor calibration assessment to support reduced sensor calibration requirements in nuclear power plants."

Currently in the US, nuclear plants are required to recalibrate all of their safety-related instrumentation every eighteen to twenty-four months (depending on the plant). Studies by the Electric Power Research Institute (EPRI) suggest that only 3-5% of the sensors are actually out of calibration. The unnecessary recalibration efforts are expensive, time consuming, and contribute to radiation exposure for plant personnel. Future reactor designs feature longer refueling cycles (from four to forty years), which don't provide the convenient opportunities for calibration assessment expected for the current fleet.

Coble's team is developing methods to use the data that are being collected by the plant process monitoring and control sensors to evaluate the calibration of these sensors as the plant is operating. With this analysis, plants can focus recalibration efforts on those sensors that need it.

Coble's future goals include expanding on the current work in monitoring and prognostics to see how the results can be used to make informed decisions. She has been involved in work with PNNL to incorporate equipment condition assessment and prognostics into online risk monitors for advanced reactors, and wants to continue in this vein to provide actionable information for prognostics-informed risk assessment, control, and operations planning. Operations and maintenance costs make up 60-70% of the generation costs of nuclear power, Coble added; reducing these costs while maintaining extremely high safety margins will continue to make nuclear competitive as an energy source moving forward.

Coble also enjoys her role in teaching future nuclear engineers, and UTNE students are some of the best and brightest in the country.

"We attract some of the best nuclear engineering students at both the undergraduate and graduate level," Coble commented. "With our close proximity to Oak Ridge National Laboratory, TVA, and the Southern Company, we're uniquely positioned to offer students a lot of opportunities for research and industry internships."

Coble is also optimistic about the possibilities for nuclear power in the future.

"This is a very exciting time for the nuclear power industry. People are starting to recognize the value of nuclear power as a safe, clean, reliable source of energy and a necessary part of our energy future," Coble said. "We have five reactors under construction in the US, with the first coming online within the next six months. We have many innovative designs available with enhanced safety features, such as passive cooling systems, and new operating paradigms like those we see with small modular reactors. As we move away from fossil fuels for our baseload energy generation and develop markets for small modular reactors, we expect a lot of growth going forward in the nuclear industry."

During her time away from campus, Coble likes to spend time with her cat, Lillith Cheeterah, who has been with the professor since Coble was an undergrad. She also enjoys hiking in the Smoky Mountains, biking on the greenways around town. Coble also frequently visits her brother, Duncan, who is an English teacher at Anderson County, and his wife, Sara, who works for the Department of Children's Services, and their family who also live in Knoxville.



Outstanding Faculty: Dr. Kevin Tomsovic

An obsession with stereo equipment led Kevin Tomsovic to a successful career in electrical engineering. Tomsovic is the director of the Center for Ultra-Wide-Area Resilient Electric Energy Transmission Networks (CURENT), a National Science Foundation (NSF) Engineering Research Center that is jointly supported by NSF and the Department of Energy (DOE). Tomsovic is also the former head of the Department of Electrical Engineering & Computer Science (EECS) and is the CTI Professor in the EECS department.

Tomsovic was born in in Slidell, Louisiana, near New Orleans, but his family moved around during his youth, living in California, Indiana, and Michigan. Tomsovic considers Detroit his hometown.

His early interest in engineering was initially sparked by an attraction to math and science, and he also was driven by a desire to understand how all of the items that surround us everyday actually work.

“In high school, I was a stereo nut and somehow found a job repairing electrical equipment for our school district,” Tomsovic said. “I suppose it didn’t hurt growing up in Detroit in the 60s and 70s where it seemed everyone in the city could pop the hood of a car and tell you what everything was.”

Tomsovic received his bachelor’s degree from Michigan Tech and his masters and PhD degrees from the University of Washington, where he joined the faculty and was named Outstanding Researcher in 2001, 2003, and 2004 and Outstanding EE Teaching Faculty in 1996 and 2002.

Tomsovic came to UT as EECS head at a time when many exciting things were happening for the department. In 2005, Dr. Min Kao, chairman of the Garmin Corporation and a UT alumnus, gave a transformational gift of \$17.5 million to the College of Engineering—\$12.5 million of which was designated for a new electrical engineering and computer science building to be named in his honor. The Department of Computer Science, previously a part of the College of Arts and Sciences, merged with EECS in in July of 2007, greatly expanding the faculty and the research capabilities of the department.

“When I came to UT as EECS department head, I was attracted to both the challenges, and the growth potential, for the newly formed EECS department with its new building and facilities,” Tomsovic commented.

Tomsovic later partnered with COE Governor’s Chair in Power Electronics Yilu Liu to write a proposal to the NSF for funding to create a NSF Engineering Research Center (ERC) focused on research, education, and technology for sustainable energy systems with an emphasis on power transmission systems at UT. The result was a five-year, \$18 million award from NSF and DOE to establish the Center for Ultra-wide-area Resilient Electric Energy Transmission Networks (CURENT). The center was the first time the university was designated to lead an ERC and the first time an ERC was established to address power transmission systems. The NSF ERC is historically the most prestigious award given to a university team.

Tomsovic was named director of CURENT, and Liu co-director. Tomsovic resigned as department head to devote his efforts full-time to CURENT and to his research in power systems.

“My research focuses on control methods and optimization for the grid,” Tomsovic said. “We have developed some ideas that allow the different equipment connected to the grid to contribute to overall system performance. The key is to provide the proper information to actuators so the control complexity is minimized but the system can take advantage of the capabilities of each piece of equipment. For example, it may be more beneficial, and economic, to use a wind turbine to support voltage rather than produce maximum power.”

Tomsovic’s role as director of CURENT is to keep the center focused on its overall research mission and to maintain the NSF’s strict requirements for an ERC.

“As director, I have many of the responsibilities that one would have as a department head. There are numerous research accounts, a large number of students, curriculum development, and laboratory facilities to maintain. In addition, we have an extensive outreach program that includes elementary schools and secondary education, as we want to grow interest in the STEM fields. Moreover, our industry program necessitates constant interaction with our member companies to ensure their continued support and value for our students. Still, probably the biggest responsibility is to make sure the research continues to develop and meets the expectations of NSF and DOE. Needless to say we are busy.”

CURENT plays a central role in President Barack Obama’s goal to overhaul the nation’s power grid. The president outlined a framework to take America’s early twentieth-century power system into the twenty-first century through cutting-edge research.

“Our vision is for a nation-wide transmission grid that is fully monitored and dynamically controlled in real-time for high efficiency, high reliability, low cost, better accommodation of renewable energy sources, full utilization of energy storage, and accommodation of responsive load,” Tomsovic said. “This really just says we want an electric grid that is flexible enough to accommodate new generation technologies without sacrificing either cost or reliability. Our mission is to develop and demonstrate the technologies that will make this possible. I personally feel a modernized power grid with long distance transmission of power is fundamental to addressing energy needs of the country whether your point-of-view is economics, energy security, or environmental impact. CURENT is a leader in this area and we bring together many industry and government decision-makers through our research who can influence policy. Still, we certainly realize energy issues are very broad and there is a need for many research centers in energy, all of whom are important.”

Tomsovic enjoys working with both students and faculty as director of CURENT.

“What is truly enjoyable about a center such as CURENT is the ability to work in teams to comprehensively address an engineering problem,” Tomsovic commented. “We are working in large groups and that is far from the usual model for university research, which is more typically one or two PIs and a couple of students work together. Working in teams, however, is how real practical engineering is done on large complex systems. It is also a lot harder.”

Long-term, Tomsovic wants to grow the center to include fifty industry members (the center currently has twenty-nine) and develop a plan for long term funding so the work can continue after the NSF support ends. He wants CURENT to have an impact on practice both in the US and around the world.

“In order to achieve that goal, we will need to form companies that can promote our technology and we need to educate students who either form new companies themselves or who become leaders that influence the field,” Tomsovic adds.

Tomsovic is married to Chien-fei Chen, who directs the CURENT education and diversity programs. The couple has two daughters, YiAn and YuKai.

“The only male companionship I have at home is our dog Yakul,” Tomsovic joked.

Although he rarely has time for hobbies, Tomsovic enjoys skiing and likes to travel to the Far East, particularly Taiwan and Japan, whenever he has the opportunity. He said the food there is the “best in the world.”



Research Feature: Dr. Arthur Ragauskas

Dr. Arthur Ragauskas, the COE's Governor's Chair in Biorefining, has a vision for the future of energy research in the US.

Ragauskas received his BS in chemistry with honors and his PhD in science, respectively, from the University of Western Ontario.

He was a postdoctoral fellow on the National Science and Engineering Research Council (NSERC) in Canada from 1985 to 1986, and moved on to become a NSERC postdoctoral fellow at Colorado State University from 1986 through 1987. He was an associate research scientist with the National Research Council of Canada from 1987 through 1989.

Ragauskas started his academic career in 1989 at the Institute of Paper Science and Technology in Atlanta, Georgia, and in 2003 transferred to the School of Chemistry and Biochemistry at the Georgia Institute of Technology, where he held the first Fulbright Chair in Alternative Energy.

In the spring of 2014, he joined the UT College of Engineering faculty in the Governor's Chair position, and he also is a professor in the Department of Chemical and Biomolecular Engineering, with a joint appointment with the UT Institute of Agriculture's Department of Forestry, Wildlife, and Fisheries.

Ragauskas developed an interest in biomaterials at an early age.

"As a child, my father and mother developed my kinship and love of camping, fishing, and in general outdoor activities; the blending of these 'loves' with science and engineering just naturally lead to my passion in biorefining bioresources to biofuels, bio-based materials, and chemicals," Ragauskas said.

During his tenure at Georgia Tech, Ragauskas and his research team developed unique analytical skills to characterize biomass and its components. At the same time, he had growing interactions with researchers at UT and ORNL, and eventually a move to the university became a natural next step. Ragauskas has transferred the use of this skill set to UT, where he works to develop novel technologies to convert biomass to second and third generation biofuels, lightweight high performance bio-composites, and bio-based chemicals polymers.

Ragauskas' research is primarily directed at understanding and exploiting innovative sustainable bioresources. The multifaceted program is targeted to develop new and improved applications for nature's premiere renewable biopolymers for biofuels, biopower, and bio-based materials and chemicals.

"In terms of future bio-energy resources first, we are honored to be part of the BioEnergy Science Center, funded by the Department of Energy (DOE) and managed by Oak Ridge National Laboratory (ORNL)," Ragauskas said. "The center's mission is to enable the emergence of a sustainable cellulosic biofuels industry by leading advances in science and science-based innovation resulting in removal of recalcitrance as an economic barrier to cost-effective production of biofuels. My research contributes to a fundamental understanding of plant cell wall recalcitrance and how to overcome it. We also have other active programs to convert biomass to biofuels on a thermo-chemical technology platform. All of these efforts will help provide the nation sustainable, secure biofuels."

Several factors attracted Ragauskas to the Governor's Chair position at UT.

"UT has an incredible resource base in this field, starting with students that want to make a difference in our future based on sustainable green technologies, a faculty and administration that is very supportive of intra-disciplinary research, a national and internationally recognized agricultural/forestry program, and the exciting opportunities provided by ORNL and their commitment to excellence in plant science/biorefining, computational modeling, and neutron science," Ragauskas commented. "Truthfully, there are few, if any, other places that provide researchers with the opportunity to have such an impact on converting biomass to biofuels and bio-based materials and chemicals."

The joint appointment with the Department of Forestry, Wildlife, and Fisheries also provides additional scope for Ragauskas' research.

"This appointment is critical to my long term vision in terms of student/researcher recruitment, access to excellent bioprocessing/conversion research facilities, and a great set of colleagues to exchange ideas with and help in problem solving; and, equally important, I truly believe that all biorefining technologies need to begin with the starting material, i.e., the plant material," Ragauskas said. "Although my group is not a plant science group, we benefit tremendously in generating novel conversion technologies by working together with plant scientists."

Ragauskas and his team engage both undergraduate and graduate students in their research projects, as well as postdoctoral scientists and visiting faculty from all over the world. He has set several goals for his future research work.

"My first goal at UT was to get our labs back up and running, and due to the dedication of my students and postdoctoral research fellow, this is ninety-nine percent done! Secondly, we are building cross-campus collaborative teams that will further leverage ORNL research infrastructure and personnel," Ragauskas said. "Additionally, some of our studies in bio based composites and materials should in the near term be spun-off into IP and eventually be leveraged with corporate interests. I hope our studies in biofuels will translate into practical applications that will simplify and reduce the cost of biofuel generation"

Ragauskas is the recipient of the 2014 TAPPI Gunnar Nicholson Gold Medal Award and the ACS Affordable Green Chemistry award. He is a Fellow of the American Association for the Advancement of Science, the International Academy of Wood Science, and TAPPI, and was elected an American Association for the Advancement of Science Fellow and to the Academy Board of the International Academy of Wood Science, both in 2012. Ragauskas and his students have won several awards, including the ACS graduate research award.

Ragauskas is excited about future opportunities at UT.

"The students, faculty, and support staff at the University of Tennessee make me a better researcher, teacher, and academician," he said.

For more information on Ragauskas and his research, visit www.engr.utk.edu/cbe/faculty/Ragauskas/default.html.

Development Update

Development Report: \$67 Million in Banner Year



Dr. Edwin G. Burdette

Fundraising in the College of Engineering moves from one success to the next because our donors understand that philanthropic investments drive accomplishment. Each commitment amplifies our efforts to provide an ever better engineering education that will benefit each student who walks through these doors. This report highlights selected new commitments in fiscal year 2014-15. The total for all gifts this year is just over \$67 million.

Faculty support remains priority one because great faculty members are the core of a great university. Our faculty teach, mentor, and work to discover solutions to global problems. We want UT engineering students studying with individuals who will challenge them to explore broadly, learn deeply, and become problem solvers. Five new faculty funds totaling over \$3 million were created or enhanced this year including the Dr. John Prados Professorship in Chemical and Biomolecular Engineering; the Jerry and Kay Henry Professorship, awarded to Dr. David Mandrus; the Dr. Edwin G. Burdette Professorship in Civil Engineering; and the Richard Rosenberg (BS/ME '54) Professorship in Mechanical Engineering. The Frank C. Smartt (BS/ME '47) Faculty Award was also endowed this year.



Dr. David Mandrus

Freshman enrollment growth means we need more of everything: more space, more supplies, and more graduate teaching assistants for this time-intensive curriculum that focuses on student learning. Tom (BS/ME '72) and Elaine Edwards added significantly to their existing endowment for the Jerry E. Stoneking *engage*™ program, providing new support for graduate teaching assistants in the freshman program.

The Diversity Challenge made tremendous progress with new support from Robert (BS/ChE '81) and Rosalind Lewis and a mini-challenge from Dr. Mark Dean (BS/EE '79), Fisher Distinguished Professor. With three years to go, \$550,000 has been secured towards the \$1,000,000 goal.



Female engineering students interact at the WomEngineers Day in 2015.

Big Orange Give was a huge success for engineering! Year two of UT's fall social media-driven one-week push began with an engineering goal of \$25,000 but challenge gifts from Mike Dodd (BS/EE '95) and John Tickle (BS/IE '65) resulted in a total of \$171,228 raised in one week. Donors designated to funds of their choice—college and department funds, engineering scholarships, diversity programs, and student-led projects like WomEngineers Day. Look for version 3.0 this fall and make a gift. Graphics on-line are updated instantly making it fun—and addicting—to watch progress.

The Estabrook Society, formed to recognize documented or realized estate commitments for the College of Engineering, added new members including: Dr. Ronald A. Cook (BS/CE '75, MS/CE '81) and Kathy J. Caldwell, PE (BS/CE '85); Janus Ellenburg (deceased), widow of Bob Ellenburg (BS/EE '42) also deceased; John Kennerly (BS/ChE '65), deceased; Mel Mingle (BS/

ME '58); Ron (BS/EE '69) and Jessica Morris; Suzanne Roat (MS/ChE '87, PhD/ChE '91); Terry Scholes (MS/CE '79); David Sims (BS/ChE '69); and Royal Watts (BS/ChE '49), deceased. Planning in a Will, creating a Trust, or designating UT Engineering as a beneficiary of an IRA, can be a simple but profound way to impact the future.

Among the new scholarships established is the Dr. Robert E. Uhrig Graduate Scholarship in Nuclear Engineering created by Dr. Uhrig's family—his widow, Paula, and their seven children. Dr. David (BS/EPh '62) and Mrs. Joan Greene Patterson also created a new scholarship endowment to benefit students in the Electrical Engineering and Computer Science Department.

The power of these gifts and commitments will be felt for decades to come.

Outstanding Alumna: Dr. Leslie Benmark



Dr. Leslie Benmark (BS/IE '67, MS/IE '70) has had a long and successful career as an engineer, corporate leader, and in public service since graduating from the University of Tennessee.

Benmark was born in Illinois during World War II, and her mother was a secretary in the Army where her father was serving as a 1st Lieutenant. Benmark's father was stationed in Atlanta, Georgia, at the time his daughter was due to arrive, so Benmark's mother went to her family home in Illinois to have her child, returning to Atlanta after ten days. The family returned to Knoxville after the war, and Benmark's father finished law school at UT, moving the family to Memphis to begin practicing law, and then relocating again to his hometown of Lawrenceburg, Tennessee. He joined the family law firm, Freemon and Freemon Attorneys, working with his father and two brothers. Once settled, Benmark grew up in Lawrenceburg and lived in that town until starting college at UT.

Benmark's interest in engineering was influenced by the culture of her formative years.

"I graduated from high school in 1962," Benmark said. "At that time there was a national concern that the United States was behind in the space race—the 'Sputnik Crisis'—due to an apparent US 'shortage' of engineers." Throughout high school, I enjoyed and made good grades in all my mathematics and science courses. After taking a battery of interest/placement tests in high school, my guidance counselor recommended that I major in teaching education for math or science in college; she commented that if I had been a male, then engineering would be a good choice but, since I was a female, that would not be possible. Luckily, my parents were more forward thinking. They suggested that I give engineering a try. While I was growing up, I saw the movie Cheaper by the Dozen about the early industrial engineers Frank and Lillian Gilbreth. Their work—but not their twelve children—interested me a great deal so I decided to major in industrial engineering which proved to be a good match since I got my BS and MS in that discipline."

Benmark had grown up listening to UT football on the radio, and since her father was an alumnus she already had strong ties to the university. Although she also applied to Vanderbilt, the engineering department at that institution was not admitting women, so that confirmed UT as her choice. In later years, Benmark enrolled in Vanderbilt's graduate information engineering program, where she earned her PhD and also was the director of Vanderbilt's Women Engineering Program while working on her doctorate degree.

"I actually started my engineering education at the University of Tennessee at Martin (at that time, called the University of Tennessee Martin Branch). UT classes were taught on a quarter basis. I decided to apply for the Co-operative Engineering Program where, quarterly, I would be able to alternate academic studies with working as an engineer in industry. I wanted to be a co-op engineer, primarily for the monies I could earn during the work sessions in industry. I found out the earnings were, by far, the least important thing that I got out of the industry experience. The most important results of my co-op periods were my growing interest in computers which affected the rest of my academic studies and my career after graduation. I was fortunate to have co-op work experiences with computers and, after returning to school, took computer courses for all my technical electives. When I graduated with a BS degree in industrial engineering, I sought work employment in the chemical industry in which I could utilize my interest in computers. This also led to me pursuing a PhD in information engineering from Vanderbilt after the MS in industrial engineering from UT."

As one of only a small number of women pursuing a career in engineering after receiving her bachelor's degree in 1967, Benmark received numerous job offers with generous salaries. She accepted a position at the Monsanto Company in St. Louis, Missouri, interested in the opportunity to live in a big city. During her time with Monsanto, Benmark was dating her future husband, Gary Benmark, and when the couple became engaged, she moved back to Tennessee. She had received an offer from the DuPont Company at the manufacturing facility near Nashville after graduation, so when she inquired with the company to see if the job was still open, they said yes. Benmark ended up working for DuPont for thirty-seven years.

"I began my employment with DuPont with a BS degree," Benmark commented. "While working for DuPont, the company paid for me to earn a MS degree in industrial engineering from UT, a PhD degree in information engineering from Vanderbilt and a Juris Doctor degree in Law from Delaware Law School of Widener University."

Benmark began her career with DuPont as a Systems Analyst, then a Systems Analyst Supervisor; she also held the positions of Industrial Engineering Supervisor, Planning/Cost Analysis supervisor, Engineering Design Supervisor, and Typar[®] Manufacturing Staff Assistant. Her final assignment at DuPont corporate headquarters in Wilmington, Delaware, was as a Certified Six Sigma Black Belt for Global Information Technology and Solutions."

The Six Sigma responsibilities combined Benmark's expertise and training in both industrial engineering and information engineering. Six Sigma, a set of techniques and tools for process improvement, seeks to improve the quality output of a process by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical and statistical methods. As a Certified Six Sigma Black Belt, Benmark was responsible for leading several teams that identified and implemented several customer satisfaction and productivity improvement projects with savings of over \$11 million for DuPont's Global IT&S. The Six Sigma program was introduced into the DuPont Company when Chad Holliday, a fellow industrial engineering graduate from UT, was CEO of the company. In addition to leading many Six Sigma projects, she also assisted in numerous other projects as consultant and coach.

Benmark was inducted into the elite National Academy of Engineering (NAE) in 1993, in two areas—Industrial, Manufacturing, and Operational Systems Engineering and Computer Science and Engineering. At the time that she was inducted into NAE, there were only twenty-seven female members. In comparison, in 2015 there are now one hundred and twenty-eight members who are women.

Benmark was the president of the Accreditation Board for Engineering and Technology (ABET) in 1990-91, the first female president of this organization in sixty-six years. She was also the Directorate for Engineering Advisory and Chair for Presidential Faculty

"The industrial engineering curriculum at UT provided an excellent, broad foundation for an individual seeking a career with major companies," Benmark commented. "I believe this broad engineering and business education, along with almost two years work experience as a co-op engineer enabled me to function immediately in my first full-time work experience with the Monsanto Company and continued to support me in a number of varied positions with the DuPont Company."

Fellow selection and the Engineering Education Coalition Selection Panels for the National Science Foundation; she served on the Manufacturing Studies Board for the National Research Council; was a member of the US delegation of the US Council for International Engineering Practice, charged with defining inter-country engineering professional licensing requirements between the US, Canada, and Mexico; and served as the Group Vice President for Professional Enhancement, on the board of directors, and in many other positions with the Institute for Industrial Engineers.

In addition to her work and activities as a professional engineer, Benmark has been extensively involved with the Civitan organization, and is currently serving a term on the International Board.

"I am in the position at this stage of my life to 'give back' for the many opportunities I have enjoyed in my career and personal life. Civitan provides an excellent opportunity to accomplish this end," Benmark said. "Civitan clubs sponsor a multitude of projects that help, support and encourage in many areas of need in our local communities—persons with developmental and intellectual disabilities, youth, elderly, veterans, disadvantaged, etc. Civitan International supplements the local efforts. And the Civitan International Research Center, supported by many individual and club contributions, enables important research and treatment for persons challenged by developmental disabilities. I am currently in my second year as Governor of Valley District of Civitan International (Valley District includes West Tennessee, two-thirds of Middle Tennessee, Western Kentucky, and Northern Mississippi). When my terms of office as District Governor is completed October 1, I will join the Civitan International Board of Directors for a two-year term and will represent approximately three thousand Civitans in three districts that include thirteen states."

Benmark has been married to Dr. Gary Benmark (PhD in Public Policy Administration from Vanderbilt; BS and MS in Health Sciences from UT) for almost forty-seven years. Gary is a retired US Army Colonel and also retired from Metro Nashville/Davidson County government. He is a Past District Governor of Rotary International and also very active in Civitan International.

The Benmarks enjoy travel; they have visited all fifty states in the US and over fifty-six countries. When not seeing the world, they live on twenty-eight acres in Metro Nashville/Davidson County and enjoy country life that includes maintaining the acreage and many other projects. They are currently erecting an eighteen foot wide and fifteen foot high outdoor stone fireplace.

Benmark believes her engineering academic studies at UT were an important factor in her successful career.

"The industrial engineering curriculum at UT provided an excellent, broad foundation for an individual seeking a career with major companies," Benmark commented. "I believe this broad engineering and business education, along with almost two years work experience as a co-op engineer enabled me to function immediately in my first full-time work experience with the Monsanto Company and continued to support me in a number of varied positions with the DuPont Company."

Dougherty Award Winner: Mr. James Porter

A night of recognition for outstanding achievement for the COE culminated with James B. Porter Jr. (*BS/ChE '65*) receiving the Nathan W. Dougherty Award—the college's highest honor—at the Holiday Inn World's Fair Site on Thursday, April 9, 2015, during the college's annual Faculty and Staff Awards Dinner.

College faculty, staff, and current and former Board of Advisors members were on hand to see Porter, who earned his degree in chemical engineering at UT, accept the award while praising the college's progress in recent years.

The college established the Dougherty Award in 1957 to pay tribute to the man who served as its dean from 1940-1956, and to honor engineers whose accomplishments have brought UT recognition.

Porter was born in Fountain City, Tennessee, a Knoxville suburban area, and grew up in the city of Knoxville. He graduated from Fulton High School.

Porter was always interested in science and math, and when he entered high school and took chemistry, he was hooked. After a conversation with his chemistry teacher, however, a future as a chemist didn't seem to be quite the career path he wanted to pursue. The teacher steered Porter towards chemical engineering, and "the rest is history," Porter said.

"During my senior year in high school, I got the opportunity to take some advanced math and science courses at UT," Porter said. "The 'feel' of the campus and the amazing quality of the instructors made it clear UT was the only place to be! I also got the opportunity to get some limited exposure to some of the engineering facilities and they were also very impressive. Now, I would probably not be completely candid if I didn't mention that my mother's brother played football at UT and my mom was a cheerleader.... so there was some family support for the choice!"

After graduating from UT, Porter joined DuPont in 1966 and remained with the company, aside from a stint in the US Army, until retiring in 2008 as the company's Vice President for Engineering and Operations. Porter also held positions including Vice President of Engineering and Vice President of Safety, Health, and Environment and Engineering at DuPont.

Porter is proud of his accomplishments at DuPont during a career that lasted over four decades.

"If I were to compile a list of what I'm most proud of during my time at DuPont, I would include that I recognized the need for three 'Discovery Teams' (Eliminating Environmental Releases, Safe Driving, and Process Safety Management) and led those teams to the point of corporate level implementation of improved practices," Porter said. "Corporate performance in all areas improved, including sustainably by several orders of magnitude. This work greatly increased the company's capability to accelerate progress toward achieving the 'zero' injury and incident goals for the corporate safety, health and environmental core values. I also developed and led implementation corporately for the 'front-end-loading' concept and capital deployment best practices and work processes now used on all DuPont Projects. A total cost reduction

exceeding thirty percent in both capital and associated cost expenditures was documented and the work processes and results have been benchmarked by Independent Project Analysis (IPA) as 'world-class.'"

Porter also conceived and led development and implementation of "Knowledge Management" practices. This led to an increased effectiveness and efficiency in the use of existing staff, provided the base for competency renewal, and enabled globalization of work forces.

In addition to his work with DuPont, Porter served on the college's Board of Advisors—including as its chair—as the chairperson for the Construction Industry Institute and the United Negro College Fund of Delaware, and on the boards of the American Institute of Chemical Engineers, FIATECH, the Mascaró Sustainability Initiative, and the Fieldbus Foundation, as well as the advisory board of AIChE's Center for Chemical Process Safety and Argonne National Laboratory's Board of Governors.

"During my time on the COE board, the collegial interactions were the best as was the opportunity to work with the faculty and dean to keep the college on track to achieve the vision of being top tier among public universities," Porter said. "Many of the relationships formed then have continued and grown over the years into other opportunities to work with each other."

Porter received FIATECH's inaugural award for technology leadership in 2008, which was named in his honor, as well as the 2007 Society of Women Engineers Rodney D. Chipp Memorial Award, the 2005 Engineering and Construction Contracting Association Achievement Award, and CII's 2004 Carroll H. Dunn Award of Excellence.

Porter currently serves as founder and president of Sustainable Operations Solutions, which helps promote safer, more efficient, more productive work environments.

"Sustainable Operations Solutions is currently providing project management support and guidance for a \$6 billion project to produce energy and chemical co-products by gasification of coal," Porter commented. "We are also supporting the restart of a nuclear power reactor, helping a major food company develop and implement a process that would enable them to achieve world-class safety, and assisting an Eastern European mining firm develop a project management process and system so the company could greatly improve the value it is able to create from capital projects. We're also consulting with a major engineering systems firm to help them identify, develop, and deploy those systems tools that are needed to help the construction industry be more cost and time effective."

Porter is married to a fellow chemical engineer, Deborah L. Grubbe ("Unfortunately, she graduated from Purdue!" Porter joked). The couple's daughter Alyson is married and has a three year old son. Porter's brother Ronnie owns "The Back School" and lives in Atlanta. Both Porter brothers are avid UT sports fans and hold football season tickets every year. Porter also enjoys photography and reading.



COE Dean Wayne Davis (left) presents the Nathan W. Dougherty Award to Jim Porter (right).

Vision Statement

The College of Engineering is resolved to become one of the country's Top 25 public engineering educational institutions. To bring this vision to reality, our college is committed to these five charges:

Attaining national and international recognition among peer institutions for excellence in both research and teaching;

Assembling a dynamic body of faculty who exemplify excellence and innovation in the pursuit and delivery of knowledge that will perpetuate the highest standards of engineering education for future generations;

Graduating students who are well educated in technical knowledge, with solid communication and teamwork skills, who can compete successfully in the global business world and contribute significantly to the national base of engineering education and technology;

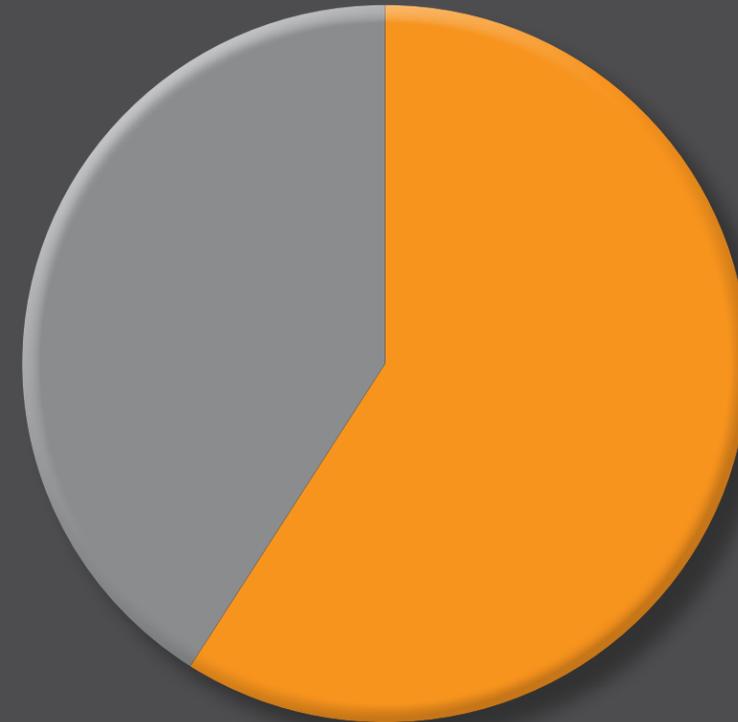
Investing strategically in the college's most important resources—students, faculty, and programs—through the vigorous acquisition of private gifts from individuals, corporations, and foundations;

Partnering with academic, industrial, and government entities that share and enhance the mission of the College of Engineering so that our educational and collaborative efforts result in the maximum, positive, economic impact locally, regionally, nationally, and globally.

Financial Information

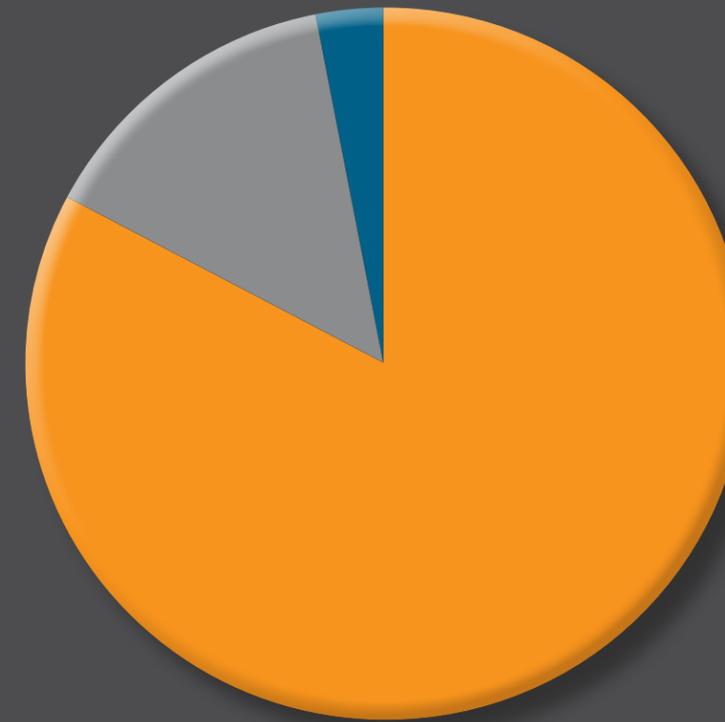
Fiscal Year 2015

Total Expenditures
\$115.4 Million



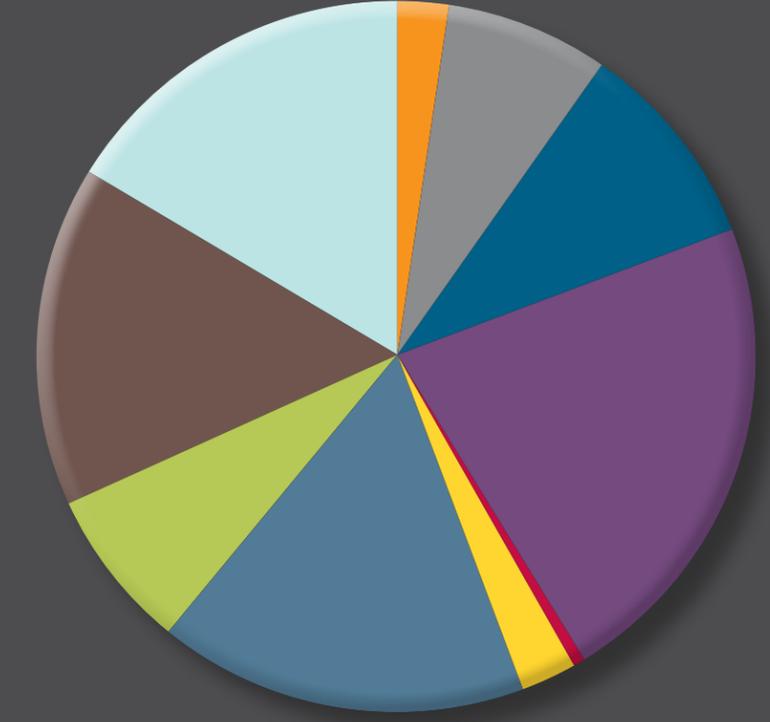
Externally Funded Gifts, Grants & Contracts	\$68,207,230
Recurring & Nonrecurring State Funds	\$47,230,549

Resources: Recurring & Nonrecurring State Funds
\$47.2 Million



Salaries & Benefits	\$39,014,620
Miscellaneous Operating Expenses	\$6,733,142
Equipment & Software	\$1,482,788

Gifts, Grants & Contracts by Department/Center
\$68.2 Million



Administration	\$1,644,289
Chemical & Biomolecular Engineering	\$4,977,592
Civil & Environmental Engineering	\$6,512,253
Electrical Engineering & Computer Science	\$15,087,604
Engineering Fundamentals Division	\$202,778
Industrial & Systems Engineering	\$1,828,630
Materials Science & Engineering	\$11,272,943
Mechanical, Aerospace & Biomedical Engineering	\$4,988,883
Nuclear Engineering	\$10,482,580
Research Centers	\$11,209,678

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