



**CLEMSON UNIVERSITY INTERNATIONAL
CENTER FOR AUTOMOTIVE RESEARCH**

2012 ANNUAL REPORT

CUMICAR
CLEMSON UNIVERSITY INTERNATIONAL CENTER FOR AUTOMOTIVE RESEARCH



About the front cover: Industrial Origami®

The photograph depicts a disruptive technology patented by Industrial Origami Inc. that is featured in CU-ICAR Deep Orange vehicle prototypes. The technology folds lighter-gauge aluminum into complex, high-load-bearing structures formed with simple, low-cost tooling and production investment.



CU-ICAR is as much an idea as it is a place. It is a unique blend of four things: education, research, economic development and a magnet venue for the automotive industry. Each of these elements interacts in such a way that the whole is much greater than the sum of the parts. Consequently, it has been named as one of five global best practices by the National Academy of Sciences. CU-ICAR serves as a showcase for economic development and the creation of a knowledge-based economy for South Carolina. It is a constant draw for national and international entities, and its track record of successful collaborations with federal, state and local governments, and the private sector continues to grow. This annual report chronicles the successes of the past year.

Given the youthfulness of the campus and its programs, the progress made in 2011-2012 is quite remarkable. The campus and its entities continue to evolve and grow as we adjust to the changing demands of the marketplace and opportunities that come our way. Our relationships with the automotive industry continue to strengthen; our graduate program is more robust; and we continue to work hard to justify the trust placed in us as a magnet for economic development in the state.

As I look back at the past year, I am amazed at what has happened. A number of the accomplishments were things we frankly expected would take many years to achieve, but the power of a good idea creates its own timetable.

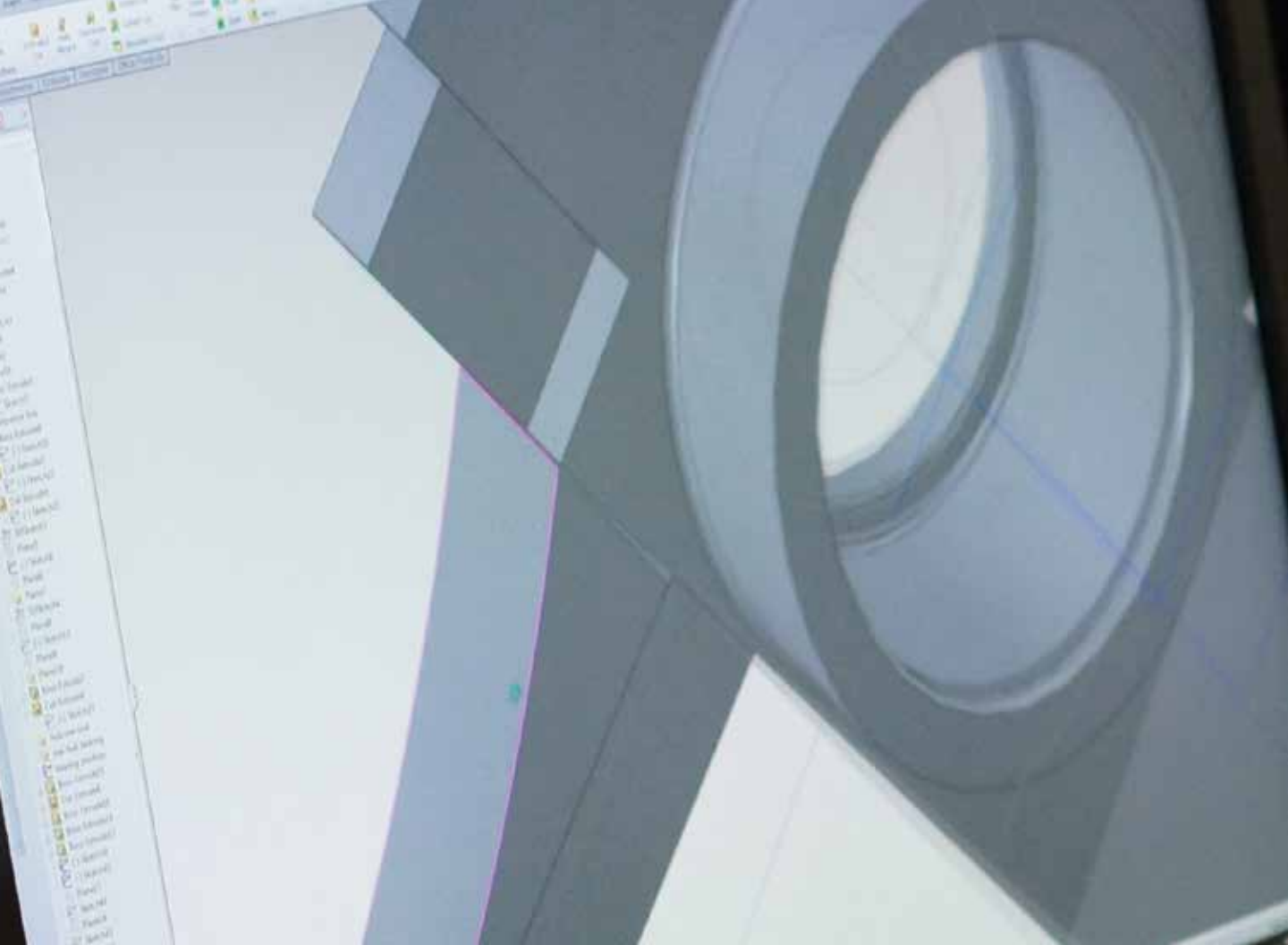
As President Barker has said many times, “At its heart, CU-ICAR is about people.” There is not much else to say. That is the very essence of CU-ICAR. We are very proud to be at CU-ICAR and proud to serve the automotive industry, the state and the nation, developing young talent and ideas that will power the next generation of transportation solutions globally. Come join us on this journey.

CU-ICAR has been named as one of five global best practices by the National Academy of Sciences.

Sincerely,

Imtiaz Haque

Founding Chair, Department of Automotive Engineering and Executive Director, Carroll A. Campbell Jr. Graduate Engineering Center



We are pleased to present the 2012 CU-ICAR Annual Report!

This year we celebrate the fifth anniversary of the CU-ICAR automotive engineering M.S. and Ph.D. programs. We are pleased that CU-ICAR has experienced exceptional levels of growth and success to date. This year's report is designed to convey to you, in quantifiable terms, just how far we have come in our first five years.

Despite the early stage of our development, we have been diligently measuring and monitoring our growth and success to date. The metrics that we have been measuring are spread across all four facets of CU-ICAR: 1) Education 2) Research 3) Campus Development and 4) Magnet Venue. CU-ICAR uniquely offers all of these elements in one place – and all focused on one industry.

It is our strong belief that this uniqueness distinguishes CU-ICAR today and as we move, with purpose, into the future.

From “South Carolina Automotive Sector: Analysis of an Emergent Cluster,” Harvard Business School, May 4, 2012:

“CU-ICAR distinguishes the (automotive) cluster.”



I. EDUCATION

Top-10 exceptional graduate curriculum in automotive engineering



II. RESEARCH

Breakthrough applied research conducted in world-class labs



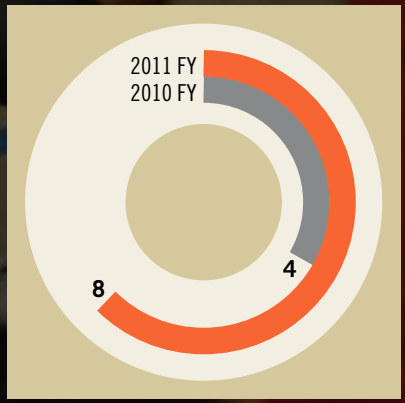
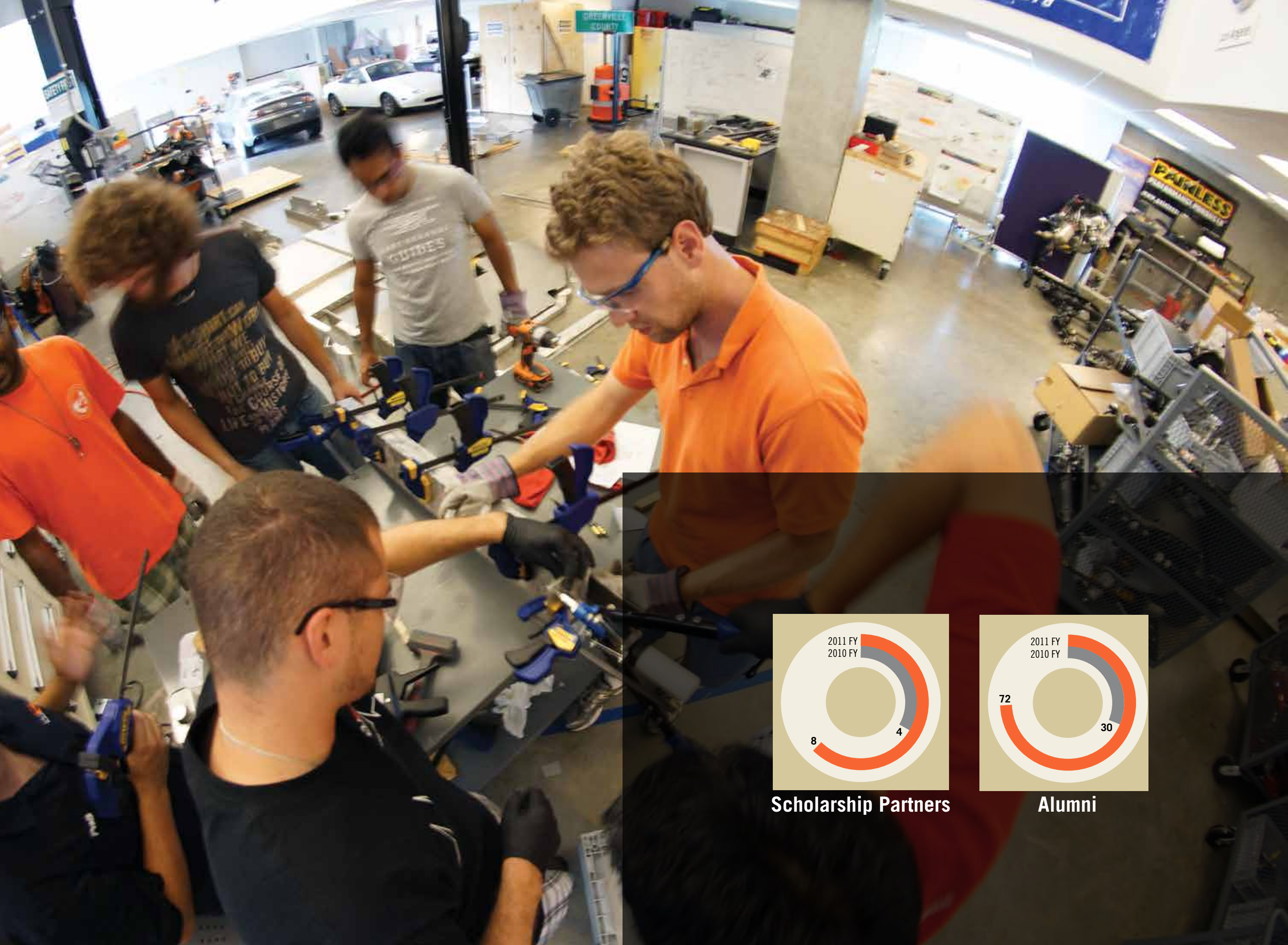
III. ECONOMIC DEVELOPMENT

Award-winning 250-acre technology research campus

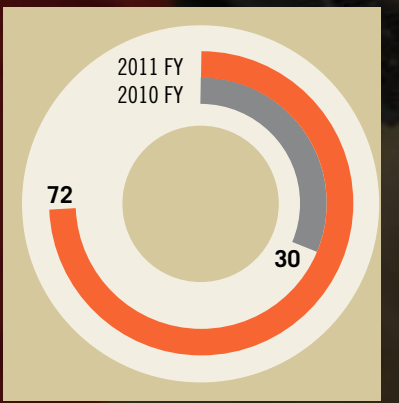


IV. MAGNET VENUE

Hot spot for regional, national and global automotive and manufacturing events



Scholarship Partners



Alumni



EDUCATION

“I know that great support from the Upstate business and political community made it easy for us to locate here. When you combine that with Clemson University’s local automotive technology initiative (CU-ICAR) and the talent base that we have here in the automotive field, Greenville is a perfect home for Proterra. Proximity to CU-ICAR also offers us tremendous research and development resources.”

— David Bennett, CEO of Proterra

CU-ICAR graduates have an impact globally and locally.

With each graduating class, our global alumni network increases. CU-ICAR graduates are making noteworthy contributions to the automotive industry in the Upstate, across the country and around the world.

Forty-four percent of our graduate alumni are employed in South Carolina. This statistic is a testament to the state's growing knowledge-based economy and the demand for educated talent. CU-ICAR's automotive engineering graduates use their extensive knowledge to create the innovative transportation solutions of tomorrow, both locally and around the globe.

This data positively reveals that CU-ICAR alumni are gainfully employed in automotive companies within the state of South Carolina. The data also shows that we are beginning to see the reversal of a historical trend such that graduates are no longer leaving the state in search of well-paying, knowledge-based employment at nearly historical rates. Five years into the program, we believe that this statistic is testimony to our success in addressing one key historical market failure within our state.



Demand for Alumni

“There is a war for talent in our industry,” Original Equipment Supplier Association president and CEO Neil De Koker said at the 2012 Automotive News World Congress in Detroit.

The primary issues of skills and workforce flexibility are key to sustainable success in the automotive industry. Both OEMs and suppliers will have to plan for a future that requires ever more-skilled workers from design to production. Tomorrow’s engineers will need to understand systems, tackle complex problems and be cognizant of the life cycle impact of their work and production, all while understanding cultural, societal and political forces.

CU-ICAR is meeting that demand today.



Contributing to automotive companies such as ...





JUSTIN H. SILL

Tesla Motors
Powertrain Vehicle Dynamics Architect

Date of Hire: April 23, 2012

Hometown: Spartanburg, S.C.

Graduation Year: Ph.D., Automotive Engineering, 2012; M.S., 2006, B.S., 2002, Mechanical Engineering

Professional Goal: To be a leader in automotive research with a focus on vehicle dynamics, control and advanced powertrains

Awards and Honors: CU-ICAR Most Outstanding Ph.D. Student 2011; Provisional patent based on dissertation; Publication of four journal articles and seven conference papers

What was the most memorable experience you had at CU-ICAR?

I served as a teaching and grading assistant in several of the classes at CGEC. Being able to share my knowledge and industry experience with the many students at CGEC was a privilege. I hope they learned as much as I did.

How has your education at CU-ICAR prepared you for your current job?

CU-ICAR has provided me with expanded and newly acquired capabilities that are very desirable by the automotive industry. Specifically, my doctoral research in vehicle dynamics and stability control led directly to my hiring at a premium electric vehicle company (Tesla Motors).

What's the most important thing you learned at CU-ICAR?

I learned how to communicate my ideas to other engineers and the broader scientific community. While earning a Ph.D., I have written 11 scientific papers on various research topics and aided my peers in their research through many spontaneous engineering discussions.

Looking back, how do you feel about your experience at CU-ICAR?

Coming to CU-ICAR was definitely the right decision, and I will remember it with great fondness. To clarify, before attending CU-ICAR, I had a comfortable, stable and well-paying job working for a leading tire company. I took a financial leap of faith to earn a Ph.D. in automotive engineering. I can honestly say it was the best career decision that I have ever made.

What advantages does CU-ICAR have over other automotive/technology/engineering schools?

The greatest advantage of CU-ICAR is the number of high-quality engineers (faculty and students) with their depth and breadth of automotive experience. Most universities that have automotive-focused programs are usually limited to one research objective (such as electric vehicles, manufacturing, performance, etc.). However, CU-ICAR is large and ambitious enough to cover most all of the topics that an automotive engineer will encounter in industry. CU-ICAR brings together a diverse group of highly skilled engineers in such close proximities that they inevitably temper and sharpen each other's skills to ever increasing levels of excellence.

How has CU-ICAR helped you in the process of obtaining your professional goals?

CU-ICAR has been instrumental in helping me pursue my professional goals of becoming a leader in the area of vehicle research. Specifically, the program provided an atmosphere in which new concepts are encouraged and embraced. The ideas that were developed during my research at CU-ICAR have drawn interest from a luxury German carmaker, a premium electric-vehicle company, a leading tire maker and a European research organization.

Do you have any other thoughts about CU-ICAR?

There's no other program that is comparable at preparing students for "real-world" engineering jobs in the automotive industry. The speed in which CU-ICAR's reputation is growing will easily put it ahead of all other automotive programs in a few years, if it's not already there.



NEERAJ CHIRMULAY

Proterra Inc.
Mechanical Design and Release Engineer

Date of Hire: August 2011

Hometown: Pune, India

Graduation Year: M.S., Automotive Engineering, 2011

Professional Goal: To excel in the field of automotive engineering and to strive toward a rewarding career in technological leadership

Awards and Honors: Altair Engineering Fellow at CU-ICAR 2010-2011

What was the most memorable experience you had at CU-ICAR?

As the project manager for Deep Orange in spring 2011, I had the privilege of representing CU-ICAR and interacting in person with the U.S. Department of Transportation Secretary Ray LaHood.

How has your education at CU-ICAR prepared you for your current job?

My education at CU-ICAR was oriented toward leadership and maintaining state-of-the-art knowledge in automotive engineering. Valuable interaction with industry and hands-on experience in systems integration has proved very useful in my professional life so far.

What's the most important thing you learned at CU-ICAR?

I learned the importance of developing a strong personality with essential soft skills in balance with the necessary scientific knowledge.

Looking back, how do you feel about your experience at CU-ICAR?

I believe that my studies at CU-ICAR gave me a balanced skill-set — a prerequisite for succeeding as an automotive engineering professional. I was fortunate to have had access to cutting-edge facilities and knowledgeable faculty.

What advantages does CU-ICAR have over other automotive/technology/engineering schools?

Being a relatively new research center, CU-ICAR has managed to develop and maintain a fresh outlook toward the automotive industry, thereby staying

immune to a somewhat parochial paradigm found in the more “traditional” research institutes. That, coupled with its industry partners and a focused graduate program, gives CU-ICAR an advantage.

I believe that my studies at CU-ICAR gave me a balanced skill-set — a prerequisite for succeeding as an automotive engineering professional.

How has CU-ICAR helped you in the process of obtaining your professional goals?

The program at CU-ICAR has allowed me to focus on my area of interest while promoting industry-relevant project work. It has also given me the opportunity to interact with influential people in the automotive industry, giving me a strong base to launch my career.

Do you have any other thoughts about CU-ICAR?

Looking at the progress made by CU-ICAR in such a short time since its conception, I strongly believe that it will become a driving force in groundbreaking research in the automotive industry.

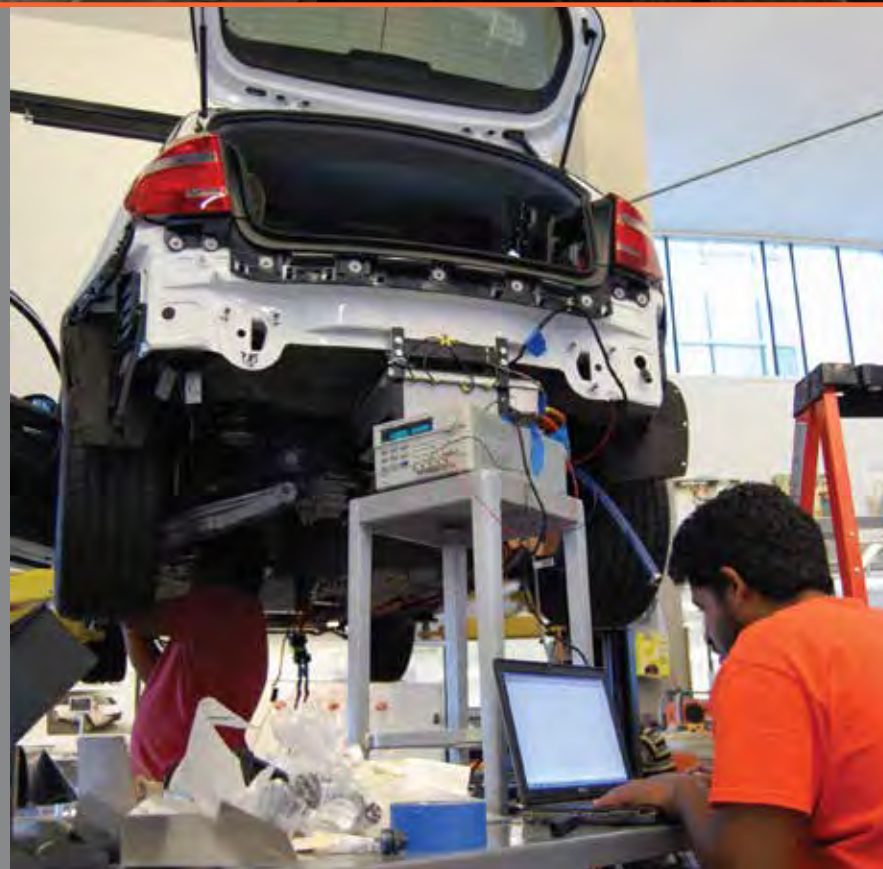
DEEP ORANGE is a framework that immerses graduate automotive engineering students into the world of a future OEM and/or supplier. Working collaboratively, students, multidisciplinary faculty and participating industry partners focus on producing a new vehicle prototype every year.

Partnerships

Deep Orange provides participating industry partners (entrepreneurs, suppliers and OEMs) with a neutral, open-innovation and proof-of-concept platform to develop, integrate, showcase and verify new innovations and technologies in a full-vehicle working product. It directly feeds the knowledge gained to both industry and academia. The use of industry-relevant teaching and mentoring methods provides a close alignment of academic and industry practices that prepare the engineers of tomorrow to address the challenges that the automotive industry will face in the years to come.

Curriculum

Tomorrow's engineering leaders will require deep knowledge of a particular technical field and a strong understanding of the holistic breadth in the context of product development. They will need to collaborate with cross-functional and sometimes conflicting organizational functions, as well as with colleagues whose perspectives are shaped by uniquely different experiences. They will need to understand systems and cultural, societal and political forces; tackle complex problems; and be thoughtful about the life-cycle impact of their work and production. The automotive engineering program at CU-ICAR merges this depth (through specialization tracks) and breadth (through the interdisciplinary Deep Orange initiative) into one outstanding integrated scholastic experience.



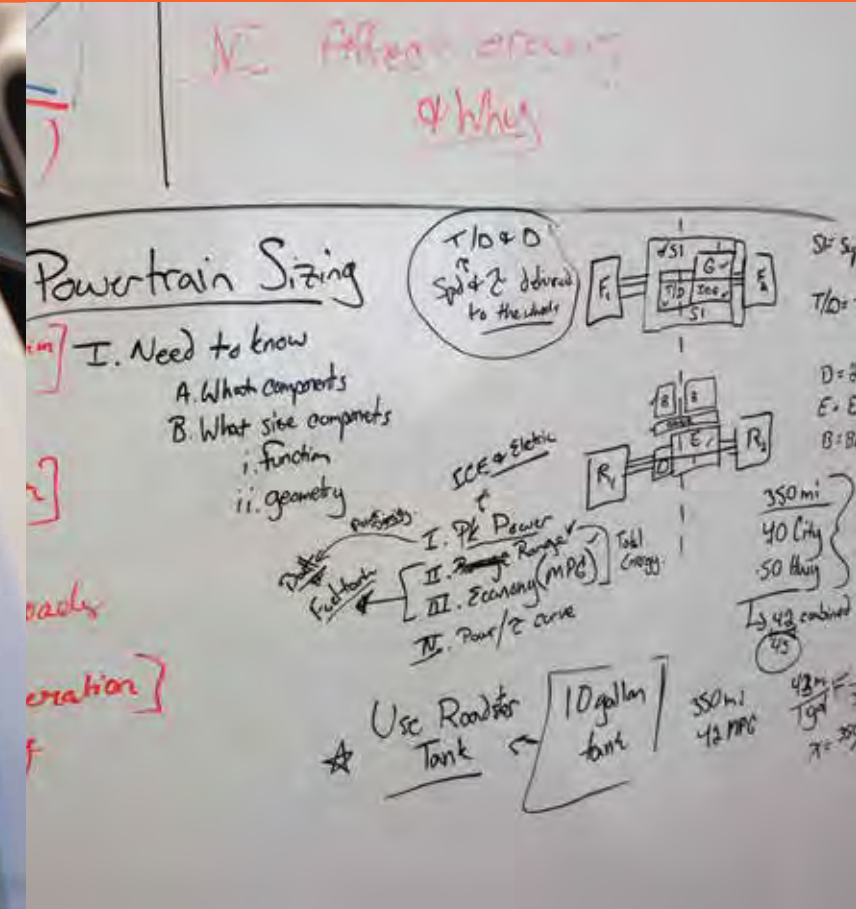
Deep Orange 2: Future Digital Cockpit Experience

Deep Orange 2 focused on the development and implementation of a digital, reconfigurable vehicle cockpit. The project was conducted from September 10, 2011, to January 12, 2012. In conjunction with Clemson's School of Computing, students designed and engineered a reconfigurable vehicle dashboard. Deep Orange 2 demonstrated a breakthrough in human-machine interface. The result of this technology was a personalized, intergenerational driver interaction with various vehicle, infotainment and climate controls.

After completion, CU-ICAR students took to the road to showcase the digital dashboard. They shared the stage with the industry's most advanced and innovative technologies. Deep Orange 2 was exhibited at the 2012 International Consumer Electronics Show, as well as the 2011 Specialty Equipment Market Association Show.

The Clemson students were demonstrating breakthrough technologies, which included the following:

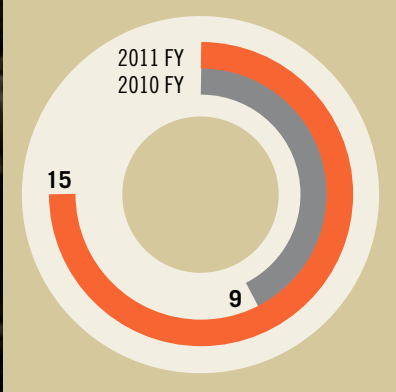
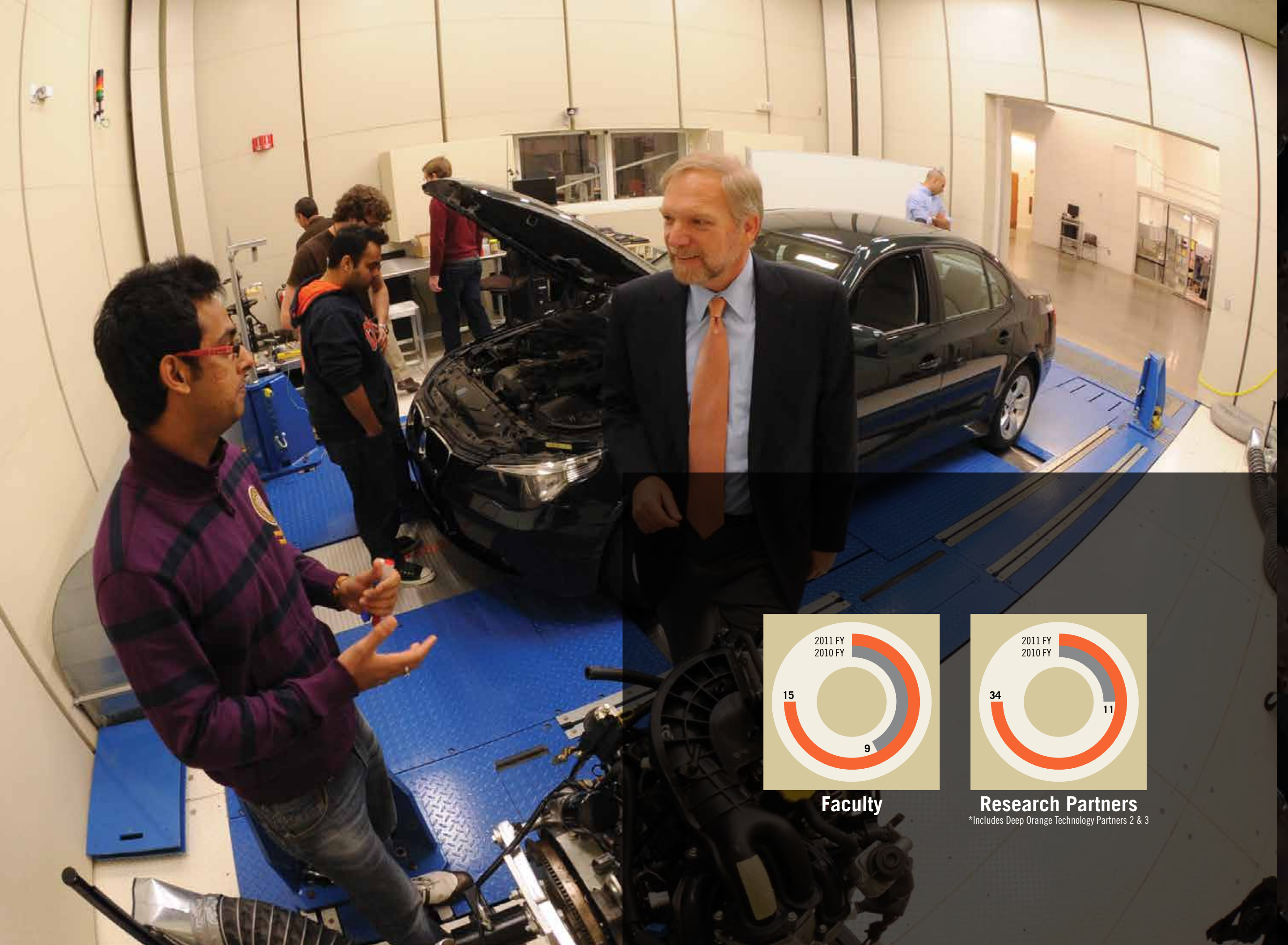
- Open Source In-Vehicle Infotainment System** — Incorporating a pre-engineered GENIVI-compliant OS distribution running on the Intel Atom E6xx series processor and reference board. Students were able to focus on the user interaction elements of a next-generation infotainment design while reusing underlying Linux software that was created by others. This approach, when applied to commercial products, reduces time to market, reduces costs and enables designers to more quickly add innovation and features. Intel Corp. provided the hardware for this infotainment platform.



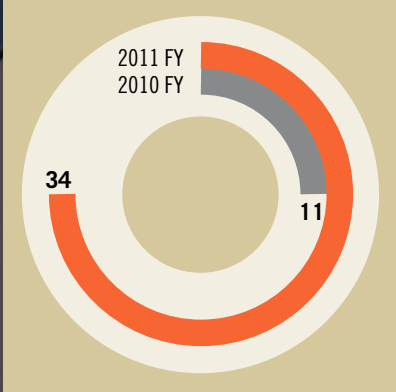
- Electronic Vehicle Access Key: cKey App** — An Android-based application developed to replicate and enhance the functionalities of a physical car key. The cellular telephone-integrated digital key not only unlocks the car door, but also is the key to a cloud server, where it can access personal profiles with vehicle cockpit themes, favorite radio stations, climate control and other settings. Dell Services Engineering Solutions provided the know-how for realizing the cKey App and communication protocol with the vehicle and cloud server.
- Deep Orange Customization Portal and Cloud Storage Concept** — Allows individual vehicle users to personalize the human-machine interface at the dealership — as an initial configuration — or at home. Drivers can store personal profiles and preferences on a cloud server and configure the vehicle's user interface and preferences anywhere, any time using a Web-based portal.



DEEP ORANGE



Faculty



Research Partners

*Includes Deep Orange Technology Partners 2 & 3



RESEARCH

From “Going South,” *Automotive News*, April 23, 2012:

“We’re here now in part due to what CU-ICAR can do for us. We’re going to need access to engineering talent locally as we grow. We like the idea of being in a center where people are focused on assisting you with your needs.”

— Ludger Reckmann, CEO, ZF Transmissions

Program Awards

The U.S. Department of Energy's Graduate Automotive Technology Education (GATE) division established a new Center of Excellence in Sustainable Vehicle Systems in Clemson's Department of Automotive Engineering in the fall of 2011.

- It is one of seven such centers in the U.S.
- The center will receive a \$1 million grant over five years.

The Department of Energy GATE Centers of Excellence focus on three critical areas of automotive technology: hybrid propulsion, energy storage and lightweight materials. The five-year GATE program funds both curriculum development and expansion, as well as laboratory work, which the energy department hopes will foster multidisciplinary training. The aim is to promote the development of an engineering workforce that will overcome technical barriers and help commercialize the next generation of advanced automotive technologies. The GATE center places Clemson in distinguished company: other centers are being established at the University of Michigan, the University of Colorado, Ohio State, Penn State, Purdue and the University of Alabama at Birmingham.

Imtiaz Haque said, "The \$1 million GATE award will help our students learn to address fundamental issues of sustainability, such as vehicle life cycle, energy use and emissions, reliability, manufacturing and cost of ownership. The center will help our students gain the strength in innovation, which is the key to our automotive industry remaining competitive."

Zoran Filipi, Ph.D., Timken Chair in Vehicle Design and Development

- Editor in chief for SAE *International Journal of Alternative Powertrains*
- 2011 SAGE Best Paper Award by the editor and editorial board of Proceedings of the Institution of Mechanical Engineers, Part D: *Journal of Automobile Engineering*

Mohammed Omar, Ph.D., Associate Professor of Automotive Engineering

- Editor in chief for the *Journal of Material Science Research*
- Editor of book *Nondestructive Testing Methods and New Applications* published by InTech, March 2012



David Bodde, D.B.A., Professor of Automotive Engineering

- Editor of the book *Chance and Intent* published by the Kauffman Foundation



Juan Gilbert, Ph.D., Chair of the College of Engineering and Science's Human-Centered Computing Division, Professor of Computer Science and Automotive Engineering

- Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring, 2011



SAE Fellow

The Society of Automotive Engineers (SAE) has awarded the prestigious status of SAE Fellow to Zoran Filipi, Ph.D. This designation recognizes outstanding engineering and scientific accomplishments by an individual that have resulted in meaningful advances in automotive, aerospace and commercial-vehicle technology. The program, established in 1975, annually recognizes an average of 20 worldwide recipients for this honor.

Tom Kurfess, Ph.D., BMW Chair in Manufacturing

- Joint chair, First Annual Smart State Conference
- Assistant director of advanced manufacturing, Office of Science and Technology Policy, Washington, D.C.

Joachim Taiber, Ph.D., Research Professor of Automotive Engineering

- Conference chairman, 2012 IEEE Electric Vehicle Conference

Student Awards

2012 Special Equipment Market Association Scholarship Award winners

Shayne McConomy, 2012 Melvin Burton Award
 Sara Mohon, 2012 Top Student Award
 Mandar Hazare, 2012 Wally Parks Award

2011 and 2012 Society of Manufacturing Engineers Scholarship Award winners

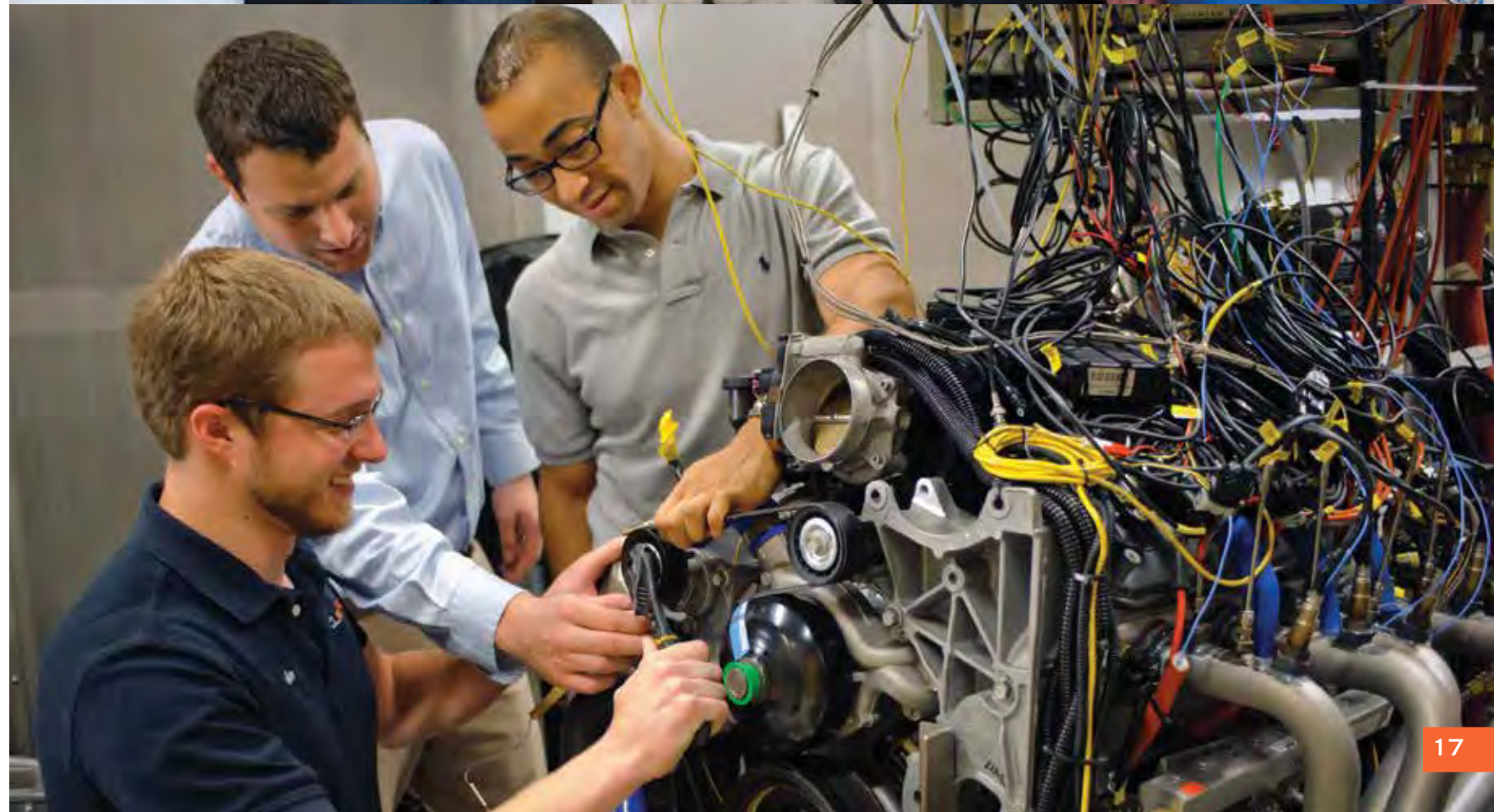
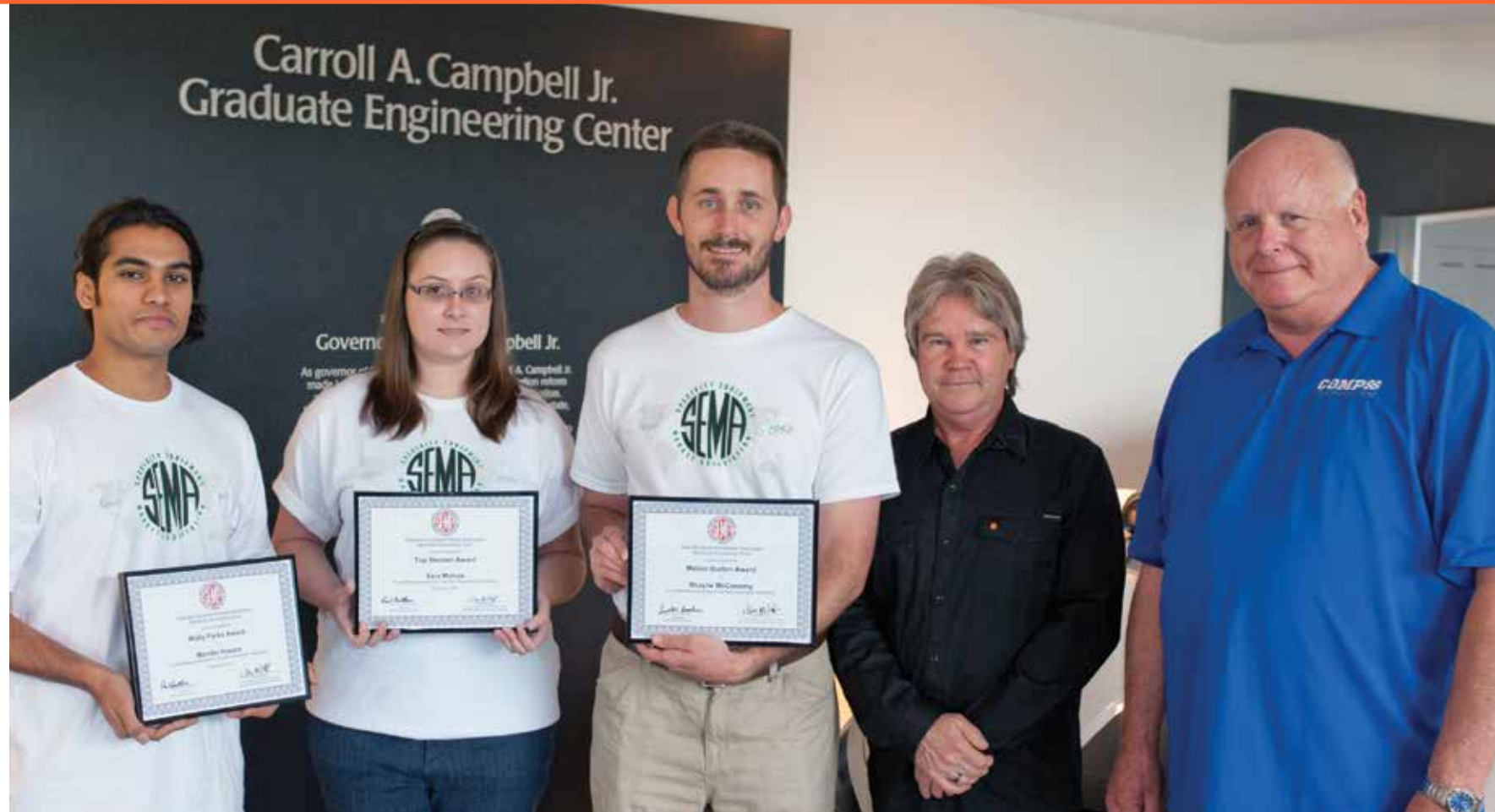
Joshua Jones, 2011 Schneider-Bingle Endowed Scholarship
 Joshua Jones, 2012 E. Wayne Kay Graduate Scholarship
 Wes Salandro, 2011 E. Wayne Kay Graduate Scholarship

2011 Tire Society Conference

John Adcox, Best Student Paper Award

A Clemson student team was among six winners in a national competition, the 2011 Connected Vehicle Technology Challenge, which was sponsored by the U.S. Department of Transportation. Joachim Taiber, Ph.D., research professor of automotive engineering, and Mashrur Chowdhury, Ph.D., professor of civil and automotive engineering, jointly supervised the students, along with three professors from the electrical and computer engineering and computer science departments. Their submission, *Integrated Intelligent Transportation Platform*, proposed a system that enables a vehicle to help with trip and day scheduling, from choosing a route to reserving a parking space.

“Innovative thinking and advanced technology have become the keys to improving safety and efficiency on our roads and highways,” U.S. Transportation Secretary Ray LaHood said. “The winners of this competition have given us ideas that will help build the transportation system of the 21st century.”



During the 2011 academic year, CU-ICAR greatly increased the number and diversity of the faculty team thereby adding to an already distinguished roster of exceptional scholars. The diversity within the team is, by design, in perfect alignment with the exciting growth within the automotive industry, particularly in the fields of driver distraction, alternative propulsion systems, human factors, lightweight materials and networked/connected vehicle advancements.

Alternative Propulsion

ZORAN FILIPI



Zoran Filipi holds the Timken Endowed Chair in Vehicle System Design at CU-ICAR. He comes to CU-ICAR from the University of Michigan, where he was the director of the Center for Engineering Excellence through Hybrid Technology and the deputy director of the Automotive Research Center, a U.S. Army Center of Excellence for modeling and simulation of ground vehicles.

His main research interests are alternative and hybrid powertrain systems, advanced IC engine concepts and energy for transportation. He is an SAE Fellow and the recipient of the SAE Forest R. McFarland Award, the IMechE Donald Julius Groen Award and the University of Michigan Research Faculty Achievement Award.

Advanced Materials

FADI ABU-FARHA



Fadi Abu-Farha joined CU-ICAR as an assistant professor of automotive engineering. He comes to CU-ICAR from Penn State Erie, where he was an assistant professor of mechanical engineering. Abu-Farha's prime area of research is lightweight design, targeting greater utilization of lightweight materials in the transportation sector. Abu-Farha was awarded the Outstanding Paper Award at the 31st Annual North American Manufacturing Research Conference in 2003 and the Young Researcher Fellowship at the third MIT Conference on Computational Fluid and Solid Mechanics in 2005.



Mashrur Chowdhury
with Leidy Klotz

Innovation Leadership

DAVID BODDE



David Bodde helps students learn to use technology to become more effective innovators and entrepreneurs. Emphasis areas include managing the risks of new ventures, open architecture innovation and new venture investment.

His professional experience includes serving as vice president of the Midwest Research Institute, assistant director of the U.S. Congressional Budget Office and deputy assistant secretary in the Department of Energy. He serves on the board of directors of several publicly traded companies and privately held ventures.

Human Factors



JOHNELL BROOKS

Johnell Brooks, Ph.D., is an assistant professor and a clinical research faculty member in the Department of Medicine at the Greenville Hospital System University Medical Center. Brooks

leads an interdisciplinary research team that strives to enable drivers to maintain their independence for as long as safely possible. She uses simulators and instrumented vehicles to develop rehabilitation tools for clinical settings.

Civil Engineering

MASHRUR CHOWDHURY



As a former senior engineer and an educator, Mashrur Chowdhury has been involved in the practice, education and research of Intelligent Transportation Systems (ITS). Chowdhury's primary research focuses in ITS are the

applications for connected vehicles and infrastructure for real-time traffic and energy management. He is the former chair of the American Society of Civil Engineers (ASCE) Committee on Computing in Transportation, was elected to the IEEE ITS Society Board of Governors in 2010 and is an ASCE Fellow.

Human-Centered Computing

JUAN E. GILBERT



Juan E. Gilbert leads the Human-Centered Computing Lab in the University's School of Computing. Gilbert has research projects in user interface design, implementation and evaluation. He was recently named an

American Association for the Advancement of Science Fellow, an ACM Distinguished Scientist and one of the 50 most important African Americans in Technology. Gilbert is a national associate of the National Research Council of the National Academies, an ACM distinguished speaker and a senior member of the IEEE Computer Society.



Johnell Brooks, Paul Venhovens and the driving simulator team



Juan Gilbert in the Human-Centered Computing Lab

CU-ICAR’s research portfolio is driven, as is our philosophy, by industry needs. We continuously analyze the market and survey industry partners, industry leaders and automotive companies to determine their technology and R&D focus. Based on that knowledge, today the research clusters and “technology identity” of CU-ICAR is centered in the following five areas:

- Advanced powertrains
- Vehicular electronics
- Manufacturing and materials
- Vehicle-to-vehicle infrastructure
- Vehicle performance, including human factors



Advanced Powertrains

- Advanced engine concepts
- Powertrain integration, flexible drivelines
- Hybrid propulsion
- Electrification and connectivity



Vehicular Electronics

- Vehicle electronic systems integration
- Electromagnetic compatibility
- Electromagnetic modeling



Manufacturing and Materials

- New manufacturing systems
- Continuous process improvement
- Sustainable manufacturing
- Advanced materials characterization, processing, and manufacturing



Vehicle-to-Vehicle and Vehicle-Infrastructure Integration and Vehicle Systems Integration

- Power connectivity
- Communication connectivity
- Human-machine interface

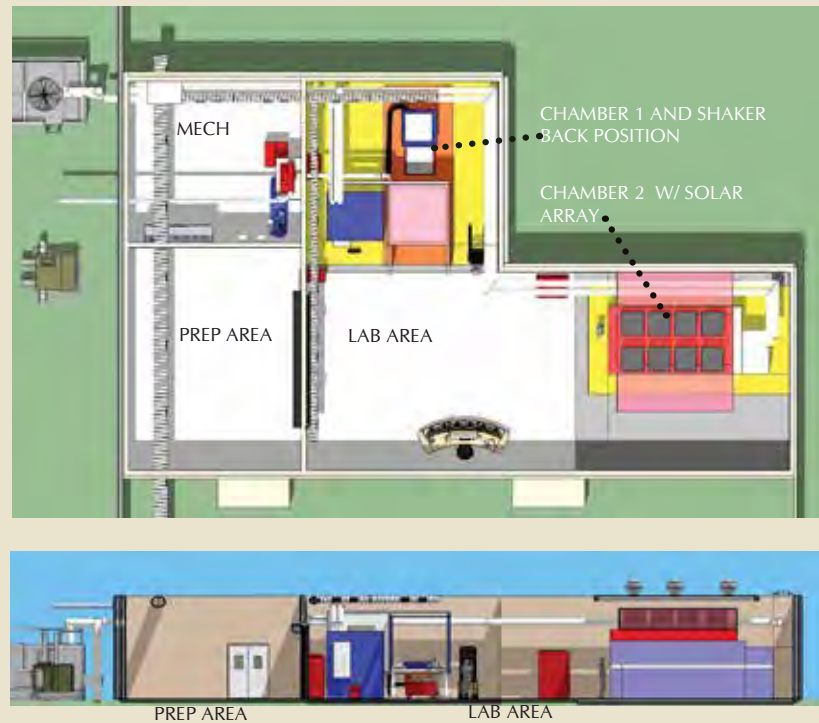


Vehicle Performance including Human Factors and HMI

- Vehicle dynamics
- Advanced driver assistance systems
- Human factors and HMI
- HIL and on-road testing



As part of our continuous process of analyzing and surveying the automotive industry to ensure that we are addressing its needs and trends, at times we also discover needs for additional infrastructure. Wherever possible, we seek to fulfill those needs by investing in required infrastructure. Two recent examples of such investment are depicted here.



Component Testing Laboratory

One of the most critical components of CU-ICAR's mission is adding value to automotive companies in South Carolina and, wherever possible, improving their competitive position. To this end, Clemson University is investing in a new commercial-use laboratory and equipment that will offer interior component testing services to the Tier 1 supplier community. Additional personnel have been hired to offer these services and manage the facility. The initial offering of testing services will include advanced solar simulation, environmental/climate testing and shaker/vibration testing. The lab will be located in the Center for Emerging Technologies building and opens in late summer 2012.

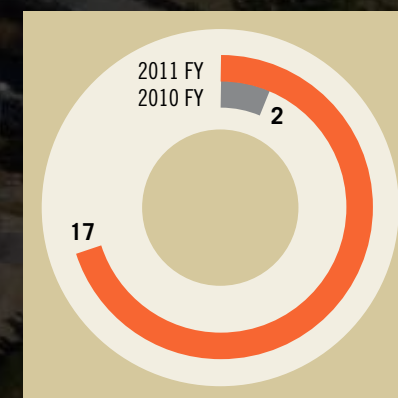
Wounded Warriors Gain Independence

In partnership with DriveSafety Inc. of Salt Lake City, Utah, and SureGrip of Canada, CU-ICAR has developed tools to train Wounded Warriors (who have lower limb amputations) to regain their independence through the use of a clinical driving simulator in which patients learn to use hand controls in place of a vehicle's pedals.

The team provides rehabilitation tools to clinicians to help patients who have suffered functional losses to regain independence and mobility. These tasks are accomplished through interactive exercises and driving scenarios to build skills, both for general activities of daily living and for driver rehabilitation.

The partnership's approach to product development, which has combined advanced technologies with direct collaboration among clinicians, scientists and patients, has won support and trust among leading voices in the industry. Introduced two years ago, the CDS-250 clinical driving simulator has now been installed in over 20 locations worldwide. New health care customers include civilian hospitals and clinics, medical device companies, and U.S. Army, Navy and VA hospitals.





Campus Partners

From "Going South," *Automotive News*, April 23, 2012:

"You hear the same message. It's pro-business and pro-economic development. It's 'How can we help you? What can we do to support your project?'"

*— Glenn Stevens, Vice President
Original Equipment Supplier Association*

**ECONOMIC
DEVELOPMENT**

In May 2012, CU-ICAR officially opened the doors to its first multi-tenant building. The Center for Emerging Technologies (CET), located at the heart of campus, provides office, administrative and laboratory space for the transportation, technology and energy sectors. The 60,000-square-foot center represents a total investment of \$11 million and marks another milestone in campus development.

At the CET, emerging or established companies are able to expand and develop technologies that complement the research of Clemson faculty and students. The center is designed to complete the technology chain from laboratory to the consumer end-user. Emphases on innovative and collaborative technologies make the center a perfect addition to the campus community.

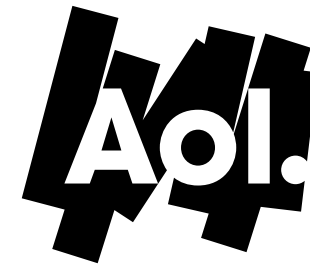


Cutting the ribbon at the Center for Emerging Technologies are (from left): George Biedinger, Clemson University Real Estate Foundation chairman; H. Philip Paradice, Economic Development Administration, U.S. Department of Commerce; Clemson President James F. Barker; Roy Abercrombie, Clemson University Real Estate Foundation board; and Charles Dalton, president, Blue Ridge Electric Cooperative.

“The Center for Emerging Technologies is another major step forward for the CU-ICAR campus. This facility will serve as a launching pad for leading-edge companies in the transportation and energy sectors while providing more job opportunities and investment in our community, and keeping CU-ICAR and Greenville in the forefront internationally.”

— Knox White, Mayor of Greenville

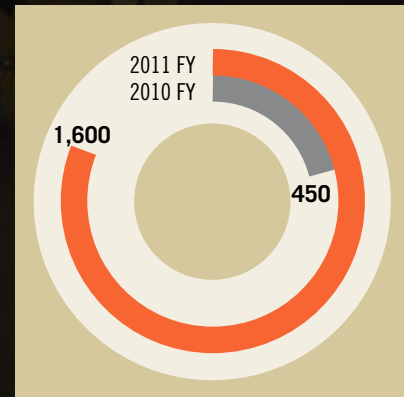
Although CU-ICAR is accustomed to the spotlight, we realized an exceptional year of both national and international press coverage in 2011-2012. Considering the early stage of our development, we are proud to be recognized by these distinguished and world-class media sources, and we thank all who made it possible.



The supply of talent Clemson produces is what convinced Proterra and founder Dale Hill to locate the plant in Greenville. “For us to maintain a two- to three-year lead on the industry, we need access to that talent. I want us to have access to the very brightest of the brightest. ... I think they are going to be here.”

— Dale Hill on “CBS News”





CU-ICAR Guests

Approximate number from attendance at CU-ICAR hosted events



“CU-ICAR was an excellent facility for our BMW Supplier Diversity event. We had wonderful access to a large auditorium for our kickoff meeting, a variety of rooms available for breakout sessions and space for over 50 exhibitors and their booths. The CU-ICAR campus was truly a state-of-the-art facility to host the BMW event.”

— BMW Manufacturing Co.

MAGNET VENUE

Beyond housing 17 resident partners, multiple research laboratories and Clemson University's automotive engineering program, the CU-ICAR campus also lends itself to accommodating major conferences and events. CU-ICAR continues to be the magnet venue for industry gatherings in the Southeast.



International Electric Vehicle Conference

IEEE chose Greenville over Austin, Detroit, San Francisco and Washington for its inaugural International Electric Vehicle Conference (IEVC). The conference addressed key trends in technology, engineering and deployment of electric vehicles and related infrastructure solutions. IEVC provided a cross-organizational platform to exchange information among leaders of the fast-growing electric mobility ecosystem. The CU-ICAR campus served as a networking venue for this event.



Second International Automotive Transatlantic Summit

In the fall of 2011, CU-ICAR hosted the second annual Automotive Transatlantic Summit jointly with the Automotive Intelligence Center (AIC). The conference theme was Winning the Future of Global Automotive-Collaborative Best Practices and Innovative International Models. The conference included a keynote address by U.S. Sen. Lindsey Graham and U.S. Rep. Trey Gowdy. The Automotive Transatlantic Summit features a broad array of international experts in the automotive field addressing critical areas in American and European automotive competition.



2012 South Carolina Automotive Council Annual Summit

The AT&T Auditorium at CU-ICAR's Carroll A. Campbell Jr. Graduate Engineering Center was the site of the South Carolina Automotive Manufacturing Summit, an educational and networking event that benefits automotive manufacturers and suppliers. Attendees included representatives from automotive manufacturing companies throughout the Southeast. The summit featured a keynote address from Peter Brown of *Automotive News*. The CU-ICAR campus served as a networking venue for this event.



BMW Manufacturing Co.

On April 12, 2012, BMW Manufacturing Co. held its first-ever supplier diversity event on the CU-ICAR campus. The objective of the event was to reinforce the importance of businesses owned by minorities and women and to prepare these groups for future opportunities. The event included a panel discussion with leading business executives and economic development experts, as well as networking sessions for businesses to make connections with more than 40 of BMW's Tier 1 suppliers.

CU-ICAR is a community of thoughts and ideas; a community of innovation and application; and most certainly, a community of passion where academia, industry and government organizations come together and advance in harmony with each other. But our community is not confined to our campus; it extends into Greenville, throughout South Carolina and across the southeastern region of the United States.

Service is an important part of the Clemson University educational philosophy, and CU-ICAR students have stepped up the plate. Their volunteerism and participation in events have made a positive impact in the local community and schools, sparking interest in engineering, science and technology for the next generation.



A.J. Whittenberg Partnership

Graduate students from CU-ICAR hosted hands-on activities at A.J. Whittenberg Elementary School of Engineering. Approximately 300 students from K4, K5, first and second grades participated in the events. The graduate students gave them a basic understanding of control, traction, turning radius and radio control using two radio-controlled cars.



Gateway To Technology

CU-ICAR hosted the Fourth Annual Gateway To Technology Program, which rallied 84 seventh-graders from Anderson, S.C. The students were tasked with building prototype vehicles that underwent rigorous performance

testing. The experience introduced the students to the world of automotive engineering.



Southern Automotive Women's Forum

On May 18, 2012, CU-ICAR hosted an event sponsored by the Southern Automotive Women's Forum (SAWF) to introduce young women in the Upstate of South Carolina to the benefits of an exceptional career in the automotive industry. Over 50 middle school girls from Greenville and Spartanburg Counties attended. The students heard from Megan Betzel, a female engineer at Clemson and an SAWF scholarship recipient. SAWF's primary objective is to provide academic scholarships for young women who are interested in engineering and to support development of the next generation of women.

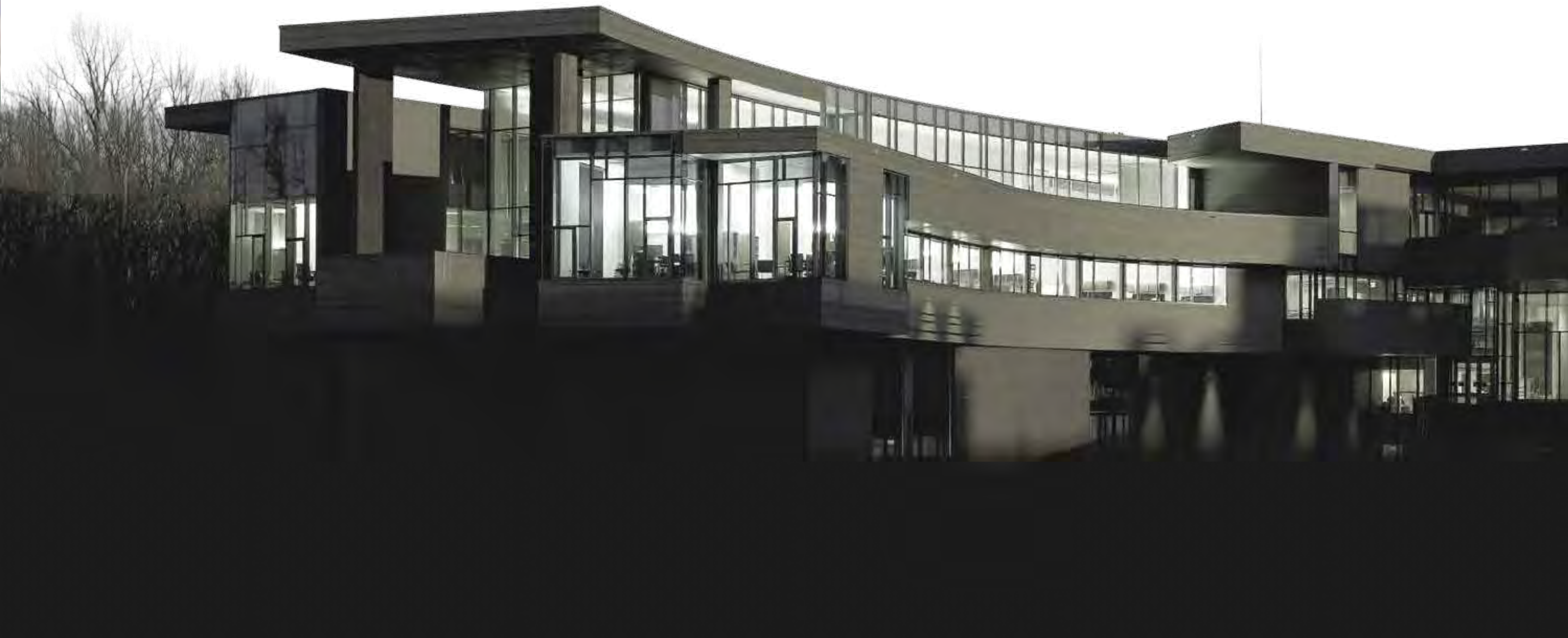


Clemson University is a nationally ranked, science and technology-oriented public research university that is known for its emphasis on collaboration, focus and a culture that encourages faculty and students to embrace bold ideas. Its teaching, research and outreach are driving economic development and improving quality of life in South Carolina and beyond. Clemson is a high-energy, student-centered community dedicated to intellectual leadership, innovation, service and a determination to excel.



Clemson University provides a world-class academic and research environment.

- *U.S. News & World Report* ranks Clemson University No. 25 among the top national public universities.
- Forty Clemson faculty have been awarded National Science Foundation CAREER Awards.
- From a pool of 42,000 professors, five Clemson educators are profiled in “The Best 300 Professors” by *The Princeton Review*.
- Sixty-five faculty members have been elected Fellows of national or international academic societies since 2000.
- Sixteen endowed-chair faculty positions have been created to attract new, top faculty through the SmartState endowed chairs program.
- The University currently has 11 National Science Foundation Graduate Research Fellows, two Goldwater Scholars and four Fulbright Scholars.
- Clemson research productivity has reached an all-time high, with research expenditures at \$107.7 million this past year.
- Top500 Supercomputing ranks Clemson’s data center eighth among public U.S. universities.



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