

A photograph of a dog with its front paws resting on a wooden board. Below the board, a man's face is visible through a rectangular hole in the wood. The dog is looking up and to the right with its tongue out. The man is smiling and looking towards the camera.

*Partnerships
Unleashed*

COLLEGE OF ENGINEERING, ARCHITECTURE AND TECHNOLOGY

FROM THE DEAN

What better partnership can there be than a man and his dog?

Civil engineering senior Paul De La Cerda, pictured on the cover, knows the importance of teamwork. The co-inventor of the “pooch pass” is partnering with industry to transfer his invention from idea to marketplace. It is one of many examples of successful partnerships within the College of Engineering, Architecture and Technology.

While De La Cerda and others are partnering to design innovative products, the CEAT is partnering with a variety of individuals, organizations and corporations to benefit Oklahomans in all walks of life.

Cooperation between the CEAT and the Oklahoma Department of Transportation is helping develop the “smart bridge” (see photo this page). The bridge will utilize ground source heat pump technology, an array of sensors, and a link with the Oklahoma Mesonet weather monitoring system to prevent it from icing during winter.

Other collaborations include partnerships with industry to develop professional master’s degree programs in engineering and technology management and control systems engineering and agreements with Halliburton to honor outstanding CEAT faculty and students each year.



A partnership between the CEAT and the Oklahoma Department of Transportation will ensure safer bridges in Oklahoma. Pictured from left to right are the project’s team players: CEAT Dean Karl Reid, former Governor Henry Bellmon, Secretary of Transportation Neal McCaleb and Mechanical and Aerospace Engineering Professor Jeff Spittler. The “smart bridge” utilizes ground source heat pump technology and the Oklahoma Mesonet to prevent it from icing over during winter.

Even some of the CEAT’s brightest students are partnering with high schools across the state through the Collegiate Recruiting for Engineering, Architecture and Technology Excellence (CREATE) program. Members of CREATE serve as role models for future engineers.

Teamwork is involved at every level in the CEAT. Student enrichment projects like the mini-baja, formula racecar, concrete canoe and aircraft design competitions are the result of committed faculty members, ambitious student crews and successful corporate partnerships.

Through creative and innovative collaborations, the College of Engineering, Architecture and Technology is making an IMPACT. We appreciate all of our partners — thank you for being a part of the CEAT team.

A handwritten signature in black ink that reads "Karl N. Reid".

Karl Reid, Dean
College of Engineering, Architecture and Technology

a college that shares itself



UNIVERSITY



INDUSTRY



RESEARCH



GOVERNMENT



COMMUNITY

Engineers, architects and technologists are often portrayed as people absorbed in calculations and formulas. Many people don't realize the communication skills and teamwork involved in designing a new product, building or computer program. And just as teamwork is important to professional engineers, it is also important to faculty, students and alumni of the CEAT. From researching the effects of pollutants on frogs to mentoring future engineers, the CEAT is partnering with others to make an IMPACT on the world.

DEPARTMENTS

PARTNERSHIPS	STUDENT DIGEST	ALUM AWARDS	NOTEWORTHY
2	12	15	16

IMPACT is a publication of the Oklahoma State University College of Engineering, Architecture and Technology and is designed to provide information on college activities and accomplishments while fostering communication among the CEAT family and friends.

The office of publication for *Impact* is 121 Cordell North, Stillwater, OK 74078-8031. Copyright © 1999, *Impact*. All rights reserved.

Oklahoma State University in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, sex, age, religion, disability, or status as a veteran in any of its policies, practices or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

This publication, issued by Oklahoma State University as authorized by the College of Engineering, Architecture and Technology, was printed by the Audio Visual Center, University Printing Services at a cost of \$18,750. 15M/October 1999/job# 5719.

IMPACT

Shelley Brinsfield, editor
Paul V. Fleming, art director
Janet Varnum, associate editor
Adam Huffer, *Barbara Swiggart*, *Vonda Evans*, contributing writers; *Mandi Anderson*, contributing designer
Andy Maxey, most photos unless otherwise noted.
Natalea Watkins, assistant v. p./Communications Services

Letters are welcome and should be addressed to:
 Oklahoma State University, Editor, *Impact* magazine,
 111 Engineering North, Stillwater, OK 74078-0513

ON THE COVER: Civil engineering senior Paul De La Cerda poses with his dog Esa and a prototype of his pooch pass invention. De La Cerda's working relationship with a patent attorney, an entrepreneur and two Stillwater engineering firms is helping transfer the invention from idea to marketplace.

Original cover photo © by Paul Rutherford.

VIP INVITATION

The CEAT wants you to have access to up-to-date information on everything from the continuing development of the Advanced Technology Research Center to the establishment of new academic programs on the Stillwater campus and in Tulsa.

We invite you to be our guest for a VIP visit to campus and the CEAT. Contact Dean Karl Reid by phone at (405) 744-5140, by FAX at (405) 744-7545, or by e-mail at kreid@okstate.edu. If a trip to campus is not possible, visit the CEAT homepage through the OSU Website at www.okstate.edu.

Assisting Inventors

When the Legislature terminated a program within the Oklahoma Department of Commerce that aided Oklahoma's inventors, the Oklahoma Center for the Advancement of Science and Technology (OCAST) was charged with reestablishing it.

Since August 1998, OSU's Division of Engineering Technology has housed the Oklahoma Inventors Assistance Service. The endeavor is a collaboration involving OCAST, the Oklahoma Technology Commercialization Center, the Oklahoma Alliance for Manufacturing Excellence and OSU.

"Our mission is to assist the inventor in navigating the process from idea to marketplace by providing education, information and referrals," says Dr. Thomas Bertenshaw, professor and head of electrical engineering technology.

Bertenshaw says the program also wants to provide inventors with a small amount of capital to offset the cost of consultants.

"We're now at a point where we believe we can help Oklahoma's inventors accomplish some significant innovations."

Going Global

An agreement between the CEAT and INTI College benefits the dozens of Malaysian students who come to OSU each year for the "American experience," but it also enhances opportunities for CEAT students who gain "global experience" without ever leaving home.

"Because many corporations deliver products all over the world, they are using multicultural teams to do their design work," says CEAT Associate Dean David Thompson. "It's a real benefit for our students to work with people from other cultures while they're in the education process. By the time they graduate, most of our students will have had a chance to work on a multicultural team."

Between 30 and 40 Malaysian students enter OSU's engineering program each year. Most of them transfer from INTI College, where they follow an American track of study featuring lower division engineering courses similar to those offered at OSU.

"They have excellent laboratory facilities," says CEAT Dean Karl Reid, who recently visited the INTI campus. "The Malaysian students are well-prepared when they come to OSU, and they value the American system of education."

From the Ground Up

A collaboration between the CEAT and industry representatives makes moving up the corporate ladder easier for engineers and scientists like John Connelly.

Connelly, a petroleum engineer and manager of major projects at Williams Energy Services, is pursuing a master's degree in engineering and technology management (MSETM) at OSU. The program, offered through the CEAT and the College of Business Administration, is designed to empower technological-savvy staff with the skills to successfully manage people, projects, technology and strategy.

On-the-job training is not good enough for the modern-day technical manager. The MSETM degree specifically addresses today's needs. It extracts elements from both an MBA and a master's in a technical discipline and combines them with other specific technical management topics. It addresses how to plan, manage and integrate the technical assets of a company in ways consistent and synergistic with a company's overall business strategy.

Tony Maggio, former senior vice president of engineering and chief technical officer, Seagate Technologies. Member, MSETM Industrial Advisory Committee



Taking Control

Necessity is the mother of invention so when demands emanated from industry for a graduate program in the emerging field of control engineering, the CEAT faculty created it.

The CEAT's master's degree in control systems engineering (MSCSE) is a collaboration between the Schools of Mechanical and Aerospace Engineering, Electrical and Computer Engineering, Industrial Engineering and Management, Chemical Engineering and Biosystems and Agricultural Engineering.

Dr. R. Russell Rhinehart, Bartlett Chair and head of the School of Chemical Engineering, says the working relationship between the schools enabled the establishment of the graduate degree.

"Other universities have a strong control base," says Rhinehart, "but they don't have the innate collaboration and cooperation between professors or the strong applications focus that we enjoy here at OSU."



RHINEHART

The curriculum is based on customer needs including input from industry executives, middle managers and individual engineers about what is needed to prepare a working technical professional for a management career. Information also comes from the MSETM industrial advisory committee, which includes representatives from Seagate, Phillips Petroleum, Halliburton, Conoco, Lucent and Dover Resources.

"It's a great integration of the business and technical side," says Connelly. "I've moved into a leadership position and know firsthand that you must have technical skills, but you must also develop management, communication and interpersonal skills. That's part of what the MSETM program can help bridge." ▲

Energy



TECH TIME ...

Structurally Sound – In the 1950s, a research team headed by Jan J. Tuma of civil engineering devised a new mathematical theory in the field of structural analysis. The breakthrough utilized simple computations and extensive numerical tables to help engineers easily compute displacements, edge reactions, stresses and bending moments of structural plates.

Partnerships Recruit, Retain Future Engineers

The CEAT knows the importance of landing top-notch students. It also knows the importance of keeping them.

"Recruitment of students is important," says Jennifer Hamby, coordinator of the Women in Engineering, Architecture and Technology Program. "There aren't many role models out there. There are no TV shows about engineers. You don't have an 'LA Engineers' show."

CEAT recruitment programs include Reaching Engineering and Architectural Career Heights (REACH), a summer program in which high school women explore career and educational opportunities in high-tech fields through a variety of activities and contact with female professionals and female CEAT students and faculty.

Other recruitment efforts include a weekend for Native American high school seniors interested in science or engineering careers; Transition 101, a one-week summer program that acquaints high school seniors with engineering and OSU campus life; and Collegiate Recruiting for Engineering, Architecture and Technology Excellence (CREATE), where CEAT student teams visit high schools to discuss technical careers.

But student success doesn't end with recruitment. The CEAT works hard to retain students through programs like Collegiate Role models for Educating Women (CREW), a mentoring program in which female freshmen and sophomores are matched with juniors and seniors.

The 3.0 Clique helps build teamwork and study skills for multicultural students. To be a part of the 3.0 Clique, students must fulfill requirements such as polishing public speaking skills and maintaining a 3.0 GPA.

"The goal is to encourage students to study," says Jovette Dew, coordinator of the Multicultural Engineering Program. "We also want them to develop peer relationships and become involved in campus activities and organizations that promote leadership potential."

The Engineering Center located in Kerr-Drummond Residence Hall is another important retention program. The CEAT students who live there benefit from a top-of-the-line 24-hour computer laboratory, faculty mentoring relationships and academic excellence workshops.

"It's important to recruit exceptional students," says Dew, "but retention and graduation rates are important, too."



DEW

HAMBY

Outstanding Faculty Recognized

Halliburton has come to represent excellence at OSU, according to Dean Karl Reid. "Some of our best students, faculty and research projects have the Halliburton name on them." That includes four CEAT faculty members who were recently honored as Halliburton Outstanding Faculty Members for 1999.



SPITLER

OUTSTANDING FACULTY MEMBER

Jeff Spitler, professor of mechanical and aerospace engineering, exemplifies excellence in research. During his nine years at OSU, he has served as principal or co-principal investigator on research contracts totaling more than \$7 million. The most significant is the "smart bridge" project that involves the use of ground source heat pump technology to prevent highway bridges from freezing in winter.



LEWIS

OUTSTANDING YOUNG FACULTY MEMBER

In the classroom, Randy Lewis, professor of chemical engineering, leads by example. "Dr. Lewis' own dedication, preparation and involvement in the class exceeds the level required of students," writes one former student. Lewis uses problem-solving sessions and team projects to get students involved. His dynamic teaching style makes his classes favorites among chemical engineering students.



BRYANT

EXCELLENT TEACHER

Students in John Bryant's architecture classes learn about more than buildings. They learn to place architecture more clearly in its cultural and geographic context. Bryant, FAIA, professor in the School of Architecture, gives his students food for thought — literally. Bryant welcomes students to his Japanese architecture history class with Japanese music and food and instructs them on the proper use of chopsticks, tea bowls and incense. The props bring the history of Japanese architecture alive and into its cultural setting.



ARENA

EXCELLENT YOUNG TEACHER

Students consistently rank Andy Arena, professor of mechanical and aerospace engineering, near the top of all faculty members in classroom teaching, and in 1994 nominated him for the all-campus Amoco Foundation Outstanding Teaching Award, even though he had not taught at OSU long enough to qualify. In 1997, Arena received the national Ralph R. Teetor Award for instruction. Students are impressed by the quality of real-world experience Arena brings to his presentations through his extensive experience as a commercial pilot and engineer.

synchronize

By helping to provide scholarships, internships, and the opportunity to interact with professionals, General Motors-Oklahoma City is achieving its corporate diversity goals, as well as those of the Council of Partners. It is our intent that students, such as Sandra McNeil, will provide a resource for leadership in the near future.

Doug Hill, Supervisor of Salaried Personnel, General Motors-Oklahoma City



Trane Keeps a Rollin'

The Trane Company, a division of American Standard, long an ally of the International Ground Source Heat Pump Association (IGSHPA), has reaffirmed its support of OSU with a substantial contribution to the Division of Engineering Technology.

The company has also enlisted the aid of IGSHPA in bolstering heat pump sales in the Peoples Republic of China. These joint ventures mean utilization of ground source heat pumps by two entities that have never before employed geothermal units to heat and cool large complexes ... the Chinese government and OSU.

In addition to use in ongoing research, the Division of Engineering Technology plans to utilize a number of Trane's 73 recently donated geothermal heat pump units in upcoming construction projects at OSU.

Trane, the only manufacturer of equipment enlisted by the Department of Energy to reduce the federal government's annual energy bill, is also working with the Division of Engineering Technology on a contract to provide heat pump technology to the Chinese government.

"We anticipate using Dr. James Bose and IGSHPA staff to actually do a portion of the training in China, not only for the Chinese government but also for our own sales people," says Howard Newton, applications manager for Trane in Waco, Texas, and a CEAT alumnus.

"We want Dr. Bose and others to be part of our team."

Diverse Opportunities

Oklahoma industry recognizes the importance of diversity.

"Industrial firms have found that engineering teams that are more diverse are also more successful," says Jovette Dew, coordinator of the Multicultural Engineering Program.

But diversity is nothing new to OSU. It was 25 years ago when the CEAT first teamed with industry leaders to form the Council of Partners (COP). Its goal? To provide financial aid and campus support for talented black students in engineering. In 1988, the council broadened its service to American Indian and Hispanic students.

Council members, including Amoco, General Motors, Conoco, Celanese, OG&E, Kerr-McGee, Phillips, Boeing, Halliburton and ONG, provide scholarships to help the CEAT recruit Oklahoma's best students.

Because of financial support from the COP, the CEAT is able to award up to a dozen scholarships annually — valued at \$2,000 a year for four years. Once on campus, COP scholars like Sandra McNeil, electrical engineering senior, are afforded field trips, internships and summer employment as well as opportunities to interact with professionals. The COP currently funds 42 scholars, 21 of whom boast a GPA of 3.0 or above. ▲

Record-Setting Endeavors

A growing relationship between the School of Mechanical and Aerospace Engineering and Advanced Racing Composites, LLC (ARC) is shattering university and even world records.



Members of OSU's aerospace teams gain valuable experience by working with industry partners like Advanced Racing Composites (ARC).

The Tulsa-based firm, which manufactures custom automotive and aircraft parts, joined sponsors of OSU's Society of Automotive Engineers (SAE) Formula Racecar team two years ago. Its owners, Todd Chapman and OSU mechanical engineering technology alumnus Brian Vermillion, have since enhanced their kinship with MAE faculty and scholars. Last winter, when the company needed a computational analysis on a new design of an experimental wing for top fuel dragsters, Vermillion turned the project over to Associate Professor Andy Arena and graduate student Tony Buratti.

The result? One ARC customer piloted his dragster to the quickest elapsed time in drag racing history. Weeks later, another ARC customer downed the speed record by reaching 330 miles per hour in the quarter mile.

But world records weren't the only ones to fall. ARC provided materials, expertise and even access to its shop to help the CEAT's Formula Racecar team and aerospace teams break records of their own.

OSU's Formula team, in just its second year in competition, improved from 71st to 46th out of a field of 100, and the aerospace teams finished in second- and 12th-place among 37 entries.

"It's important for students to get these kinds of experiences because there needs to be a balance between functionality and theory," says Vermillion. "Companies today are looking for well-rounded engineers who understand that it doesn't matter how impressive their designs are in theory. If it can't be built because of cost or complexity, it's not a good design."

STORIES THIS PAGE BY ADAM HUFFER
AND SHELLEY BRINSFIELD

Uncovering a Closely Guarded Secret

A unique “shear-slitting” machine recently donated to the Web Handling Research Center by Tidland Corporation is stimulating a new area of research and fostering a three-year study by Hongbing Lu, assistant professor of mechanical and aerospace engineering, for Alcoa, Inc.

Using the laboratory slitter, Lu recently began a unique project — in fact, the first and only study of its kind — to limit edge defects that result from the slitting of aluminum webs. “Shear slitting” is used to cut or “slit” web materials into narrower forms.



LU

“When you slit a web material such as aluminum, you often incur defects, the typical ones being burr-edge micro-cracks and debris, that often cause manufacturing defects in products such as aluminum cans,” says Lu. “Alcoa is a major supplier of aluminum rolls to the can making industry. A typical roll weighs 15 tons and represents a significant investment.

“Improved understanding of shear slitting and techniques for minimizing edge defects during slitting could lead to substantial savings for Alcoa and its customers.”

The laboratory slitter, which until now has been used to cut paper and plastic webs, will be outfitted with rotary blades exactly like those used by Alcoa. The researchers will perform cuts on aluminum webs and evaluate the machine’s performance under a number of different factors that have remained vague in most plant operations.

“We are heading into uncharted territory because the slitting machine operators who perform this process are reluctant to talk about how they do it, even to their colleagues,” says Lu. “It has been something of a trade secret.

“We will look at the effects of variations in things such as tension, speed, rake-angles and blade overlapping to try to optimize slitting conditions and develop a method to take directly into plants,” Lu says. “If this project goes well, we may be able to save Alcoa a lot of money.”



TECH TIME ...

Bend, Don't Break – In 1981, Atmaram H. Soni of mechanical and aerospace engineering collaborated with medical doctors at the University of Oklahoma on the development of an artificial knee.



photo/Nike Wieder

Understanding the effects of pollutants on frogs may help us learn more about maintaining other species in their natural environment and about preserving these environments for ourselves and our heirs.

Dr. Gary Yen, assistant professor of electrical and computer engineering

Look Who's Talking

A research collaboration between Williams and the CEAT could increase the number of available telephone lines.

Engineers within OSU’s School of Electrical and Computer Engineering and Williams Technology Development Laboratory in Tulsa are studying ways to maximize the information carrying capacity of optical fibers within telecommunications networks.

Optical fibers can carry millions of signals simultaneously along a channel, and variations in frequency, or wavelength, allow the



(un) Sensored

Sensor and control systems technologies developed at OSU are finding application in areas varying from defense to the environment.

Dr. Gary Yen, associate professor of electrical and computer engineering, in conjunction with the Department of Defense, developed a conditional health monitoring system to support flight systems in military helicopters. With funding from the Measurement and Control Engineering Center at OSU, Yen's innovation was advanced to monitor acoustic emissions signatures of air and water flow through pipes and to aid efficiency in chemical process

plants. Now, with support from OSU's Environmental Institute, Yen is taking the sensor system one step further and teaching it to recognize the vocalization patterns of frog calls.

By quantifying the croaks of different frog species, the automated environmental health monitoring system will use the amphibian population as an indicator of environmental and water quality.

Yen says frogs are excellent indicators of environmental health because of their aquatic and terrestrial life histories and because their permeable skin makes them susceptible to toxicants. ▲

Ventures Spark Catalyst Opportunities

A newly developed catalyst is the basis for the latest of ventures between the CEAT and Conoco.

Martin High, Karen High and Alan Tree, professors of chemical engineering, are heading a project to explore a catalyst that may be used to refine hydrocarbons into more valuable products like high-octane gasoline, according to Martin High.

"This material could potentially replace catalysts currently used in hydrocarbon upgrading that have properties which are potentially hazardous to workers and the environment," says High.



HIGH

In addition to existing applications, the catalyst could also assist in the development of new products.



HIGH

Conoco donated a catalytic reactor to the college for the project as well as funding that was matched by the Oklahoma State Regents for Higher Education and the Noble Foundation for the purchase of additional equipment. The project exemplifies the kind of relationship the college seeks to strengthen with industrial partners.



TREE

"This is a good fit in terms of what we can offer them and they can offer us," High says. "They have a lot of practical skills in running a refinery that we don't have here, but we have an ideal setting for fundamental science research."

Tree adds that this, the latest of Conoco's gifts to the college, can be built upon exponentially.

"Through this endeavor, we have acquired new, state-of-the-art equipment that will allow us to work on many other future projects for industry."

fiber to support multiple channels. By pushing the boundaries of a methodology called dense wavelength division multiplexing (DWDM), the researchers hope to increase the number of channels an optical fiber can carry cleanly.

"Optical fibers have an extremely large frequency bandwidth with a capacity we are nowhere near the limit of for carrying information," says Scott Shepard, professor of electrical and computer engineering and principal investigator for the project. "A tremendous potential exists that we have not yet tapped."

Although companies have trumpeted their use of fiber optics in advertising telephone service since the late 1980s, optimization of optical network capabilities remains an ongoing, and lucrative, undertaking. The economic ramifications of increasing traffic millions-fold on existing and to-be-installed networks are tremendous, says Shepard.

The project, which is funded in part by the Oklahoma Center for the Advancement of Science and Technology (OCAST), will be sustained in part with matching monies from Williams.

Making History

Students in OSU's fourth-year architectural design studio are providing the first glimpse of the proposed \$46 million Oklahoma History Center (OHC).

Students designed models of the center as class projects under the direction of OSU School of Architecture Professors Randy Seitsinger, Jeff Williams and David Hanser.

"This type of project gives students the opportunity to work with a client on a real project, and it is a very real application of the learning process," says Williams.

Students toured the current OHC headquarters and museum and visited with the client for more than two hours before beginning the project. Throughout the six-week project, students maintained a constant dialogue with Oklahoma Historical Society officials.



Architecture students show off a design of the proposed \$46 million Oklahoma History Center to a member of the Oklahoma Historical Society.

"We had more than 10 teams, or 'firms,' asking questions, which helped us analyze and gain a better understanding of what we wanted," says OHS Executive Director Dr. Robert Blackburn.

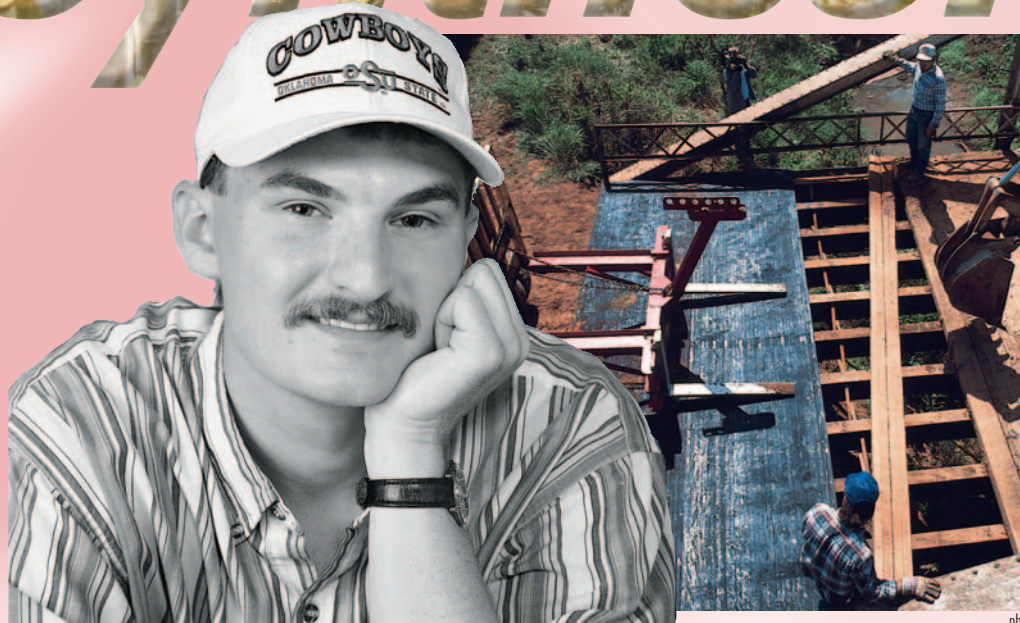
He says the experience will be particularly useful in negotiations with the actual firms competing for the final contract of the center.

"The architects and designers want to look at these models, so there may be different aspects of these ideas that will end up in the final design."

The Design Squad is a win-win situation. ODOT benefits by having a fully functional design team along with trained employees at graduation. Students like myself benefit by earning money while also receiving valuable design experience.

Anthony Echelle, civil engineering senior from Kiowa, OK

Synthesis



Students Hit the Road

Think that highway you drive on every day was designed by a team of seasoned engineers? Think again! It may be the work of CEAT students in the Oklahoma Department of Transportation (ODOT) Design Squad Laboratory.

Civil engineering students are getting on-the-job experience even before they graduate, thanks to an agreement with ODOT. The nine students who work in the lab receive pay and benefits just like other ODOT employees. Many have even gone on to full-time positions with the agency upon graduation.

Students must have completed 60 hours of credit in order to participate in the program.

A similar collaboration with The Benham Group is also giving civil engineering students real-life work experience. In an agreement struck last year, six students work part-time in The Benham Group's on-campus laboratory designing streets, highways and other engineering projects for the city of Tulsa.

In both instances, students work 20 hours per week and attend classes full-time during the academic year. They work 40 hours per week during holidays and in the summer. ▲

Attracting and Retaining the Best and Brightest

Endowed professorships and chairs help the CEAT retain outstanding faculty like the college's newest appointees: **Gary Foutch**, professor of chemical engineering, Kerr-McGee Chair • **Keith Good**, professor of mechanical and aerospace engineering, Noble Foundation Professor • **Don Lucca**, professor of mechanical and aerospace engineering, Tom J. Cunningham Professor.

Endowed professorships and chairs also help the CEAT attract outstanding faculty members. Appointments to endowed positions were key factors in the recruitment of the following: **Dan Grischkowsky**, professor of electrical engineering, Henry and Shirley Bellmon Chair, from IBM • **Ranga Komanduri**, professor of mechanical engineering, MOST Chair in Intelligent Manufacturing, from the National Science Foundation • **Russell Rhinehart**, professor & head of chemical engineering, Edward Bartlett Chair, from Texas Tech University • **Tom Woodford**, associate professor and head of fire protection and safety engineering technology, Simplex Professor, from Western Fire Center.

Other CEAT faculty members who hold endowed positions are: **Robert Robinson**, professor of chemical engineering, Amoco Chair • **R.G. Ramakumar**, professor of electrical engineering, PSO/Albrecht Naeter Professor • **Khaled Gasem**, professor of chemical engineering, Robert Maddox Professor • **Greg Wilber**, associate professor of civil engineering, Centennial Professor.

Endowments were nearly non-existent until the late 1980s when state government offered to match money given by private donors. Today, the CEAT boasts 14 endowed chairs or professorships.

Funds are used for instructional and research laboratory equipment, post-doctoral fellows, graduate student support, professional development, and visiting faculty support.

"These professorships and chairs serve as a catalyst by bringing talented faculty to campus," says OSU Foundation President Ron Area. "This in turn attracts top-flight scholars, graduate students and other faculty members."



FOUTCH



GOOD



LUCCA

Working in a Coal Mine

Until now, industrial compliance with governmental mandates to limit carbon dioxide emissions has been penalty driven, but that might change due to research underway in OSU's School of Chemical Engineering.

R.N. Maddox Professor Khaled Gasem and Professor and Amoco Chair Robert Robinson hope to optimize a process in which carbon dioxide and nitrogen are injected and trapped within coal beds in the ground to displace the natural gas residing there. The results of the study, which has received funding from the U.S. Department of Energy, may be used by companies to reduce the most prevalent of greenhouse gases in the atmosphere and, simultaneously, increase the nation's supply of clean-burning methane.

"By freeing a useful fuel that companies can process, sequestration of carbon dioxide in coal beds allows them to economically address the issue of excessive greenhouse gases," says Gasem.

Less than 10 years ago, Amoco became the first company to attempt to harvest methane reservoirs in coal deposits. Due to coal's ready adsorption of nitrogen and carbon dioxide mixtures, Amoco began research on injecting the gases to free more methane. According to Gasem, their concept is very similar to pumping water or gas into a well to displace and recover oil.

Gasem and Robinson's research builds on Amoco's findings. "Our goal is to develop mathematical models in order to analyze the characteristics of a coal sample," says Gasem. "We want to be able to tell a company exactly what to expect in terms of adsorption rate at a given temperature and pressure."

STORIES THIS PAGE BY ADAM HUFFER AND SHELLEY BRINSFIELD



TECH TIME ...

Getting a Second Wind – In the late 1970s, the energy crisis prompted a need for cheaper sources of energy. The college responded by generating a wind energy research project in the form of a 60-foot high structure adjacent to the Stillwater airport. The structure supported a wind turbine fashioned from a 30-foot bicycle-type wheel. The turbine was the first of its kind in the nation.

confluent

Getting Creative

CEAT students like Johnny Whitfield, Roberto Seda and Dawn Knight are creating excitement at high schools across the state. No, it's not the pizza they bring for lunch. Or even the hands-on engineering projects. It's the talk of high paying, rewarding careers as engineers, architects and technologists.



WHITFIELD

Members of the Collegiate Recruiting for Engineering, Architecture and Technology Excellence (CREATE) Program are visiting Oklahoma students to discuss engineering education and careers. CREATE members emphasize the rigors of challenging degree programs and the importance of math and science classes.

"We want to recruit students earlier in their high school careers. We want to motivate them to select the right courses and work harder so they are not at a disadvantage when they come here," says Dr. Virgil Nichols, director of the CEAT's student services office.

Nichols believes current students are the best messengers because of their college experiences and their ability to relate well to young students.

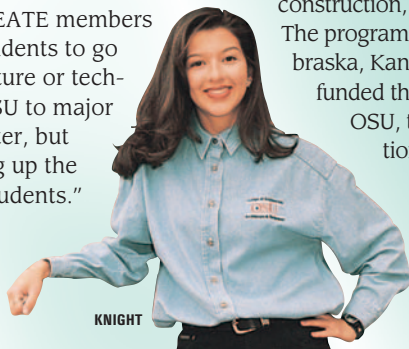


SEDA

CREATE is also designed to appeal to students from groups that historically have not been well represented in the fields of engineering, architecture and technology. The four-member teams are diverse in both gender and race.

"Although these fields traditionally have been dominated by white males, our teams are not," says Nichols.

Jennifer Hamby, coordinator of the Women in Engineering, Architecture and Technology Program, agrees. "CREATE members encourage high school students to go into engineering, architecture or technology. If they come to OSU to major in engineering, all the better, but our first priority is opening up the world of engineering to students."



KNIGHT



I enjoy mentoring young women, whether they're college freshmen or sixth-graders at Girl Scout Day. Through these experiences, I'm able to show young girls that engineering is within their capabilities and can be fun and exciting. I want them to leave with a greater appreciation for the teamwork involved in the engineering process — teamwork we emphasize through mentoring, encouragement and support.

Melissa Caldwell, chemical engineering senior from Stillwater

Making Inroads

The Center for Local Government Technology (CLGT), an outreach of the CEAT, is paving the way for members of Native American communities.

The Tribal Technical Assistance Program (TTAP), headquartered at OSU, provides technical expertise on road and bridge construction, maintenance and repair. The program serves 47 tribes throughout Nebraska, Kansas, Oklahoma and Texas and is funded through an agreement between OSU, the Federal Highway Administration (FHWA) and the Bureau of Indian Affairs (BIA).

"Our job is to provide on-site assistance and serve as a free source of civil engineering advice and expertise," says TTAP Manager Jodie Paden. "We offer guidance on the development of roads and bridges from planning stages to construction."

Through the Indian Reservation Road Program, tribes receive a limited amount of construction dollars. Most of the money is used to extend roads from county roads or state highways or for access into tribal headquarters or ceremonial grounds. Tribes also construct roads and bridges to connect

Follow the Leader

Female students in the CEAT want others to follow in their footsteps. That's why they mentor girls and young women who are interested in careers as engineers.

Each year more than 1,000 fifth and sixth grade girls from across the state come to campus for Girl Scout Day. The event is organized by the CEAT's Society of Women Engineers (SWE) to promote science and engineering studies. Participants even earn a badge for their efforts!

Girl Scout Day includes hands-on teaching sessions that cover basic engineering and science concepts. In the Skittles session, participants learn about quality control by evaluating individual bags of Skittles candy. In another session, Scouts are challenged to build a load-bearing structure using paper.

CEAT students and engineering professionals, many of them women, lead the sessions and serve as role models for these future engineers. ▲



tribal members living in rural areas to hospitals and schools in urban communities.

Paden says that due to the limited amount of funds, many tribes want to do a majority of the legwork themselves instead of contracting out. "That's why education is needed," he says.

TTAP offers workshops on heavy equipment operator training, surveying, road construction methods and computer mapping. TTAP also provides technical literature and on-site technical assistance at no charge.



PADEN



TECH TIME ...

First Lady – In 1946, Virginia Thompson became the first woman appointed to the engineering faculty. Thompson was only the 10th woman to receive a degree in engineering from Oklahoma A. and M. College when she graduated in 1941. Seven years later, she became the first woman to be licensed as a professional engineer in Oklahoma. ▲

Source: OSU Centennial Histories Series' *Research* by Craig Chappell and *Engineering, Architecture and Technology* by James Vernon Parcher.

Impacting Tulsa

One year after the creation of OSU-Tulsa, a number of initiatives led by the CEAT are impacting residents of the surrounding Greenwood area and the entire city of Tulsa.

Architecture students have completed conceptual models detailing the Greenwood Chamber of Commerce's vision for a renovation of areas ravaged by the Tulsa Race Riots of 1921.

In addition, a study on Greenwood-area merchant satisfaction, conducted by industrial engineering and management students and professors, has already yielded results in the form of a pay phone, newsstands and covered bus stop near the Greenwood Business Resource Center. The Center will also be the site for Internet-delivered, desktop training courses offered through the CEAT.

A manufacturing extension agent will soon be hired by the CEAT to work within the Greenwood area. Much like OSU's applications engineers, the agent will provide consultation to primarily small- and medium-size manufacturing firms.

The most ambitious initiative, a technology development center, is still in the preliminary stages. Headed by Dr. Karl Reid, dean of

the CEAT, the center will provide a place for Tulsa-based entrepreneurs, research-based faculty and students from OSU-Tulsa and private investors to develop new products and processes that are spin-offs of research efforts at the local university.

OSU personnel, Metropolitan Tulsa Chamber of Commerce and Greenwood Chamber of Commerce representatives are developing strategies to fund the first phases of the facility. Planners hope to emulate similar endeavors at leading research universities such as Stanford, MIT and Georgia Tech. Collaboration by Oklahoma's largest universities in a new research facility in Tulsa, as proposed by OSU President James Halligan, makes it feasible.

"This kind of facility exists on the periphery of some of the country's best research institutions, and with OSU and four other universities involved in the research center, we will have a very rich combination of faculty and students," says Reid. "This center, where we can spin-off OSU-Tulsa technology and research into business, will be complimentary to and synergistic with the research center President Halligan proposes."

Studentdigest

An OSU, CEAT First

Phoebe Brown wants to make the world a safer place.

“I want to work as a process engineer to limit, if not eliminate, the toxic pollution resulting from chemical processing,” she says.

Brown, a chemical engineering sophomore, recently became OSU’s first Morris K. Udall Scholarship recipient. The national award is given by the Udall Foundation to distinguished undergraduates who demonstrate a commitment to fields related to the environment and to Native American and Alaska Native students pursuing degrees in health care and tribal public policy. The scholarship honors Congressman Morris K. Udall, who initiated many groundbreaking environmental laws.

Brown is one of 75 Udall Scholars from 42 states for the 1999-2000 academic term. The Sand Springs native was the sole winner from Oklahoma.

“Phoebe’s candidacy is particularly impressive because she is both Native American and committed to studying the environment, likely a rare combination among applicants,” says Robert Graalman, director of University Scholarships at OSU.

Brown’s interest in chemistry and strong desire to work in environmental protection are allowing her to specialize in an area that will advance her career goals.

“Because of its broad application, there is a steady demand for people with chemical engineering backgrounds,” Brown says. “I thought that the environmental option (of chemical engineering) would not only provide the most employment opportunities, it would also allow me to do much more on the job.”

Summer internships with Baker Petrolite and Williams Companies’ Energy Services validated her decision.

“Industrial pollution is one of the biggest affronts to our environment, and I have learned firsthand about how companies must deal with environmental problems and issues surrounding a chemical process plant,” says Brown. “The development of new technology in the control of unit operations involved with energy use and production processes can significantly limit pollution and perhaps help identify applications for products that we now consider waste.”

Brown is also working with Dr. R. Russell Rhinehart, Bartlett Chair and head of the School of Chemical Engineering, on a project that could help plant operators improve the efficiency of existing chemical processes and perhaps revolutionize the industry. ▲

ADAM HUFFER

Brown

Outstanding Scholars



De La Cerda

Paul De La Cerda, senior in the School of Civil and Environmental Engineering, has been elected to a national office for the Society of Hispanic Professional Engineers. De La Cerda will serve as Region V Regional Student Representative. De La Cerda was also winner of the 1998 Hispanic Engineer National Achievement Award for Student Leadership.



Compston

Christal Compston, junior in the School of Biosystems and Agricultural Engineering, has been elected a national representative to the American Society of Agricultural Engineers (ASAE). She currently serves as chairperson of ASAE’s student advisory board.

Rashad Moore, 1999 graduate and former National Society of Black Engineers’ Student Member of the Year, has negotiated an assignment with Anderson Consulting in Washington, D.C.,

after initially being offered a job with the same firm in Dallas. The

Tulsa native began his new job in September with a starting salary in the high 50s. ▲



Moore



ASAE TAKES THE SILVER

The OSU student branch of the American Society of Agricultural Engineers (ASAE) has been judged the best chapter in North America. The group received the silver cup in the Group A competition for the Equipment Manufacturers Institute (EMI) Trophy. The award is presented each year to the ASAE student branch in North America that has the most outstanding record of activities and achievements.

BUILDING A REPUTATION

Students from the Department of Construction Management Technology (CMT) built upon their program's reputation by capturing first and second place finishes in the team events at the Associated Schools of Construction (ASC) Region V Student Competitions. Coached by Professor **Mark Pruitt**, the OSU Design-Build Team took first place honors, with OU and Texas A&M grabbing second and third, respectively. The OSU Construction Management Team, coached by Professor **Dana Hobson**, placed second behind OU and ahead of Texas Tech.

EARNING THEIR DUE

Students representing OSU's chapter of the American Society of Mechanical Engineers (ASME) more than tripled last year's score in the ASME Region X Best Student Chapter competition and earned the title "Most Improved Chapter." The group was acknowledged for increasing chapter activities and membership by more than 50 percent over the past year.



OSU's Formula team, in just its second year of competition, improved from 71st to 46th out of a field of about 100. Team members have set their sights on finishing in the Top 10 of next year's Society of Automotive Engineers (SAE) Formula Competition in Detroit, Mich.

A DECADE OF EXCELLENCE

The local chapter of Alpha Pi Mu, the national industrial engineering honor society, has been named the Outstanding Student Chapter in the country for 1998. The OSU chapter has won the award for the past 10 years.

FLYING HIGH

Seniors from the School of Mechanical and Aerospace Engineering captured two of the top 15 positions at the American Institute of Aeronautics and Astronautics (AIAA) International Design Competition. The two teams, the Aggie Aquanauts and Hercules Aircraft Systems, landed second and 12th place, respectively, among 37 entries worldwide in the aircraft design, build and fly contest. ▲

Riders on the "Storm"



Kristi Kelty, left, and Annie Forsberg, both members of the local chapter of the American Society of Civil Engineers (ASCE), helped OSU paddle to its highest finish ever in the Concrete Canoe Competition. The team, "Rising Storm," finished third at the national championships in Melbourne, Fla. (ASCE/UAH photo by Phil Gentry)

Hot Training Program Gets Additional Funds

Fire Service Training, Oklahoma's provider of continuing education to state emergency responders, has been given a boost from additional funding.

Emergency responders throughout Oklahoma will receive continued educational support for courses and training.



photo/Mike Wieser

As a result of months of working with state fire service organizations and the Oklahoma Legislature, OSU-Fire Service Training has received \$350,000 in new, recurring money for fiscal year 2000 from the Oklahoma State Regents for Higher Education (OSRHE).

Fire Service Training will also receive an additional \$150,000 in recurring money for fiscal year 2001, bringing the total to \$500,000 of new money over the next two budget years.

"The additional funding from the Regents has enabled us to maintain the current number of courses without increasing their cost during this fiscal year," says OSU-FST Director Randy Novak.

Fire Department Instruction Techniques (Instructor I), was of particular interest to lawmakers.

"We had discussions internally and with key legislators, and told them if we could have more trained instructors in the field, that would enable some departments to be more self-sufficient in the training of firefighters," Novak says. "If a few departments can provide some of the basic training on their own, we can focus on more advanced training programs."

Additional funds from Hazardous Materials Emergency Preparedness (HMEP) and Superfund Amendments and Reauthorization Act of 1986 (SARA Title III) grants and a Federal Emergency

Management Agency (FEMA) grant are being used to provide training for all of Oklahoma's emergency responders. The programs are designed to aid cooperation between various departments that may be called in the event of a crisis.

"The HMEP and SARA grants allow us to open up our training beyond the traditional scope of OSU-FST," Novak says. "They enable us to support training consistent for responders who have to work together in a hazardous materials emergency, including professionals from law enforcement, fire service and emergency medical care providers."

The FEMA grant also supports multi-departmental training.

"We now teach a number of different types of courses that address the level of response and the actual capabilities of the department, whether fire, police or medical," Novak says. "Our goal is to enhance the capabilities of all first responders in Oklahoma to manage the consequences of terrorist acts." ▲

ADAM HUFFER

Lucca Elected to Exclusive Scientific Society

Don Lucca, professor of mechanical and aerospace engineering, has been elected to full membership in CIRP, a very prestigious international research society. That makes OSU one of only two institutions in America to have two members in the society. Lucca joins professor of mechanical and aerospace engineering Ranga Komanduri who was selected prior to coming to OSU. To put in perspective how prestigious this is, institutions that have only one member include: M.I.T, the University of California at Berkeley, Stanford, Ohio State, Cornell, University of Connecticut, Michigan Tech, the University of North Carolina and Lawrence Livermore Laboratories. The translation of CIRP from French is "International Institution for Production Engineering Research." Worldwide membership is capped. Presently, there are only 161 members representing 37 countries, and each country may have no more than 15 members. ▲

1998 CEAT Hall of Fame Inductee Ronald D. Wickens

His intuition told him that his life could be influenced by the wisdom and vision of two great men: Ladislaus J. Fila, professor and head of aerospace engineering at Oklahoma State University (then Oklahoma Agricultural and Mechanical College), and Frederick W. Smith, CEO of Federal Express Corporation.

Ronald D. Wickens followed his intuition, and today, the 1957 mechanical engineering graduate is vice president of strategic projects for the Air Operations Division of FedEx.



Wickens

Technology attracted Wickens as a teen. He had a love for airplanes and a desire to fly. Transforming his dreams into realities, his engineering education and aviation training prepared him for rewarding accomplishments in the air transport industry. His career has taken him from a stint in the U.S. Air Force flying B-47E strategic bombers to project

engineer of KKRH Consulting Engineers to director of operational and advanced engineering for Continental Airlines before joining FedEx in 1977.

His leadership at FedEx has built an engineering department that now employs some 300 engineers. He has been responsible for the technical definition and delivery of numerous aircraft — increasing the fleet from 32 to 621. The most notable projects in which he has been involved were 727 passenger-to-freighter conversions and the design of a “noise hush kit,” developed to make aircraft noise compliant. FedEx subsequently commercialized the hush kit making it available throughout the industry.

Wickens knows that in the corporate world teamwork is essential and believes the most important facet of management is hiring the right people. He advocates offering people a career, rather than a job and telling them what to do, not how to do it.

He and his wife, Julia, have four children and three grandchildren. ▲

VONDA EVANS

DOUBLE TAKE

Donald L. Wickens, Ronald D. Wickens' identical twin brother, was inducted into the Hall of Fame in 1997.

Honoring a Cold Warrior's Vision

The Cold War is over, but Dr. **Heinz W. Schmitt**'s contributions to the nuclear weapons race live on.

The retired vice president of Weapons Systems Engineering, Sandia National Laboratories, was recently named recipient of the Melvin R. Lohmann Medal.

Each year since 1991, the medal has been awarded to a CEAT graduate who has made outstanding contributions to his or her profession and/or contributions to the education of engineers, architects or technologists.

Schmitt earned his doctorate in mechanical engineering from OSU in 1966. He also holds degrees from Brooklyn Polytechnic Institute and the University of New Mexico.

Schmitt's career began at General Electric, where he worked on the fire control system for the first nuclear submarine, the USS George Washington. He then moved to Sandia National Laboratories in Albuquerque, N.M., where he worked in space and weapons programs for more than 35 years.

Schmitt was involved in a number of projects that characterize the strength of the United States throughout the Cold War. His career spans the development and proliferation of nuclear weapons technology to more recent reduction and stockpiling of nuclear arms.

Schmitt was a principal scientist in the development of re-entry vehicles, winged vehicle platforms and control of Trident II warheads. Some of his most significant work focused on the Space Nuclear Auxiliary Power (SNAP) programs, the early development of portable nuclear generators that power satellites.

Schmitt and his wife, Barbara, have two children and reside in Albuquerque, N.M. ▲



Schmitt

Noteworthy

Select Faculty Honored



Cindy Finkle, program coordinator at Fire Service Training, has received the Fire Service Instructor of Oklahoma's (FSIO) Lifetime Achievement Award. Finkle is responsible for all inspection, investigation and fire and life safety education deliveries and was instrumental in the establishment of the Oklahoma Life Safety Educator's Association, which is now part of FSIO.



Wayne Turner, professor of industrial engineering and management, has been inducted into the Association of Energy Engineers (AEE) Managers Hall of Fame. The recognition acknowledges outstanding contributions to AEE as an organization and to the field of energy engineering. A former international president of AEE, Turner currently heads OSU's Industrial Assessment Center, which provides productivity and waste assessment reports to Oklahoma's manufacturing firms. He and his staff have conducted energy audits for more than 500 industrial plants and commercial buildings, saving Oklahoma industries millions of dollars.



Marvin Stone, professor of biosystems and agricultural engineering, presented the 23rd American Society of Agricultural Engineers (ASAE) Distinguished Lecture on Tractor Design at the ASAE Agricultural Equipment Technology Conference. The lecture series is sponsored by the Power and Machinery Division of ASAE. Stone also gave an encore presentation of his lecture at the ASAE International Meeting in Toronto.



Michael Soderstrand, professor and head of the School of Electrical and Computer Engineering, and Professor **Rao Yarlagadda**, a long-time member of the school's faculty, both recently achieved Fellow distinction within the Institute of Electrical and Electronics Engineers (IEEE). Currently four professors on the school's 18-member faculty have Fellow distinction with IEEE.



Ken Case, Regents Professor of industrial engineering and management, has been elected to a two-year term on the national board of directors of the American Society for Quality (ASQ). Case, who has been a member for 30 years, will be involved primarily in the strategic planning of the society. He will also work to develop and implement the ASQ Research Committee with new innovations for how ASQ sponsors research. ▲



Reid

A Right "Reiding"

Former CEAT Dean Melvin R. "Pete" Lohmann became an international luminary for his leadership in establishing a professional school model in engineering education. His vision was later adopted by every reputable engineering institution and is also credited for putting the CEAT on the map.

Following Lohmann's footsteps into the position of dean, Dr. Karl Reid has furthered his mentor's vision, and those of Deans McCollom and Stapley, and brought the college to a level of prominence that even Lohmann probably never dreamed possible. Reid's contributions, which span a teaching career that began in 1959 at Massachusetts Institute of Technology, have been recognized by the American Society for Engineering Education (ASEE). Recently, Reid was among distinguished honorees to receive ASEE Fellow recognition.

"Everyone has had visions of what the College of Engineering should be, but Karl has been inspirational in bringing some of those to reality," says former OSU A&M Regent and CEAT Associate Ed Malzahn.

"Karl's leadership has culminated in two landmark initiatives that will distinguish him for many years and make OSU a leading engineering institution," says Wayne Allen, chairman of the board at Phillips Petroleum Company. "The student programs, the CEAT Scholars and Phillips Scholars, give OSU access to the best students out there, and through his persistence and hard work, he was able to bring about the construction of the Advanced Technology Research Center, the first major engineering facility built in 30 years."

Allen says Reid's contributions ensure that OSU is a school the world's most promising, ambitious undergraduate and graduate scholars will consider.

"We have all the chemistry needed — top students, upgraded facilities and an outstanding faculty — to really become a top-tier institution, and Karl deserves a good deal of credit for that." ▲

ADAM HUFFER

Who What When Why

CEAT *people*



CEAT PEOPLE: Many individuals help bring the dreams of our students to life. Their continuing efforts ensure that all students benefit from the OSU experience. They help make this college the best it can be.

1-Pat Brock, assoc. prof. of fire protection & safety tech.; 2-Daleene Caldwell, staff asst., MAE; 3-Don Norvelle, assoc. prof., MET; 4-Thomas Berenshaw, prof. & head of EET; 5-Cindy Finkle, program coord., FST; 6-Nancy Trench, asst. dir., fire service programs; 7-John Bryant, prof., School of Architecture; 8-Bob Healty, prof., School of Architecture; 9-William Haire, prof., School of Architecture; 10-Eric Price, prof., MAE; 11-Brenda Rakey, staff asst., electrical & computer eng.; 12-Patsy Coleman, unit asst., indust. eng. & mgmt.; 13-Janice Walter, staff asst., indust. eng. & mgmt.; 14-Carol Douglas, unit asst., School of Architecture; 15-Janet Smith, academic sec., School of MAE. Photos by Adam Huffer, collage by Paul V. Fleming and Mandi Anderson.



Following a long-time tradition, Halliburton Inc. is bringing dreams to life at OSU — for many years to come. Students, faculty and research at OSU's Advanced Technology and Research Center are the focus of Halliburton's interest and support. Their \$325,000 gift puts into place mechanisms creating excellence in all three areas.

Halliburton = Excellence



*Halliburton —
bringing dreams to life —
for the state and the nation.*

Excellence for Students — Through the "Halliburton Scholars" program, 14 top students annually will be selected from the fields of civil, mechanical, industrial and chemical engineering to receive \$1,000 scholarships. This gift enables OSU to continue to attract and retain top students from the region.

Excellence for Faculty — Through the "Halliburton Outstanding Faculty" program, four outstanding professors yearly will be selected to receive a \$1,500 stipend based on their interest in enhancing the learning experience through service to students and excellence in their career responsibilities.

Excellence through Research — Halliburton is putting into place laboratories dedicated to polymer research. Polymers touch every aspect of human life. These world-class labs will give students a cutting-edge education in polymer engineering and stimulate economic development by converting new scientific discoveries to commercial technologies.

The OSU College of Engineering, Architecture and Technology salutes Halliburton for making excellence the criteria for "Bringing Dreams to Life" for the state and the nation. ▲

**B. N. MURALI, VICE PRESIDENT OF TECHNOLOGY,
HALLIBURTON ENERGY SERVICES.**

For more information about the "Bringing Dreams to Life" campaign, contact Marc Thompson, director of development, at (405) 744-3734.

