

organization
 Standards Job Sequencing warehousing
 methods schedule Assembly Line Balancing
 Human Factors information systems
 anthropometry Ergonomics optimize processes
 Project Management management science Therblig
Energy cost Money work design
 design efficiency machines Heuristics
industrial engineering operations research
 engineering management people effectiveness Reliability
 simulation Time Statistics Distribution sustainability
 supply chain manufacturing systems biomechanics Computers facility layout control
 engineering economy Knowledge **Integration** Problem Solving
 Occupational Health & Safety time studies **Materials**
 material handling logistics **measurement**
quality maintainability inventory
 life cycle cost Leadership
Location Analysis

DEPARTMENT OF INDUSTRIAL ENGINEERING



UNIVERSITY OF
ARKANSAS

COLLEGE OF
ENGINEERING



Department Vision

To be a nationally-competitive, student-centered, Industrial Engineering program serving Arkansas and the world through undergraduate and graduate studies, through leading-edge research programs, through contributions to the profession, and through our unique access to major organizations with world-class logistics and distribution operations. To be a model program providing a broad, personalized undergraduate experience, contemporary graduate and professional programs, and research emphasizing the application of quantitative modeling and analysis. To be leaders in the industrial engineering profession.

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From the Department Head

Dear Colleagues,

It is my pleasure to address you for the first time in my new role as Department Head. This past year has been one of transition in the Department of Industrial Engineering. Dr. Kim LaScola Needy, who served as Department Head since 2008, has accepted the position of Dean of the Graduate School and International Programs at the University of Arkansas. While we are sad to see Kim leave, we are fortunate that we will continue to work with her in her new role here at the University of Arkansas. I would like to acknowledge the dedication and leadership that Kim provided to the department over the last six years. Under her leadership, the department developed a five year strategic plan that created a shared vision for the department, hired three outstanding junior faculty members, saw graduate and undergraduate enrollments grow, saw an increase in the number of national awards for the faculty, and continued to be one of the most visible and active departments in the college. The department is grateful for Kim's dedicated service and leadership.

While change is difficult in the short term, it presents us with not only new challenges, but new opportunities to think creatively and be innovative. It has been and will continue to be a very busy year for the department. We continue to maintain a vibrant undergraduate program, our MSIE and PhD programs continue to grow in enrollment numbers, and our professional Master of Science in Operations Management remains the largest graduate program on campus. We are proud to announce the recent creation of the Department of Transportation sponsored center, Maritime Transportation Research and Education Center (MarTREC), under the direction of Dr. Heather Nachtmann. This center received a second installment of funding this fall of \$1.4 Million, for a total of \$2.8 Million.

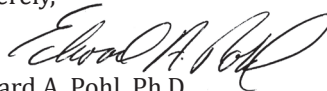
The faculty and staff have been busy making final preparations for our fall ABET visit. The department has begun a national search to fill the Hefley Professorship in Logistics and Entrepreneurship as well as a search for an Assistant Professor. The college is working on releasing a new strategic plan designed to support the University's goal of becoming a top 50 public research university by 2021 and we will begin work to revise and

align our department strategic plan with the college's plan.

We are excited to welcome to campus our newest faculty member, Dr. Harry Pierson, who joins our faculty as an Assistant Professor. Harry comes to us from the Ohio State University. Harry's research interests are in process and system design for industrial manufacturing. We are fortunate to be able to welcome back Dr. Greg Parnell who joined our faculty in the fall of 2013 as a Visiting Professor. Greg comes to us after a distinguished military career in the Air Force followed by 15 years of service on the faculty at the United States Military Academy. Greg is one of the nation's leading experts in the area of Decision and Risk Analysis, having served on several National Research Council committees. Greg has stepped in this fall to lead our Operations Management Program.

In closing, I am honored and extremely excited to step into my new role as department head. I am fortunate to be able to work with an outstanding faculty, dedicated staff, excellent students and an exceptional group of giving and motivated alumni whose support and hard work continue to help us improve our standing as one of the emerging leaders among Industrial Engineering departments. Please feel free to contact us and stop by for a visit when you are close by.

Sincerely,



Edward A. Pohl, Ph.D.
Department Head and
21st Century Professor of Industrial Engineering



*Dr. Ed Pohl
Department Head and
21st Century Professor of Engineering*

☀️ Needy Appointed Dean of Graduate School and International Education



*Dr. Kim LaScola Needy
Dean, Graduate School and
International Education*

Kim LaScola Needy, a national leader in the field of industrial engineering, has been appointed dean of the Graduate School and International Education at the University of Arkansas.

Needy is the first woman appointed to lead the school since it was founded in 1927. She had been serving as interim director of the Graduate School and International Education since April after spending nearly six years as head of the Department of Industrial Engineering in the University of Arkansas' College of Engineering.

"I am thrilled to be chosen as the next leader of the Graduate School and International Education and to work alongside such a talented group of people," Needy said. "The Graduate School and International Education is doing tremendous things on campus, including increasing the numbers of graduate students and international students. Becoming the first woman to lead these efforts is a special honor."

Sharon Gaber, provost and vice chancellor for academic affairs, said, "I am pleased that Kim Needy agreed to take on this important leadership position. Her experience and ability to move programs forward will be helpful to the Graduate School and International Education in their current period of growth."

Needy is a respected scholar in her field, with more than 132 publications. She co-authored the 2014 book

Fundamentals of Engineering Economic Analysis with four colleagues, including John A. White, chancellor emeritus of the University of Arkansas.

Needy has ample experience working with graduate students. The department of industrial engineering has the largest graduate program on campus — the Master of Science in Operations Management — and she has also served on the Dean of the Graduate School and International Education's advisory committee.

Needy has held various leadership roles in professional societies. She is the current past-president of the Institute of Industrial Engineers. As president of the 15,000-member organization in 2013, she led its board of trustees in the development of a new five-year strategic plan.

She has served on the board of directors of the American Society for Engineering Management since 2000, including as its president from 2008-2009. Needy was recently elected a Fellow of the American Society for Engineering Education.

Needy participated in the Southeastern Conference University Academic Leadership Development Program in 2010-2011.

Prior to her work at the University of Arkansas she was at the University of Pittsburgh. She has also worked in industry at the Boeing Company and PPG Industries.

Needy earned a doctorate in industrial engineering from Wichita State University and holds both a bachelor's and a master's degree in industrial engineering from the University of Pittsburgh. ☀️



**C. Richard Cassady, Ph.D.
Professor**

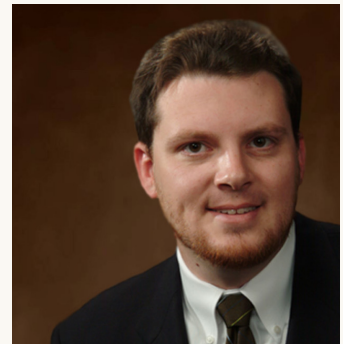
Dr. Cassady serves as Director of Freshman Engineering for the College of Engineering. His primary research interests lie in repairable systems modeling. He also conducts research in the areas of reliability engineering, statistical quality control and sports applications of operations research. Dr. Cassady teaches courses in reliability and maintainability engineering, operations research, probability and statistics, and statistical quality control. He joined the faculty in 2000.

Education:
Ph.D. (Virginia Tech)
M.S.I.S.E. (Virginia Tech)
B.S.I.S.E. (Virginia Tech)

**Justin R. Chimka, Ph.D.
Associate Professor**

Dr. Chimka serves as the Graduate Program Studies Chair. His research interests include categorical data analysis, inventory control, statistical quality control, survival analysis and time series. He teaches courses in applied statistics, generalized linear models, optimization and production. Dr. Chimka joined the faculty in 2002.

Education:
Ph.D. (University of Pittsburgh)
M.S.I.E. (University of Pittsburgh)
B.S.I.E. (University of Pittsburgh)



**John R. English, Ph.D, P.E.
Dean, Professor & Irma F. and Raymond F. Giffels
Endowed Chair in Engineering**

Dr. John English serves as Dean of Engineering at the University of Arkansas. He is active in research focusing on quality and reliability engineering. He has published numerous articles and book chapters in the field of logistics and material handling. His awards include the Halliburton Research Award, the Dr. Theo Williamson Award from *Integrated Manufacturing Systems* and the Continuing Professional Development Best Paper award from the American Society for Engineering Education. He is a fellow of the Institute of Industrial Engineers. Dr. English returned to the college in 2013.

Education:
Ph.D. (Oklahoma State University)
M.S.O.R. (University of Arkansas)
B.S.E.E. (University of Arkansas)

**Carol S. Gattis, Ph.D.
Adjunct Associate Professor**

Dr. Gattis has been responsible for undergraduate student recruitment and taught courses in statistics, work methods and measurement, and engineering economics. She currently serves as the Associate Dean of the Honors College. Dr. Gattis joined the faculty in 1991.

Education:
Ph.D. Engineering (University of Arkansas)
M.S.E.E. (University of Arkansas)
B.S.E.E. (University of Arkansas)



Ashlea Bennett Milburn, Ph.D.
Assistant Professor

Dr. Milburn's research interests include applying operations research tools and techniques to problems encountered in healthcare and transportation systems. She is especially motivated by the modeling and analysis of challenges associated with the delivery of home healthcare. Dr. Milburn teaches courses in probability and statistics, healthcare systems, and transportation logistics. She joined the faculty in 2010.

Education:
Ph.D. (Georgia Tech)
M.S.I.E. (Virginia Tech)
B.S.I.E. (University of Arkansas)



Heather Nachtmann, Ph.D.
Professor and Associate Dean of Research, College of Engineering

Dr. Nachtmann serves as the Director of the Maritime Transportation Research and Transportation Center and the Mack-Blackwell Transportation Center. Her current research program focuses on economic and decision analysis of transportation systems focusing on inland waterways and rural transportation networks, cost and quality issues in the healthcare supply chain, and advanced methods for engineering economic analysis. Dr. Nachtmann teaches in the areas of engineering economy, cost analysis, and decision modeling. She joined the faculty in 2000.

Education:
Ph.D. (University of Pittsburgh)
M.S.I.E. (University of Pittsburgh)
B.S.I.E. (University of Pittsburgh)

Kim LaScola Needy, Ph.D., P.E., CFPIM, PEM
Dean, Graduate School and International Education

Dr. Needy's research interests include engineering management, engineering economic analysis, sustainable engineering, and integrated resource management. She has taught courses in project management and IE design. Dr. Needy joined the faculty in 2008.

Education:
Ph.D. (Wichita State University)
M.S.I.E. (University of Pittsburgh)
B.S.I.E. (University of Pittsburgh)



Gregory S. Parnell, Ph.D.
Visiting Professor of Industrial Engineering and
Interim Director of the M.S. in Operations Management

Dr. Parnell's research interest include decision analysis, systems engineering, and resource allocation in the areas of defense, national security, homeland security, and R&D planning. He teaches courses in decision models, systems engineering, project management, operations management, and industrial engineering design. He joined the faculty in 2013.

Ph.D. Engineering-Economic Systems (Stanford University)
M.S., Systems Management (University of Southern California)
M.E., Industrial & Systems Engineering (University of Florida)
B.S., Aerospace Engineering (State University of New York at Buffalo)



Harry A. Pierson, Ph.D.
Assistant Professor

Dr. Pierson's research interests include collaborative robotics and agile automation. Applications include distribution center operations and low-volume, high-mix manufacturing environments. Additionally, he conducts research in additive manufacturing (commonly referred to as 3D printing). Dr. Pierson teaches courses in applied robotics and manufacturing processes. He joined the faculty in 2014.

Education:
Ph.D. The Ohio State University
M.S.M.E. University of Missouri-Rolla
B.S.M.E. University of Missouri-Rolla

Letitia Pohl Ph.D.
Clinical Assistant Professor

Dr. Pohl serves as the undergraduate academic advisor. Her interests include facility logistics, transportation security and engineering education. Dr. Pohl teaches courses in engineering economic analysis, operations management and human factors/ergonomics. She joined the faculty in 2012.

Education:
Ph.D. (University of Arkansas)
M.S. Systems Engineering (Air Force Institute of Technology)
B.S. Mechanical Engineering (Tulane University)



Chase Rainwater, Ph.D.
Assistant Professor

Dr. Rainwater's research interests lie in the areas of large-scale optimization, integer programming and supply chain logistics. In addition, he conducts research in areas of healthcare planning, homeland security and reliability. Dr. Rainwater teaches courses in probability and statistics, optimization and decision support systems. He joined the faculty in 2009.

Education:
Ph.D. (University of Florida)
B.S.I.E. (University of Arkansas)

Ronald L. Rardin, Ph.D.
Distinguished Professor Emeritus

Dr. Rardin officially retired in 2013, but remains active teaching for our distance education programs. His research and teaching interests center on large-scale optimization modeling and algorithms, including their application in healthcare delivery, transportation and logistics, and energy planning.

Education:
Ph.D. (Georgia Institute of Technology)
M.P.A. Municipal Administration (University of Kansas)
B.A. Mathematics/Political Science (University of Kansas)



Sarah E. Root, Ph.D.
Clinical Assistant Professor

Dr. Root's interests include defining, modeling, and solving applied large-scale optimization problems. She is particularly interested in the application of optimization tools to problems encountered in healthcare and logistics. She teaches courses in operations research and service systems engineering. Dr. Root joined the faculty in 2007.

Education:
Ph.D. (University of Michigan)
B.S.I.E. (University of Pittsburgh)



Manuel D. Rossetti, Ph.D., PE
Professor and Associate Department Head

Dr. Rossetti's research is focused on the design, analysis and optimization of transportation, inventory, healthcare and manufacturing systems, using stochastic modeling, computer simulation, information systems and heuristic modeling techniques. He teaches courses in the areas of probability modeling, discrete event simulation, object-oriented and database systems, transportation/logistics modeling, and inventory modeling. He serves as the Director of the Center for Excellence in Logistics and Distribution (CELDi) Dr. Rossetti joined the faculty in 1999.

Education:

- Ph.D. (The Ohio State University)
- M.S.I.S.E. (The Ohio State University)
- B.S.I.E. (University of Cincinnati)

Kelly Sullivan, Ph.D.
Assistant Professor

Dr. Sullivan's research focuses on developing and applying operations research methodology to design systems that are resilient against disruption. His primary research interests lie in the areas of integer programming, network optimization, and reliability. Dr. Sullivan teaches courses in probability and statistics, operations research, and network optimization. He joined the faculty in 2012.



Education:

- Ph.D. (University of Florida)
- M.S.I.E. (University of Arkansas)
- B.S.I.E. (University of Arkansas)



John A. White, Ph.D., PE
Distinguished Professor & Chancellor Emeritus

After serving for eleven years as Chancellor of the University of Arkansas, Dr. White joined the faculty of the Department of Industrial Engineering full-time in 2009. A distinguished alumnus of the department, Dr. White teaches engineering economics, facilities planning, and queueing systems.

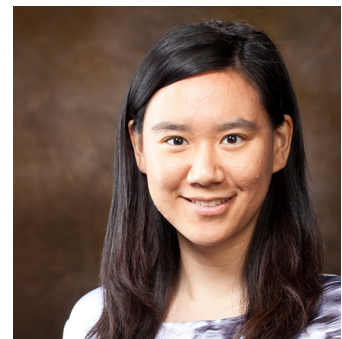
Education:

- Ph.D. (The Ohio State University)
- M.S.I.S.E. (Virginia Tech)
- B.S.I.E. (University of Arkansas)

Dr. White also holds honorary doctorates from the Katholieke Universiteit of Leuven in Belgium and George Washington University.

Shengfan Zhang, Ph.D.
Assistant Professor

Dr. Zhang's research interests are mathematical modeling of stochastic systems with an emphasis on statistical and decision analysis as applied to health care, manufacturing and service environments. One of her research goals is to develop methods for addressing the complexity of breast cancer modeling in diverse populations in order to create more personalized screening and treatment strategies. Dr. Zhang teaches courses in advanced stochastic processes, decision modeling in health care, and quality engineering and management. She joined the faculty in 2011.



Education:

- Ph.D. (North Carolina State University)
- M.I.E. (North Carolina State University)
- B.M. (Fudan University)

Undergraduate Program Overview

The objectives of the undergraduate program in the Department of Industrial Engineering at the University of Arkansas are to produce graduates who, within just a few years of graduation, can: (1) successfully apply core industrial engineering knowledge and skills for industrial or public-sector organizations, (2) successfully pursue advanced professional degrees, graduate studies in industrial engineering, professional training, or engineering certification, (3) demonstrate professional and intellectual growth as managers and leaders in industrial engineering, society, and their communities. Our curriculum includes not only industrial engineering courses, but also courses in engineering science, computer science, mathematics, physical science, English, economics and other social sciences, the humanities, and the fine arts.

Dr. Richard Cassady, Professor of Industrial Engineering, serves as the Chair of Undergraduate Studies. More information on the undergraduate program can be found at ineg.uark.edu/1444.php.

Our undergraduate program included 205 students in 2012 and 258 students in 2013.

Students enter our program as sophomores, since all first-year College of Engineering students participate in the Freshman Engineering Program.

Directed by Dr. Richard Cassady, the Freshman Engineering Program includes two semesters of academic coursework, peer mentoring, professional development, academic advising, and academic assistance programs. Since the Freshman Engineering Program was implemented in 2007, second-year retention (in engineering) of first-year engineering students has increased from approximately 60% to approximately 70%. Roughly 13% of retained Freshman Engineering Program students choose industrial engineering for their sophomore year.

Our program also includes opportunities for study abroad, cooperative education, and an honors experience. Administered by the Office of Study Abroad and International Exchange, study abroad gives

students the opportunity to earn credits toward their degree while being immersed in an international culture. In our department, the John L. Imhoff Global Studies Endowment supports academic scholarships that help defray expenses incurred by industrial engineering students engaged in for-credit overseas study and/or an overseas internship or cooperative education experience. In 2012-2013, seven students received Imhoff scholarships for study in Australia, Belize, England, India, Italy, Qatar, and Spain.



Megan Peters, BSIE 2013 with a friend in Belize


Cooperative education provides interested students with opportunities to complement their engineering

education with full or part-time, paid, degree-related work experience. The work experience provides participants with opportunities to apply what they have learned in the classroom and to interact with experienced industrial engineers. Participants also gain insights into the industrial engineering profession that help them define their educational and career goals. In 2012-2013, students from our department have participated in cooperative work experiences at Acumen Brands, Frito-Lay, Harrison Energy Partners, International Paper, L'Oreal, MiPhones Unlimited, Nyoombl, PAM Transport, Pinnacle Foods, Reckitt

with a thesis. In 2012-2013, six students completed the Honors College experience in our department.

Members of the classes of 2012-2013 were hired by nationally-recognized companies such as Accenture, ArcBest, Ayrshire Electronics, BNSF Railway, Cameron, FM Global, Hewlett-Packard, J.B. Hunt Transport, Koch Industries, National Oilwell Varco, PepsiCo, Pinnacle Foods, Quorum Business Solutions, Tyson Foods, and Walmart Amazon, Axiom, BNSF, Cameron, JB Hunt, Tyson Foods, and Wal-Mart Stores. The average starting salary for BSIE graduates was approximately \$60,000 (high \$98,000). A number of graduates chose to pursue graduate studies at the University of Arkansas and other prominent institutions.

The department continues to report successes within professional societies. In 2012, the Alpha Pi Mu student chapter (faculty advisor Dr. Ashlea Milburn) received the 2nd Place Outstanding Chapter Award from the executive council of the national organization. In 2013, they received 5th place, In 2012, our student chapter of the Institute of Industrial Engineers (faculty advisor Dr. Chase Rainwater) received the Frank F. Groseclose Gold Award. In 2013, they received the Silver Award.

Finally, our department continues to expand its scholarship program. In April 2013, 43 students were awarded departmental scholarships for the 2013-2014 academic year. The total dollar value of these scholarships is \$98,000. 



Benckiser, Rheem, Superior Industries, Transplace, Wal-Mart Stores, and Walt Disney World. Cooperative education is supported by the Career Development Center and Brian Henderson, Director of Employer Relations for the College of Engineering. Industrial engineering cooperative education students Bo Dillon, Danny Dixon, and Jordon Morris received the Porter Stone Award for excellence in cooperative education from the College of Engineering.

The honors experience in our department is designed for students who are also enrolled in the University of Arkansas Honors College. The experience includes a minimum of 12 credit hours of honors courses, as well as an undergraduate research project that culminates

Graduate Program Overview

Graduate course offerings of the Department, as well as research opportunities for Industrial Engineering graduate students, continue to grow and diversify. A sampling of our graduate students' published work, highlighted in this section, illustrates the range of research interests being pursued under the guidance of our faculty. Also featured in this section is our professional graduate program in Operations Management.

For students pursuing graduate studies in the field of industrial engineering we offer several options with respect to degree, area of specialization, and full-time or part-time studies.

Graduate degrees for on-campus students are offered in two areas:

- Master of Science in Industrial Engineering (MSIE)
- Doctor of Philosophy in Engineering (PhD)

In addition to traditional degree options the Department offers a Master of Science in Operations Management (MSOM).

Our faculty's wide range of expertise provides opportunities for study in a variety of areas such as:

- Transportation, Logistics & Distribution
- Healthcare Systems Engineering
- Reliability, Maintainability & Quality Engineering
- Engineering Management
- Manufacturing & Automation

These areas continue to be supported by research centers and laboratories such as:

- Center for Excellence in Logistics and Distribution
- Mack Blackwell Rural Transportation Center
- Center for Innovation in Healthcare Logistics
- ReliaSoft Risk, Reliability and Maintainability Research Alliance

Justin Chimka serves as Graduate Coordinator for programs in Industrial Engineering. Greg Parnell serves as Interim Director of the program in Operations Management. More information about can be found at www.ineg.uark.edu/3535.php

Highlights

Enrollment growth in the department's graduate programs in Industrial Engineering increased by greater than 2/3 from 2008 to 2013. Fall 2013 PhD enrollment in Industrial Engineering was second largest in the College of Engineering, and our department had the greatest number of female PhD students in the College.

Our graduate students have gained national recognition through awards, honors, and publications.

- ▶ 2012 IIE Annual Conference doctoral student Lisa Thomas and her faculty mentor Russ Meller received the Best Paper Award in Facility Logistics for the paper titled, "A Warehouse Model for Replenishment to a Bottom-level Forward Area with Random Storage."
- ▶ Doctoral student Kellie Schneider and her faculty



mentors Chase Rainwater and Ed Pohl won the Quality Control and Reliability Engineering division Golomski Award for their outstanding paper in the proceedings of the Reliability and Maintainability Symposium.

- ▶ 2013 IIE Annual Conference doctoral student Ridvan Gedik won the EJ Sierleja Memorial Fellowship
- ▶ Jingjing Tong won a Gilbreth Memorial Fellowship, at the 2013 IIE Annual Conference.
- ▶ Jingjing Tong was also recognized in the 6th Annual “From Abstract to Contract: Graduate Student Research and Creative Expression Competition.” She received first place for her poster on the research project “Supporting Secure and Resilient Inland Waterways” directed by Dr. Heather Nachtmann.
- ▶ Lisa Thomas and Russ Meller received the Best Paper Award in Facility Logistics again, this time for the paper titled, “Using Empirical Data to Assess Performance in Overall Warehouse Design.”



Arkansas Governor Mike Beebe and master's student, Jessica Spicer

In 2012 and 2013 our students were honored in the University Graduate Student Research competition. Taking first place awards in 2012 were Jessica Spicer, a master's student advised by Ashlea Milburn, and Crystal Wilson, a doctoral student advised by Sarah Root. Jingjing Tong, a doctoral student advised by Heather Nachtmann, was a back-to-back winner with second place in 2012 and first place in 2013. 🌻

The Winds of Change...

The department saw the departure of several of our friends and colleagues. In the summer of 2013 two of our senior faculty members retired; Dr. Steve Johnson, a Professor in the department for 31 years and Dr. Ron Rardin, holder of the John and Mary Lib White Chair in Systems Integration and Director of the Center for Innovation in Healthcare Logistics. We thank them for their service and wish them both well in their retirement.

In the fall of 2013, Dr. Nebil Buyurgan moved to Quinnipiac University School of Business & Engineering.

Also in the fall of 2013, Dr. Ernie Fant, a longtime Associate Professor in the department passed away unexpectedly. Ernie's passion for working with students, enthusiasm in the classroom, and his quick wit and propensity for corny jokes will be sorely missed by all.

In the summer of 2014, Dr. Russ Meller, holder of the Hefley Professorship in Logistics and Entrepreneurship, resigned his position to accept a job as the VP of Research at Fortna.

Russ's leadership, wisdom, and candor will be missed by the department.



Operations Management Program Overview

The Master of Science in Operations Management graduate degree program continues to be the University's largest graduate program with more than 220 graduates and over 2,700 course enrollments in the 2013 calendar year. This applied management program for working professionals attracts managers and professionals in various business sectors, industries, military branches of service and government offices. In the fall 2013 semester, more than 600 students were enrolled in MSOM courses.

The program is offered at the University of Arkansas's flagship Fayetteville campus, at five Graduate Resident Centers throughout Arkansas and the Southeast, and via distance learning online. The program is hosted on three active duty bases including Little Rock Air Force Base at Jacksonville, Arkansas; Naval Support Activity Mid-South at Millington, Tennessee; and the Air Force Special Operations Hurlburt Field base at Fort Walton Beach, Florida. Courses are also offered at SAU Tech in Camden, Arkansas; and ANC University Center in Blytheville, Arkansas. These sites and the option of online classes allow the program to reach a diverse student population among career fields and undergraduate majors.

The MSOM program offers students flexibility by operating in 8-week terms, remaining low cost, and having an online option for most program courses. This flexibility accommodates students employed full-time by Fortune 500 companies such as Walmart, Sam's Club, Tyson Foods, J.B. Hunt Transport, Fed Ex, Lockheed-Martin, and Pratt & Whitney. We are also proud to be affiliated with the military and have many current military members and veterans from all branches of

service stationed at our host bases and throughout the world.

Operations Management coursework emphasizes practical knowledge in areas such as project management, economic decision-making, supply chain management, human behavior analysis, quality management, and operations research, as well as many other areas of importance to today's manager. Program



content focuses squarely on the concepts, methods, and tools that are essential to the successful management of work processes, projects, and people in a wide spectrum of organizations. The curriculum has an Industrial Engineering perspective on the science of management and equips graduates to carry out their managerial responsibilities both more efficiently and more effectively. Students are able to select from 26 graduate courses to make up the ten required to complete the degree.

The curriculum is presented by outstanding faculty members who are drawn from the University's IE

Department and from businesses throughout the country. Six IE faculty members are actively involved and over 60 adjunct faculty members teach in the program. The program recruits business professionals who are academically qualified and have accrued extensive managerial industry experience in the specific subject that they teach.

In 2013, the MSOM program increased admission and graduation requirements. For admission consideration, students who are not native speakers of English and who do not have a conferred master's degree from an accredited U.S. college or university must submit




Professor Randy Roy's Project Management class enjoys pizza for Student Appreciation Night at Naval Activity Mid-South.

a 550 paper-based score or an 80 internet-based score on the Test of English as a Foreign Language (TOEFL). Before taking any graduate classes in the Operations Management program, such students must also demonstrate proficiency on one of the following test of written English: TOEFL IBT (26), ELPT (75) or GRE/GMAT (4.0). The MSOM program also aligned the graduation GPA requirement with the Industrial Engineering Department. The requirement was increased from the Graduate School requirement of 2.85 to the Industrial Engineering requirement of 3.0.

Sharon Garner was recognized as Employee of the Second Quarter by UA Staff Senate in February 2013.

Sharon serves as the operations management representative at the Little Rock Air Force Base in Jacksonville. As the full-time coordinator and adviser for the program, her responsibilities include all the daily activities associated with running an off-site program for the



University's largest graduate major. Sharon takes great pride in engaging students, whether active duty, veteran, or civilian to ensure continuous movement toward completion of their Master of Science in Operations Management. She knows each of her students, and her priority is their success and the success of the program at LRAFB. As Carol Altom, MSOM Assistant Director, stated in her nomination, "We rely on Sharon for her sound judgment and knowledge of our program policies... On a daily basis, she continually completes more than what is expected of her...the MSOM program continues to have the confidence in her ability to manage our LRAFB Graduate Resident Center with professionalism and pride." 

More information concerning the Operations Management Program can be found at msom.uark.edu.

Facilities

In January of 1987, the students, faculty and staff of the College of Engineering began the spring semester in a brand new building: Bell Engineering Center. Bell provided space for four of the college's departments—chemical engineering, civil engineering, electrical engineering and industrial engineering—as well as plenty of room for teaching and labs, and these changes proved to be revolutionary for the college.

“Before Bell, the situation was very grim,” remembered Neil Schmitt, who was dean at the time of the move. “We had four departments in Engineering Hall. There was no space for expansion, no room for research, no lab facilities. Everybody realized we had to do something.”

When Bell was finished, the neighboring Engineering Hall was also renovated. At the same time, new labs were being created at the Engineering Research Center, which was then called Engineering South, and all of these improvements did much more than provide space.

“Having new instructional and lab facilities and having new research facilities really propelled the COE from a small teaching college into a nationally competitive college,” said Schmitt.

Bell Engineering Center is named in honor of Owen and Hildur Bell by their son Melvyn L. Bell, a 1960 graduate of the College of Engineering. Its most notable feature is the large ramp that runs north and south, from one corner of the building to the other. Schmitt explained that the ramp is on the site of an old road, Campus Drive, which was one of the main arteries on campus.

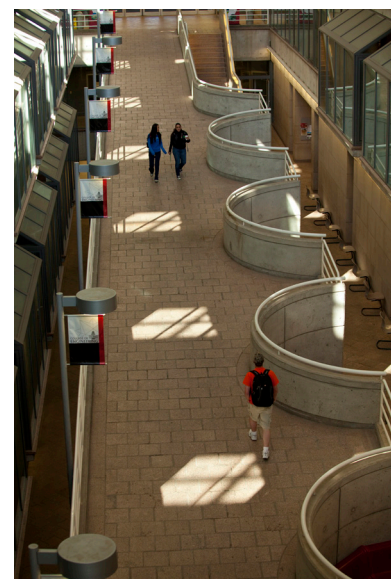
When the college got permission to put a building on top of this road, it agreed to maintain a direct entrance to campus, and this agreement is the reason for the ramp, which creates a path from Dickson Street to the



heart of campus. Today, Campus Drive is no longer a feature of the campus, and the ramp inside Bell is one evidence of its former path.

Schmitt explained that each of the four departments housed in Bell has its own designated space, with four study areas, one for each department, included at either end of the building to give students a place to gather and work.

“The design has proven to be very functional and very efficient,” said Schmitt. “The first time I walked in, I was amazed. Bell is a striking building today and will be 50 years from now.”



Former Chancellor, Dr. John A. White Recognized With Building Dedication

In 2012 historic Engineering Hall was formally dedicated as the John A. White Jr. Engineering Hall in honor of former chancellor and College of Engineering alumnus John A. White Jr. The ceremony was held on the lawn in front of the building and speakers included Chancellor G. David Gearhart; Terry Martin, then interim dean of the College of Engineering; Julian Stewart, College of Engineering alumnus; and former Chancellor White.




The Board of Trustees voted to honor White for his achievements, which include his success in academia, business and public service, his leadership in the Campaign for the Twenty-First Century, his vision of the university as a nationally competitive education and research institution and his efforts to lead the university to new levels of achievement. These achievements were listed in a resolution, which was framed and presented to White at the ceremony.

“John White altered the entire direction of this university, and left it irrevocably changed,” said Chancellor Gearhart. “He raised expectations and standards, instilled in us a sense of mission, and set challenging goals for the enrollment, research

expenditures, the endowment, and other critical areas. His leadership lifted us from a historically third-tier institution into a top-tier institution. In short, John White made a significant and lasting mark on this university through his career, and we are here today to honor his memory by naming the Engineering Hall the John A. White Jr. Engineering Hall.”

White earned a bachelor’s degree in industrial engineering from the University of Arkansas in 1962, a master’s degree from Virginia Polytechnic and State University, and a doctorate from Ohio State University. He also holds honorary doctorates from Katholieke Universiteit of Leuven, Belgium, and George Washington University. Prior to returning to Arkansas, White was dean of engineering at the Georgia Institute of Technology, where he served on the faculty for 22 years. His career in higher education and in management and engineering consulting carried him into the national ranks, including service as assistant director for engineering at the National Science Foundation in Washington, D.C.

White’s term as chancellor ended in 2008, and he is currently a Distinguished Professor in the department of industrial engineering. 

Research and Teaching Laboratories Overview

The Industrial Engineering Department has three physical computer laboratories for student use. These are the Foust Lab (BELL 4127-4128), Stephens Lab (BELL 4134A), and a general access computer lab shared with Civil Engineering (BELL 4133). All are equipped with the latest hardware, software and specialized programs. Designated lab space is described in detail below.

David D. and Nancy J. Foust Computation Laboratory

The David D. and Nancy J. Foust Computation Laboratory is a general computing lab open to all Industrial Engineering students. Generous funding for this lab was provided by Mr. and Mrs. David D. Foust. Mr. Foust is a 1963 BSIE graduate from the University of Arkansas, Department of Industrial Engineering. He is also an active member and former president of the Arkansas Academy of Industrial Engineering (AAIE). Mr. and Mrs. Foust play a significant role in the development of AAIE scholarships. The Department of Industrial Engineering is very appreciative of the continued support of David and Nancy Foust.

The Foust Computation Laboratory is INEG's premier computing and teaching lab providing general computing access for all Industrial Engineering students and supports the computing needs associated with course work. Included in the lab are a project area with whiteboards to encourage student discussions, and a separate conference area with a large LCD TV, DVD and VCR. Occupying approximately 2,100 square feet, the



computer lab area can accommodate 44 students. It also functions as a general PC lab outside of class hours.

The Industrial Engineering department is committed to providing the latest in computer technology, software capability, and technical expertise to enhance the educational experience for all students. The Foust Computation Lab is open 24 hours a day throughout the semester to all faculty, staff, and students enrolled in INEG classes.

Larry and Gwen Stephens Undergraduate Research Laboratory

The Larry and Gwen Stephens Undergraduate Research Lab provides state-of-the-art facilities including the latest computer hardware and software designed for industrial engineering projects.

The lab provides individual work space for up to 15 undergraduate students. To be eligible for a space in this lab, a student must be engaged in research with an Industrial Engineering faculty member.



Generous funding for this laboratory was provided by Larry and Gwen Stephens. Larry Stephens is a 1958 BSIE graduate from the University of Arkansas, Department of Industrial Engineering and President of Mid-South Engineering. As one of the charter members, Larry was the driving force that organized the Arkansas Academy of Industrial Engineering and became its first president in 1986.

Manufacturing Automation Laboratory

The AT&T Manufacturing Automation Laboratory houses four work cells where...

- One work cell has integrated robotic arms (a six-axis articulating arm and a two-axis linear module) to form a unit where the robots are moved to the work object within a range of 1200mm to 1800mm. Both robots use the same controller and programming, but different power supplies. An electric-hydraulic scissor table can lift projects within the reach of the inverted six-axis articulating arm as the arm lowers itself to the project below.
- Two vision guide robot (VGR) work cells with



four-axis SCARA are available with four cameras. One of the VGR work cells was a component of an Automated Temperature Measurement system where a touch screen panel computer for system control coordinated the SCARA, temperature data logger, and conveyor.

- The last unit is a stand-alone machine vision work cell with several new lighting sources and optics for Cognex, PPT, and Banner Engineering smart cameras, which can perform research and introduce students to this technology.

The Manufacturing Automation Laboratory's purpose is for students to gain hands-on exposure to the predominant machines for automated assembly, inspection, palletizing, and measurement through research activities and instructional projects. The laboratory supports INEG 4563 Application of Robotics, INEG 4533 Application of Machine Vision, and INEG 5523 Topics in Automated Systems. This laboratory directly or indirectly supports the following objectives from these courses:

- To develop the ability to apply teach-pendant and off-line programming to perform pick and place applications for three types of industrial robots.
- To develop the ability to apply image conversion, basic processing techniques, and planning to ensure image processing.
- To develop the ability to apply human machine interface through a touch screen panel computer for system control of automation
- To develop the ability to apply electronic sensing to automation

ReliaSoft Alliance Laboratory

ReliaSoft Corporation donated software to the University of Arkansas to form and support the ReliaSoft Risk, Reliability, and Maintainability Research Alliance. The software provides engineering students

with state of the art tools to help identify potential risks and calculate the severity of disruptions within a manufacturing or transportation environment.

The Bill and Margaret Harrison Family Video Conferencing Facility



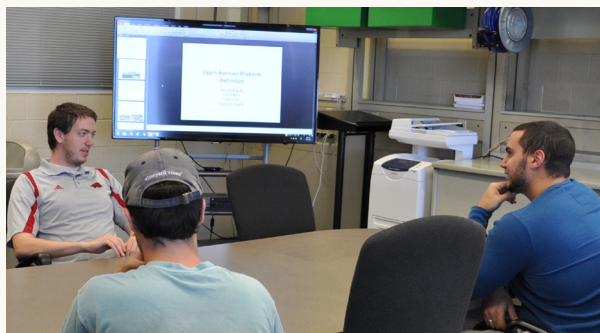
An obsolete computing research laboratory in the College of Engineering has been transformed into the Bill and Margaret Harrison Family Video Conferencing Facility thanks to a contribution from alumni William and Margaret Harrison of Little Rock.

The space has been upgraded aesthetically by installing new carpeting and all new furnishings, but the paramount feature in the facility is the state-of-the-art software and equipment. The Bill and Margaret Harrison Family Video Conferencing Facility is equipped with the LifeSize 220 Express, described as the most full-featured video conferencing system available.

The system allows remote video and audio communication between up to eight parties concurrently, and users can share content, control cameras, change layouts and add participants with ease. It includes an application for smart phones, tablets and computers and has the ability to record meetings and stream viewing.

Bill Harrison, a 1966 industrial engineering graduate, is chairman and CEO of Harrison Energy Partners, his children are the fourth generation to graduate from the university.


Senior Design Lab



A dedicated space for students in the capstone course INEG 4904 was developed during the fall 2013 term to be used primarily for students in the Industrial Engineering Senior Design. It is equipped with a conference area, mobile media cart with a 60" television monitor and computer. This enables students to make presentations to industry partners.

New Space for Classroom Lab



A new space was designated in Fall 2014 to establish a lab to support two undergraduate courses, INEG 3713 Methods and Standards and INEG 4723 Ergonomics. The space is used to hold lab meetings for these two courses, where students conduct experiments related to cognitive ergonomic concepts, hand tool design, anthropometric measurement, time studies, work sampling, and worksite analysis and design. 

Featured Research

Starting in 2008 with a two-year National Science Foundation Industry/University TIE grant, Dr. Rossetti has conducted a line of research that emphasizes the importance of improving inventory management practices within the healthcare supply chain. The NSF TIE grant identified two critical areas that needed to be addressed 1) ensuring that healthcare logistics is part of the strategic mission for a healthcare provider and 2) ensuring that healthcare providers adopt best practices in the area of inventory management. The NSF TIE grant led to initiatives within the Industrial Engineering Department's Center for Innovation in Healthcare Logistics (CIHL) that focused on supply chain improvements for healthcare providers.

The first major initiative was a study that identified the gaps in supply chain best practices between the retail industry and healthcare industry. While ten distinct practice recommendations were made three stood out 1) collaborative planning forecasting and replenishment, 2) actual usage inventory management practices, and 3) education/training for healthcare professionals. Since that time a joint effort between Dr. Ed Pohl and Dr. Manuel Rossetti has resulted in the creation of tools, techniques, and



analysis to improve each of these areas.

In 2012, a case study to illustrate the impact of improved inventory management practices was performed by the team. The study examined three hospitals within the Mercy network and found that adoption of advanced inventory management systems can significantly reduce costs associated with medical and surgical items used in operating rooms. The study, funded by Covidien, focused on medical and surgical items used in operating rooms at Mercy hospitals in Oklahoma City, OK, Fort Smith, AR., and Springfield, MO. The researchers studied supply-chain processes on a total of 370 items – 119 at Fort Smith, 103 at Oklahoma City and 148 Springfield. The items were manufactured by Covidien, which

makes thousands of health-care products. The focus was on items in Covidien's medical/surgical category, which includes diagnostic equipment and monitors; instruments such as clamps, scalpels, needles and suction tubing; and other general products such as latex gloves, towels, trays and sponges. Usage data on these items were extracted from software over a 578-day period, from October 1, 2010, to April 30, 2012.

The team analyzed inventory and procurement practices at each hospital and evaluated the potential for cost savings by applying inventory management techniques that are driven by actual usage data. Actual

usage data is demand data based on actual demand patterns (e.g. point of use data) rather than ordering data. The analysis included multiple stages – initial data collection, holding and ordering cost estimation, inventory analysis and demand classification, forecasting analysis,


analysis of minimum-cost inventory by location, analysis of single- and multi-echelon minimum-cost inventory, and sensitivity analysis and cost-savings projections. Single-echelon optimization focused on measures of operational performance, such as out-of-stock items, fill rates, average backorders and average on-hand inventory. Multi-echelon optimization allowed for the analysis of a pooling effect on inventory connected to the hospital sites and a consolidated service center. The study found that a high percentage of the items have intermittent and lumpy demand. A specialized intermittent demand forecasting technique, MCARTA, developed by Dr. Rossetti and Dr. Varghese within the Center for Excellence in Logistics and Distribution (CELDi) was shown to be the superior forecasting



method for a large portion of the items.

The analysis showed that inventory stock was high at all three locations, and that holding costs associated with this high inventory contributed most to inefficiency. Savings and cost reductions in this area can be achieved by implementing forecasting policy setting methods that result in less inventory on hand while still providing very high service levels for the items. Overall, the analysis showed that forecasting was better for 61 percent of all items at the Fort Smith hospital, 65 percent of all items at the Oklahoma City hospital and 71 percent of all items at the Springfield hospital. Savings by

location varied between 23 to 53 percent in terms of total inventory cost for the items analyzed. The results of the study have been publicized in healthcare trade magazines and through an article in the Arkansas Democratic Gazette.

Follow on work to model continuous replenishment programs for Covidien, Inc. are underway through the Center for Excellence in Logistics and Distribution. 

Grants

During 2012-2013, the following research grants were active. Project PIs are indicated in bold face type.

Fant, Earnest, and Nebil Buyurgan, Red River Army Depot/CELDi, \$50,000, "Robotic Surface Preparation Development," 2012-2013

Fant, Earnest, and Manuel Rossetti, Red River Army Depot/CELDi, \$60,000, "Robotic Spray Coating Development," 2013-2014

Gattis, Carol, Shannon Davis, James Hestekin, Todd Shields, and Richard Cassady, National Science Foundation, \$599,988, "Breaking Barriers: Pathways to Graduation for Underrepresented Talent," 2008-2014

Gattis, Carol, Bryan Hill, Ed Clausen, and Janet Woodland, Arkansas Department of Education, \$335,883, "UA Engineering & Mathematics Partnership-Yr2," 2012-2013

Gattis, J.L., and **Steve Johnson**, Arkansas State Police, \$154,285, "Seat Belt, Motorcycle Helmet and Child Restraint Survey," 2011-2012

Meller, Russell D. and Kimberly P. Ellis, National Science Foundation, \$106,938, "Establishing the Logistics System Gain Potential of the Physical Internet," National Science Foundation, 2010-2012

Meller, Russell D., American Air Liquide, American Transportation Research Institute, The Boeing Company, CHEP, ES3, Hewlett-Packard, JB Hunt, Leggett and Platt, Menasha Packaging Company, Material Handling Industry of America, Millwood, Inc., The Procter & Gamble Company, Procter & Gamble Eurocor N.V., S.C. Johnson, Volvo Logistics North America, Walgreens Company, Walmart, \$145,0000, "Physical Internet Initiative," 2010-2012

Meller, Russell D., National Science Foundation, \$1,179,936, "CELDi Center Administration," 2002-2014

Meller, Russell D., Medline/CELDi, \$50,000, "Analytical Performance Models of Pick Modules," 2011-2013

Meller, Russell D., and Ashlea Milburn, National Science Foundation, \$200,000, "Non-Traditional Designs for

Order Picking Warehouses, 2012-2015

Meller, Russell D., and Manuel Rossetti National Science Foundation, \$189,000, "I/UCRC for Excellence in Logistic & Distribution, Phase III," 2012-2017

Meller, Russell D., IAB of CELDi, \$50,000, Decision-Support Tool for Warehouse Design," 2012-2013

Milburn, Ashlea, and Chase Rainwater, US Department of Transportation, \$27,595, "Model for Disaster Relief Shelter Location and Supply Routing," 2011-2012

Milburn, Ashlea, Medline/CELDi, \$120,000, "Medline," 2012-2013

Nachtmann, Heather and Kevin Hall, U.S. Department of Transportation, \$653,104, "Mack-Blackwell Transportation Center, University Transportation Center Administration," 2007-2012

Hall, Kevin, **Heather Nachtmann**, and Letitia Pohl, U.S. Department of Homeland Security, \$554,846, "Mack-Blackwell Transportation Center National Transportation Security Center of Excellence Administration," 2008-2014

Nachtmann, Heather, Justin Chimka, and Edward Pohl, U.S. Department of Homeland Security, \$444,714, "Supporting Secure and Resilient Inland Waterways," 2010-2014

Nachtmann, Heather, Edward Pohl and Chase Rainwater, U.S. Department of Defense, \$99,547, "Budget Allocation for Dredge Scheduling and Procurement: A Mathematical Modeling Approach," 2012-2013

Nachtmann, Heather, U.S. Department of Transportation, \$31,525, "Economic Evaluation of AR Inland Waterways and Potential Disruption Impact," 2011-2013

Nachtmann, Heather, and Kevin Hall, U.S. Department of Transportation, \$1,414,101, Department of Transportation, "Tier 1 Maritime Transportation Research and Education Center," 2013-2017

Needy, Kim, Construction Industry Institute, \$224,067 total of which, \$74,143 is the Arkansas portion,

"Achieving Zero Rework through Effective Supplier Quality Practices," 2012-2014

Needy, Kim, Construction Industry Institute, \$119,691, "Creating Standards for Industry-wide Quality Metrics," 2013-2015

Pohl, Edward and Richard Cassady, National Science Foundation/CELDi, \$40,000, "Research Experiences for Teachers," 2012-2013

Pohl, Edward, Arkansas Department of Higher Education, \$2,750, "Decision Support Tool for Operations Management Course and Instructor," 2013

Pohl, Edward, Ashlea Milburn, Chase Rainwater, and Scott Mason, Department of Homeland Security, \$162,901, "Mitigating Dynamic Risk in Multi-Modal Perishable Commodity Supply Chain," 2010-2012

Pohl Edward, and Kelly Sullivan, Department of Defense, \$129,940, "Economic Design and Analysis of Reliability Growth Test Plans," 2013-2014

Rainwater, Chase, National Science Foundation, \$60,292, "Physical Internet for a Sustainable Logistics Future," 2013-2015

Rainwater, Chase, National Science Foundation, \$147,575, "Dynamic Resource Allocation for Law Enforcement Operations," 2013-2016

Rardin, Ronald, and Nebil Buyurgan, Logi-D Inc., \$7,877, "Charge Capturing and Reimbursement Regulations," 2013

Rardin, Ronald, Ashlea Milburn, Nebil Buyurgan, Scott Mason, Heather Nachtmann, Edward Pohl, and Manuel Rossetti, Corporate and Professional Sponsors of the Center for Innovation in Healthcare Logistics \$2,930,000, (All projects), 2007-2014

Root, Sarah, and Chase Rainwater, Arkansas Electric Cooperative Corp, \$56,000, "Design of a Coal Cooperative," 2011-2012

Root, Sarah, Sam's Club/CELDi, \$55,000, "Developing and Economic Order Quantity Model and Application," 2011-2012

Root, Sarah, and Manuel Rossetti, National Science Foundation, \$8,000, "REU: Coll: CELDi Renewal," 2012-2013

Root, Sarah, Sam's Club/CELDi, \$63,122, "Sam's 2012-2013 Research Project, 2012-2013

Rossetti, Manuel, CELDi, \$53,334, "Supply Chain Network Simulator using Cloud Computing," 2010-2012

Rossetti, Manuel, Department of Homeland Security, \$625, "Communicating & Implementing the Results from MBTC1102," 2012

Rossetti, Manuel, Edward Pohl, and Vijith Varghese, Covidien, \$39,204, "A Case Study Analysis of Inventory Cost and Practices for Operating Room," 2012-2013

Rossetti, Manuel, National Science Foundation, \$16,000, "Research Experience for Undergraduates," 2011-2013

Rossetti, Manuel, CELDi Center Designated Projects, \$23,700, "Variation Identification System for Operational Risks," 2013-2014

Rossetti, Manuel, National Science Foundation, \$8,000, "Research Experience for Undergraduates," 2013-2014

Rossetti, Manuel, National Science Foundation, I/UCRC Defense Logistics Agency, \$59,962, "Impact of Lead Time Variability," 2012-2014

Rossetti, Manuel, Ed Pohl, and Shengfan Zhang, Covidien, \$60,000, "CELDi - A Decision Support Tool for Continuous Replenishment Program Analysis," 2013-2014

Rossetti, Manuel, Kim Needy, Carol Gattis, and Ed Clausen, National Science Foundation, \$597,316, "Student Integrated Intern Research Experience (SIIRE) a Pathway to Graduate Studies," 2012-2017

Zhang, Shengfan and Kristen Jozkowski, University of Arkansas Women's Giving Circle, \$17,887, "Increase Awareness of Early Prevention of Cervical Cancer through Designing a Personalized HPV Vaccination," 2013-2014

FIRST Robotics

Dr. Chase Rainwater

The College of Engineering hosted 3 robotics tournaments in 2013-2014. The first official FIRST Robotics Competition (FRC) event in the state of Arkansas was held in Barnhill Arena from April 4-6,



2014. More than 40 teams from 7 states participated in the event co-chaired by Dr. Chase Rainwater, Assistant Professor Industrial Engineering. FRC is marketed as "The varsity Sport for the Mind," and combines the excitement of sport with the rigors of science and technology. The department also provided support for the 2013 Ozark Mountain Brawl held at Springdale High School in August 2013. Finally, Dr. Rainwater and Dr. Richard Cassady led the 2014 Ozark Mountain Brawl at Bud Walton Arena in July 2014.

These events exposed hundreds of future engineers to the University of Arkansas and offered Industrial Engineering faculty a unique opportunity to advance STEM education in the state.

FIRST "For Inspiration and Recognition of Science and Technology," was founded in 1989 to inspire young people's interest and participation in science and technology. Based in Manchester, NH, the not-for-profit public charity designs accessible, innovative programs that motivate young people to pursue education and career opportunities in science, technology, engineering, and math, while building self-confidence, knowledge, and life skills. Under strict rules, limited resources, and time limits, teams of high school students are challenged to raise funds, design a team "brand," hone teamwork skills, and build and program robots to perform prescribed tasks against a field of competitors. Volunteer professionals from companies and universities lend their time and talents to serve as mentors through this extraordinary and difficult process. In 2014, 2,727 teams participated in FRC around the world. FIRST has grown to include almost 68,000 high school students


from 20 countries and 49 states. Excitingly, the number of high school FRC teams has grown from just 1 to 24 in a matter of only 4 years.

The 2013 and 2014 challenges required



each team design and build 120-pound robots to play an exciting variation of ultimate frisbee that pitted 6 robots against one another for 2-minute matches. During each match robots shot upwards of 90 frisbees into various goals. At the end of each match, robots tried to scale an 8-foot pyramid to earn extra points. In 2014, teams were asked to collaborate with one another to pass and score a large exercise ball into defended goals. Teams were also tasked with throwing the ball over a 6-foot truss to gain bonus points in an effort to outscore their opposing alliance.

All events could not have been possible without the wealth of support from the faculty and staff of the Industrial Engineering Department, the Freshman Engineering Program, the entire staff of the College of Engineering Dean's Office and the Ozark STEM organization.

For more information on FIRST and Arkansas FIRST please check out these web pages: <http://www.usfirst.org/> or <http://first.uark.edu/> 

Students and Faculty Represent the Department



ISERC San Juan, Puerto Rico 2013

ISERC Montreal, Canada 2014




Spotlights

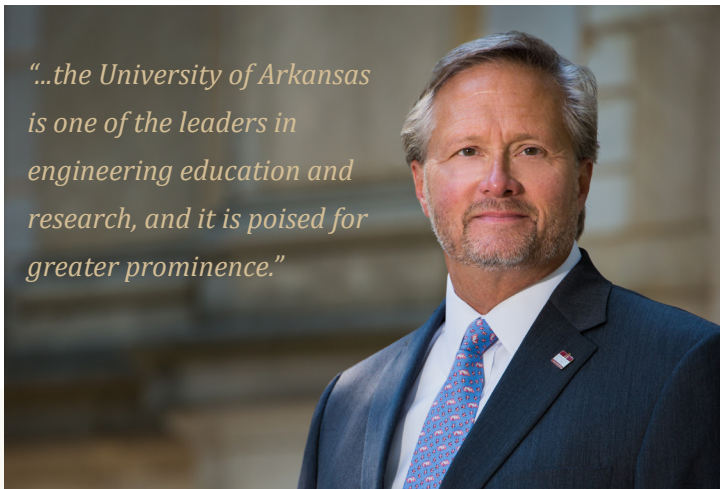
Dr. John English

In July of 2013, Dr. John English was named the ninth dean of the College of Engineering. English, who was most recently dean of the College of Engineering at Kansas State University, will also hold the Irma F. and Raymond F. Giffels Endowed Chair in Engineering.

member in the University of Arkansas department of industrial engineering from 1991 to 2007 as well as head of the department from 2000 to 2007. In this role, English helped increase the reputation of the department, which is currently ranked 19th by U.S. News and World Report. From 2000 to 2005, English was the founding director of the Center for Excellence in Logistics and Distribution, a National Science Foundation Industry and University Cooperative Research Center. While director of the GENESIS Technology Incubator at the University of Arkansas from 1999 to 2001, English helped start-up companies commercialize technological advances.

The focus of most of English's research is on quality and reliability engineering. He has published numerous articles and book chapters in the field of logistics and material handling, and his awards include the Halliburton Research Award, the Dr. Theo Williamson Award from Integrated Manufacturing Systems and the Continuing Professional Development Best Paper award from the American Society for Engineering Education. He is a fellow of the Institute of Industrial Engineers.

At Kansas State, English held the LeRoy C. and Aileen H. Paslay Chair in Engineering. He has also worked as an assistant professor at Texas A&M University and has industry experience from a career at AT&T. 



"It is exciting to return to my alma mater as the dean of engineering," said English. "I have been fortunate to hold the same position at Kansas State University, and I am ready to jump in with both feet at the University of Arkansas. With its talented faculty, staff and students, the college at the University of Arkansas is one of the leaders in engineering education and research, and it is poised for greater prominence."

English received a bachelor's degree in electrical engineering and a master's degree in operations research from the University of Arkansas. He holds a doctorate in industrial engineering and management from Oklahoma State University. English was a faculty

Dr. Kelly Sullivan


Dr. Kelly Sullivan, assistant professor, joined the Industrial Engineering faculty in August 2012. Sullivan completed his B.S.I.E. and M.S.I.E. from the University of Arkansas, and returned to the university after earning a Ph.D. from the University of Florida. Sullivan's research agenda centers around using and developing operations research methodologies to design systems that are resilient against disruption. Sullivan's efforts focus on disruptions resulting due to malicious action (with applications in counter-terrorism and homeland security) as well as failures occurring randomly or due to normal wear and tear.

Several of Sullivan's current and former projects focus on locating a limited number of sensors within a transportation network to maximize a potential smuggler's chance of successfully transporting nuclear material between two uncertain locations.

In another project, Sullivan and Dr. Chase Rainwater are seeking to develop secure solutions for managing data on the cloud. The benefits of cloud computing include high scalability and flexibility, ease of access across a range of locations and computing platforms, and relatively low cost. In addition, cloud functionality presents an opportunity to increase reliability of web and/or data services by mirroring content at multiple locations through the network. However, perceived vulnerability to cyber-attack prevents pervasive business use of the cloud. Sullivan and Rainwater are seeking to design cloud storage systems that limit the potential damage due to a targeted cyber-attack. A challenge within this project is the wide variety of




fundamentally different cyber-attacks that pose a threat to cybersecurity. On one hand, mirroring increases the system's resilience against resource-exhausting attacks such as denial of service (DoS) and distributed denial of service (DDoS); on the other, mirroring increases vulnerability to phishing attacks that could result in loss of sensitive data.

In addition to performing research, Sullivan is teaching courses at both the undergraduate and graduate levels. Sullivan developed a new Ph.D.-level network optimization course in the Fall 2012 semester. 

Dr. Greg Parnell

Dr. Greg Parnell, visiting professor of industrial engineering, joined the department in August 2013. Dr. Parnell serves as the interim director of the Operations Management Graduate Program within Industrial Engineering. He is retired from his position as professor

improve the healthcare supply chain. He draws on his fourteen years of experience with strategic planning and resources allocation to assist Dean John English and the College of Engineering in developing an updated strategic plan.

Parnell explained that he was drawn to the University of Arkansas because he is familiar with several of the faculty members and research projects here, and he knew he would enjoy working with them, as well as with the students. He has taught Industrial Engineering Senior Design, Decision Models, Project Management and Systems Engineering and Management. Parnell holds a bachelor's degree in aerospace engineering from the State University of New York at Buffalo, a master's degree in industrial and systems engineering from the University of Florida, a master's degree in systems management from the University of Southern California, and a doctorate in engineering-economic systems from Stanford University. He is a Fellow of the Institute for Operations Research and Management Science, the Military Operations Research Society, the International Committee on Systems Engineering, the Society for Decision Professionals, and the Lean Systems Society. He is a retired Colonel in the U.S. Air Force, author of over 100 publications, and co-editor of the Wiley & Son's Decision Making for Systems Engineering and Management, second edition, and co-author of the Wiley & Sons' Handbook of Decision Analysis. 

Parnell's research focuses on decision analysis, risk analysis, and resource allocation for defense, intelligence, homeland security, and environmental applications.



of systems engineering at the U.S. Military Academy at West Point. He has also served as a distinguished visiting professor at the U.S. Air Force Academy, associate professor of mathematical sciences at Virginia Commonwealth University, and head of the operational sciences department at the Air Force Institute of Technology.

Parnell's research focuses on decision analysis, risk analysis, and resource allocation for defense, intelligence, homeland security, and environmental applications. He has received over \$1.9 million in research funding over the course of his career. At the University of Arkansas, Parnell is working with the Center for Innovation in Healthcare Logistics, using decision analysis techniques to determine ways to

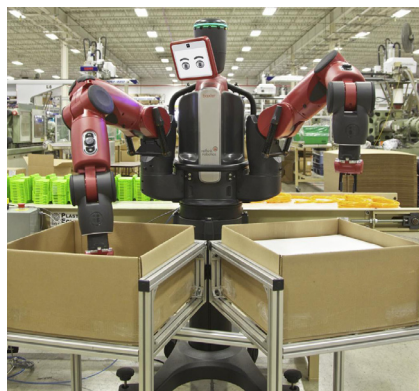
Dr. Harry Pierson

Dr. Harry Pierson, assistant professor of industrial engineering, describes his research as being “between industrial and mechanical.” With a background in mechanical, manufacturing and systems engineering, Pierson has insight into the processes and systems involved in industrial manufacturing.

One of Pierson’s research focuses is on collaborative robots. This new generation of robots presents new opportunities for manufacturers. Traditionally, industrial robots are dangerous machines. They are separated from human workers, except for the specialized programmers and engineers who give the robots instructions. Collaborative robots are different. These robots have features that allow them to safely and easily interact with humans.

Pierson explained that the robot he just acquired for his lab, named Baxter, has sensors and force feedback, which means it can sense the presence of humans and react to them. “If you get in front of him, he’ll stop,” said Pierson. Baxter also has a pair of eyes that “look” in the direction it is moving or reaching toward, to help its human co-workers know what to expect.

Another feature of this robot is called “human friendly task specification.” Instead of needing complicated programmed instructions, Baxter can repeat processes that he’s learned directly from people. A human worker can move the robot’s arm through a task, for example, and Baxter will record the task so that he can repeat it.



Pierson is also looking at another breakthrough in manufacturing—3D printing. This technology has the potential to benefit many different industries, especially

One of Pierson’s research focuses is on collaborative robots. This new generation of robots presents new opportunities for manufacturers.



ones that need small amounts of custom-designed parts. Pierson is working with the Air Force, looking at 3D printing processes and specifications to make sure that 3D printed parts will be reliable.

Pierson received a bachelor’s degree in mechanical engineering and a master’s degree in engineering management from the University of Missouri-Rolla. He holds a doctorate in industrial and systems engineering from The Ohio State University. Pierson has worked as a visiting assistant professor of mechanical and manufacturing engineering at Miami University, and has experience in the manufacturing industry through positions with Spang & Co. and Ingersoll-Rand. 


Achievements and Service

- ▶ Dr. Kim Needy received the Distinguished Service Award for the Industrial Engineering Division at the conference of the American Society for Engineering Education in June 2012.
- ▶ Dr. Heather Nachtmann was named a Fellow of the American Society for Engineering Management (ASEM) at the Annual ASEM Conference in Lubbock, TX - 2012. Dr. Heather Nachtmann was also recognized with the Outstanding Research Award, Fall 2012
- ▶ Dr. Richard Cassady, professor, and Dr. Manuel Rossetti, each received the IIE Fellow Award signifying the highest level of membership in the institute. This award is bestowed to leaders who have made significant, nationally recognized contributions to industrial engineering.
- ▶ Dr. Ronald L. Rardin, Distinguished Professor of Industrial Engineering, was the 2012 recipient of the David F. Baker Distinguished Research Award from the Institute of Industrial Engineers.
- ▶ Dr. Russ Meller, received the Annual Award for Excellence in the Teaching of Logistics and Supply Chain at the annual Institute of Industrial Engineers Conference in San Juan, Puerto Rico, May 2013. Meller and his graduate student, Lisa Thomas also received the ISERC Best Track Paper Award in Facility Logistics for their paper "Using Empirical Data to Assess Performance in Overall Warehouse Design.
- ▶ Dr. Chase Rainwater, assistant professor of industrial engineering, was named Outstanding Faculty Advisor for the South Central Region 2013. Ridvan Gedik, a graduate student advised by Rainwater, received the E.J. Sierleja Memorial Fellowship. Jingjing Tong, a graduate student advised by Dr. Heather Nachtmann, received a Gilbreth Memorial Fellowship. Undergraduate student Katy Accurso received the UPS Scholarship for Female Students, and undergraduate Christopher Bayles received the Dwight D. Gardner Scholarship. Hannah Corbitt, undergraduate, received an IIE Council of Fellows award.
- ▶ In 2012 alumnus, Kellie Schneider, and faculty members Dr. Ed Pohl, and Dr. Chase Rainwater, were recognized for receiving the William A.J. Golomski Award in the Quality Control & Reliability Engineering Division. This award honors an outstanding paper from the Annual Reliability and Maintainability Symposium (RAMS) which is authored or co-authored by a member of IIE.
- ▶ Dr. Manuel Rossetti was the 2012 recipient of the John L. Imhoff Award for Teaching. This award was established in 2004 by John Imhoff, former head and founder of the industrial engineering department, to recognize faculty members who have excelled in teaching in the College of Engineering.
- ▶ Dr. Russell Meller received the 2013 AAIE Faculty Member of the Year and the 2013

Alumni Association Faculty Distinguished Achievement Research Award

- ▶ Dr. Manuel Rossetti received the 2013 Charles & Nadine Baum Faculty Teaching Award and was elected Fellow of the Teaching Academy signifying his outstanding performance as a teacher at the UA.
- ▶ Dr. Shengfan Zhang received funding from the University of Arkansas Women's Giving Circle for her Personalized HPV (Human Papillomavirus) Vaccination Program. She and colleagues from NC State performed a study to help physicians and policymakers better identify specific patient groups who may be at a greater risk for HIV infection and help hospitals better plan resources.
- ▶ Dr. Heather Nachtmann led efforts to secure \$1.4M from the U.S. Department of Transportation to create the Maritime Transportation Research and Education Center (MarTREC) to increase economic competitiveness through efficient, resilient and sustainable transportation systems on U.S. navigable waterways.
- ▶ Dr. Justin Chimka has been named editor-in-chief of the *International Journal of Six Sigma and Competitive Advantage* (IJSSCA). IJSSCA publishes original research articles that advance the theory of statistical process improvement and its application to a diversity of fields including healthcare, manufacturing, service and sustainability.
- ▶ A new National Science Foundation funded program will help Arkansas students earn graduate degrees in engineering and prepare them for careers. The Student Integrated Intern Research Experience, or SIIRE, aims to increase

the number of highly skilled employees in Arkansas who are ready to apply engineering research. PI – Dr. Manuel Rossetti Co-PIs – Dr. Kim Needy (INEG), Dr. Carol Gattis (Honors College), Dr. Ed Clausen (CHEG), Dr. Micah Hale (CVEG)

- ▶ Dr. Ed Pohl has been selected to serve as associate editor of *Quality Technology & Quantitative Management*. QTQM is an international refereed journal that publishes articles in the fields of industrial engineering, operations research, management science and statistics.
- ▶ Dr. Kim LaScola Needy and Dr. John A. White co-authored the engineering textbook, *Fundamentals of Engineering Economic Analysis*, published by John Wiley & Sons. This book is designed for use in courses teaching engineering economic analysis. It features learning objectives, key terms, real-world vignettes with discussion questions, enhanced summary sections, and over 800 end-of-chapter problems. The online companion tool, WileyPLUS, provides video lessons, video solutions, algorithmic problems and tutorials. 

Publications

In 2012-2013 the faculty of the Department of Industrial Engineering at the University of Arkansas contributed two textbooks, nine book chapters, 41 refereed journal articles, 38 other refereed publications and proceedings. The faculty authors are indicated in bold face type.

Textbooks

White, J. A., K. E. Case, D. B. Pratt, *Principles of Engineering Economic Analysis, 6th*, Editors: John Wiley & Sons, New York, NY, 2012.

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Buyurgan, N., S. Landry, and R. Philippe, "RFID Adoption in Healthcare and ROI Analysis." *RFID Applications, Alp Ustundag*, Editor, 81-86, Springer-Verlag London, 2012.

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Xiang, Y., **C. R. Cassady** and E.A. Pohl, "Optimal Maintenance Policies for a System Subject to a Markovian Operating Environment," *Computers and Industrial Engineering*, 62 (2012): 190-197

McClure, B., **C. R. Cassady**, C. Rainwater and J. R. Chimka, "Optimizing the Sunday Singles Lineup for a Ryder Cup Captain," *Interfaces*, 42(2) (2012):180-190

Chimka, J. R., "A Review of Automated Identification Technology and Quality Control," *International Journal of Automated Identification Technology*, 4(2) (2012): 85-89

Black, R. and **J. R. Chimka**, "A Theoretically Appropriate Poisson Process Monitor," *International Journal of Performability Engineering*, 8(4) (2012): 457-461

Zhang, F., **J. R. Chimka**, and E. A. Pohl, "Global Versus Sequential Learning Styles Related To Attitudes About Online Learning," *Computers in Education Journal*, 3(2) (2012): 83-94

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- Ozturkoglu, O., K. R. Gue, and **R. D. Meller**, "Optimal Unit-Load Warehouse Designs for Single-Command Operations," *IIE Transactions on Design and Manufacturing*, 44 (2012): 459-475
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- Nachtmann, H.** and E.A. Pohl, "Emergency Medical Response Services via Inland Waterways." *Journal of Risk Management*, Vol. 15, No. 4 (2013): 225-249
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- Guzman, M., K. Schneider, **E. A. Pohl** and C. Rainwater, "Application of Reliability Methods to Social Networks," *Military Operations Research*, 17 (4) (2012): 51-58
- Miman, M. and **E. A. Pohl**, "Multi-Objective Optimization of a Contingency Logistic Network through Physical Programming." *International Journal of Collaborative Enterprises: Special Issue on Transportation Modeling and Evacuation Planning*, Vol. 3, No. 1: (2013)
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Montreuil, B., **R. D. Meller**, C. Thivierge, and Z. Montreuil, "Functional Design of Physical Internet Facilities: A Road-Based Distribution Hub," *Progress in Material Handling Research: 2012*, Gardanne, France, June 2012.

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Ellis, K. P., **R. D. Meller**, and S. Roesch, "Operational Challenges in Collaborative Freight Logistics," *Progress*

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Thomas, L.M. and **R. D. Meller**, "Using Analytical Models to Assess Performance in Overall Warehouse Design." *Proceedings of the 2013 Industrial and Systems Engineering Research Conference*, San Juan, Puerto Rico, May 2013.

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Nachtmann, H., and Kenneth Ned Mitchell, "Systems Optimization within the U.S. Army Corps of Engineers' Navigation Program," *Proceedings of the 2012 Industrial Engineering Research Conference*, Orlando, Florida, May 2012.

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Specking, E., **K. L. Needy**, & E. A. Pohl, "Global studies: A study on why more engineering students do not participate," *American Society for Engineering Education Annual Conference Proceedings*, San Antonio, Texas, 2012.

Needy, K. L., E. A. Pohl, and E. Specking, "Raising the level of participation in study abroad by industrial engineering undergraduate students," *2012 American Society for Engineering Education Annual Conference Proceedings*, San Antonio, Texas, 2012.

Hall, K., D. Xiao, **E. A. Pohl**, and K. Wang, "Reliability-based Mechanistic Empirical Pavement Design using Statistical Methods," *Compendium of Papers for the Transportation Research Board*, Washington, DC, January 2012.

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Alumni

The Arkansas Academy of Industrial Engineering (AAIE) was founded in 1986 to recognize the achievements of University of Arkansas Industrial Engineering graduates and to provide

continuing guidance and support to the Department of Industrial Engineering. The Academy also provides its members with the opportunity to nurture the organization that played an important role in their professional growth and development. Academy members provide tremendous financial resources that endow many scholarships for the Industrial Engineering students.

The AAIE organizes a liaison committee that serves in the capacity of an advisory board to the department. The committee is comprised of accomplished professionals from business and industry who bring both an applied perspective and an independent assessment to the industrial engineering program at the University of Arkansas.

“We are sincerely grateful for the service and wise council of this committee,” said Ed Pohl, Department Head.

Recent members of the Liaison Committee include:

- **G. Kent Burnett**, Senior Vice President of IT at Dillard’s.
- **Grant DuCote**, Senior Manager - Logistics Engineering at Wal-Mart.



- **Bryan Grimsley**, Senior Production Engineer at FMC Technologies.
- **Mike Gross**, Administrator, Mt. Carmel Community in Rogers.
- **Lee Hartz**, Walgreen’s IT Organization, Homecare Division.
- **Sunderesh S. Heragu**, Professor and Head of the School of Industrial Engineering and Management at Oklahoma State University.
- **Roman Hlutkowsky**, The Hlutkowsky Group.
- **David Humphrey**, Vice President of Investor Relations, ArcBest Corporation.
- **Alice E. Smith**, Professor, Auburn University.
- **Tarek Taha**, Senior Director of Intermodal IT and Engineering, J.B. Hunt Transport.
- **Eileen M. Van Aken**, Professor and Associate Department Head, Grado Department of Industrial and Systems Engineering at Virginia Tech.
- **Gary Whicker**, Senior Vice President of Engineering and Enterprise Services at J.B. Hunt Transport Services, Inc.
- **Rick Wilkinson**, Senior Director of Logistics Engineering for Walmart.

Alumni Achievements

- ▶ Mr. Reynie Rutledge Sr. B.S.I.E. 1972, M.B.A. 1973, AAIE Member 1994, from Searcy, AR received the Citation of Distinguished Alumni for exceptional professional and personal achievement and

extraordinary distinction in a chosen field in November 2012. Then in March 2013, he was named to the University of Arkansas Board of Trustees by Governor Beebe to fulfill the remainder of the term vacated by John Tyson through 2017.

- ▶ College of Engineering Hall of Fame Alumnus and AAIE Member Mr. William L. Cravens from Little Rock, AR was recently inducted into the Arkansas Business Hall of Fame. Established in 1999 by the Sam M. Walton College of Business at the University of Arkansas, the Arkansas Business Hall of Fame recognizes the exceptional business success its honorees have achieved in Arkansas and beyond.

Mr. Cravens received his B.S.I.E. in 1956 and is a certified public accountant and professional engineer who retired after a long career in banking and telecommunications management.

- ▶ Ms. Ritchie Manley Bowden (B.S.I.E.) received the University of Arkansas Black Alumni Society Citation of Distinguished Alumni. Ritchie is a retired administrator for the Mid-South Gastroenterology Clinic and Outpatient Ambulatory Surgery Center.
- ▶ Mr. Sam Chaffin, M.S.I.E. 1960 was the recipient of The Marie Award 2013 in October of 2013. The award recognizes outstanding Arkansans who have made a significant contribution to the advancement of the public interest by word, action, and example through interfaith engagement and civic service over a number of years.
Chaffin graduated with a BS in Chemical Engineering and a MS in Industrial Engineering, from the University of Arkansas, which he uses today as a Logistics and Management Consultant.


- ▶ Recent doctoral graduate, Dr. Brian Smith was recognized by the American Society for Engineering Management for his dissertation titled “An Empirical Investigation of Supply Chain Excellence in Healthcare” at the ASEM’s 33rd International Annual Conference, in Virginia Beach, VA. His research was funded in large part by the Center for Innovation in Healthcare Logistics.
- ▶ Alumnus Dr. Jen Pazour (MSIE 2008, PhD 2011), now Assistant Professor at the University of Central Florida (UCF) was among just 16 researchers nationwide to be honored with 2013 Young Investigator Awards from the Office of Naval Research. She was recognized for showing “exceptional promise for doing creative research” early in her tenure track, according to the Navy. Pazour received a three-year, \$509,000 grant to study the design of sea-based logistic delivery systems, which operate in challenging environments that include the need for increased security measures, synchronization of sea-based logistics with land operations, the absence of permanent infrastructure, and individual logistic-transport needs. Pazour is developing models and algorithms to evaluate and improve naval logistics.
- ▶ Kevin Oden (BSIE 2007) is co-founder of cycleWood Solutions. The company has received accolades, cash awards, and numerous investors including the National Science Foundation since developing the concept for cycleWood Solutions. In 2012 cycleWood Solutions received an Edison Award, one of the highest honors a company can receive in the name of innovation and business. The XyloBag was assessed by a panel of more than 3,000 judges and, after a long peer-review process, the team was presented with a bronze

Edison Award, named after the American inventor Thomas Edison. The XyloBag is a sustainable alternative to the high-density plastic bags currently used in stores. A local Northwest Arkansas business is already selling them.

- ▶ Bryan Hill (BSIE2003, MSIE 2007), alumnus of the department and now assistant dean in the College of Engineering, was appointed by the University of Arkansas Provost to serve as director of the UTeach Arkansas program. UTeach is a four-year teacher education program in which students can earn both a degree in science or mathematics and a secondary teaching license.
- ▶ Angela (Harrison) Kuli (BSIE 1992) is becoming known as “the STEM Lady.” After 12 years at Intel Corporation, she began her own company, AHK Consulting which provides engineering management and workplace learning expertise to Arkansas-based companies. In addition she is actively involved in volunteerism as a liaison between the university and P.A.R.K., Positive Atmosphere Reaches Kids. P.A.R.K. is a program in central Arkansas run by Keith Jackson that provides ‘high-risk’ students the opportunity to further their education by completing high school so they can attend college. Angela is known as “the STEM lady” (science, technology, engineering and mathematics), since she brings STEM experiences to these middle and high school students.

College of Engineering Alumni Awards

The Distinguished Alumni Award honors College of Engineering graduates who have provided leadership in their communities and achieved distinction in their fields of endeavor. Recent recipients of the Distinguished Alumni Award include Carl Imhoff (BSIE 1978, Manager, electric infrastructure market sector, Pacific Northwest National Laboratory, Richland, Washington), G. Kent Burnett (BSIE 1968, Senior Vice President of IT at Dillard’s), and Dana Sedgass (BSIE 1981, MSIE 1982, Partner -retired, Accenture, Frisco, TX). Alumnus Robert “Bob” Davidson (BSIE 1970, retired president and CEO of ABF Freight System) received the College Hall of Fame medal in 2014.

The College also recognizes early career standouts with an Outstanding Young Alumni Award. This recognizes exceptional professional and personal achievements of College of Engineering graduates who are within up to 20 years post-graduation. The most recipients from the department are Thomas Duncan (BSIE 2005, Investment banking associate, Wells Fargo Securities, Charlotte, NC), Bryan Billingsley (BSIE 1997, President, HEBCO Inc., Springdale, AR) and Drew Harrison (BSIE 2000, Vice President of Operations, Harrison Energy Partners, Little Rock, AR). 

Global Studies



In 2004 our founding department head, Dr. John Imhoff with his wife, Lois provided a generous gift to the department to establish the John L. Imhoff Global Studies Endowment. The initial gift of \$300,000 has grown substantially over recent years. The endowed account has been able to award more than \$81K to 40 undergraduate students allowing them the opportunity to study abroad.

The university, college and department consider studying abroad as a vital part of helping our graduates become global leaders. Engineering students at the U of A can travel the globe, learn about different cultures and gain a new perspective on their studies. The college offers six study abroad programs designed specifically for engineering students. With the John L. Imhoff Global Studies Endowment, the department is able to strongly support this initiative. The Department of Industrial Engineering is working toward the goal of having at least 25% of our undergraduate students participate in a global studies experience while obtaining their bachelor's degree.

A word cloud of study abroad destinations. The words are arranged in a roughly circular pattern. Some words are in bold black, some in bold red, and some in grey. The background features a faint globe and several interlocking gears in black and red.

Africa
Australia **Belize**
Ireland **England** **Italy**
Prague **Mozambique**
Greece **Singapore** **London**
France **Germany** **Spain**
Turkey **China** **South**
India

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