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* ASU IE Faculty Ranked 4th in scholarly productivity by The Chronicle of Higher Education (details on page 3)
Welcome to our 2007-2008 Annual Research Report. The report describes our goals, accomplishments, and transitions over the past year. We have spent considerable time on strategic planning over the past year and believe we have laid out a path that will further our mission of enhancing the global quality of life through leading discovery and innovation. One notable achievement already recognized is the announcement by The Chronicle of Higher Education that our IE department ranks 4th nationally for faculty scholarly productivity. This ranking was based on a quantitative analysis of the number and impact of faculty publications and research grants. That’s quite an honor and a tribute to the quality of our faculty.

In keeping with our new strategic vision, we are changing our name to Department of Industrial, Systems and Operations Engineering. This new name both better reflects where we are as a department and where we are headed. “Systems” recognizes our emerging activity in Systems Engineering to support the needs of the regional aerospace and defense industries that engage in the “Spark to Dark” life-cycle of development, deployment, support, and retirement of large scale systems of systems, and, our active and growing participation in health care delivery, financial engineering, logistics and other service industries. “Operations” acknowledges that many IE’s are engaged in designing procedures for and managing production operations throughout a broad spectrum of manufacturing and service industries and frequently use tools associated with “operations research”.

The remainder of this report will detail the specifics of our faculty and student accomplishments. We encourage you to invest a few minutes to learn what we are doing and invite you to keep in mind that we are always interested in partnering with industrial, government, and other academic institutions to leverage our talents through collaborative research. We’ll be here, so if you see an opportunity where both groups and the greater society can all benefit, please contact us and let’s make it happen.

—Dr. Ronald G. Askin, Chair

Degrees Awarded 2007-2008

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Enrollment Fall 2007

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Montgomery receives international engineering award

Douglas Montgomery, a professor in the Department of Industrial Engineering, has been selected to receive one of the top honors bestowed by the European Network for Business and Industrial Statistics (ENBIS).

Montgomery will receive the 2008 George Box Medal, recognizing outstanding contributions to the development and application of statistical methods in European business and industry.

He will give an address and be presented the award at the ENBIS international meeting in Athens, Greece in September.

The ENBIS awards committee cited Montgomery's industrial statistics work in the design of experiments, quality control, applications of linear models, and time-series modeling and forecasting.

The committee also noted his authorship of several books in the field and many journal articles that reflected the depth of his expertise.

Montgomery has worked in engineering assignments with major businesses such as Union Carbide Corporation and Eli Lilly and Company, and been a consultant to many national and international engineering organizations.

He has lectured extensively throughout the Americas, Europe and the Far East, and is one of the co-editors of Statistical Practice in Business and Industry, which the ENBIS awards committee deems a “famous” book in the statistics field.

In 2006, Montgomery was made an Arizona State University Regents’ Professor. The designation is given to faculty members at Arizona’s public universities who have demonstrated exceptional scholarship and outstanding achievement. He is one of six Ira A. Fulton School of Engineering faculty members to hold the Regents’ Professor designation.

Writer: Joe Kullman

Esma Gel receives top industrial engineering award

Esma Gel, associate professor in the Department of Industrial Engineering, received the Hamid K. Eldin Outstanding Young Industrial Engineer in Education Award from the Institute of Industrial Engineers (IIE) at its annual conference in May in Vancouver, Canada. The award recognizes young IIE members who have demonstrated leadership and professionalism in industrial engineering education.

Since joining the Ira A. Fulton School of Engineering in 2000, Gel has been teaching graduate and undergraduate courses in operations research and production systems. Her research focuses on the use of applied probability techniques for modeling, design and control of production systems and supply chains, with emphasis on workforce engineering. Her work has been published in leading journals and funded by the National Science Foundation and industrial partners such as Intel, IBM and Infineon. Gel earned her masters of science and Ph.D. degrees from Northwestern University in 1995 and 1999, respectively.
George Runger awarded for IIE top applied IE research paper & shared ASU President’s Medal

George Runger was awarded the 2008 *IIE Transactions* Quality & Reliability Engineering Best Application Paper award; Runger is one of the authors of “Multivariate Statistical Process Control with Artificial Contrasts,” published in *IIE Transactions: Special Issue on Data Mining* in 2007.

In addition to his best paper award, Runger was a contributor to Arizona HealthQuery: A Community-University Partnership project, recognized with the President’s Medal for Social Embeddedness. For the project, he collaborated with other researchers in biomedical informatics, and used applied statistical and analytical modeling to correlate variables consistent with different disease incidents.

Teaching accolades

Each year, the Ira A. Fulton School of Engineering recognizes its top teaching faculty. Three of the industrial engineering faculty—Linda Chattin, lecturer, and professors George Runger and Dan Shunk—were recognized in the top 5% of best teachers in the school.

Top faculty are selected in a process that starts by collecting student nominations, which are then evaluated by the Quality of Instruction Committee. The top professors are then ranked according to the influence they had on their students. Industrial engineering faculty are regularly recognized as excelling in teaching evaluations.

Study ranks IE@ASU No. 4

The ASU Department of Industrial Engineering ranks 4th in faculty scholarly productivity among U.S. industrial engineering programs, according to *The Chronicle of Higher Education*. The *Chronicle* study involved creating a quantitative index of faculty scholarship and research activity for all departments that offer a Ph.D. degree.

The 2007 index measured faculty members for the following five categories: books published, journal publications, citations of journal articles, federal grant dollars awarded, and honors and awards.

Villalobos featured in top 100

J. René Villalobos was featured in *Revista Poder y Dinero*, one of the most prestigious financial magazines in Mexico and Latin America, in a special edition (October 2007) of the 100 professors who were born in Mexico and are now teaching and “making waves” in the United States. Selection was competitive, including review of 230 professors with highly significant accomplishments and from universities such as Harvard and Columbia.

Left to right:
Dr. George Runger,
Dr. J. René Villalobos
2007–2008 Sponsored Research

Project Title, Sponsor, P.I.(s)

Production Systems & Logistics

“Banner Throughput Collaborative: Operations Research,” Banner Health, Jeffery Cochran
“Banner Health/ASU Partnership for ED Patient Safety,” Banner Health, Jeffery Cochran
“ASAP Customization,” Advanced Micro Devices, John Fowler, Gerald Mackulak
“The SRC Fellowship,” SRC, John Fowler, Gerald Mackulak
“Scheduling Assembly and Test Facilities,” Intel, John Fowler, Ron Askin
“GOALI Collaborative Research: Matching Demand and Supply through Price and Lead Time Decisions,” NSF-ENG Civil, Mechanical and Manufacturing Innovation (CMMI), Esma Gel
“Multi-Product Cycle Time & Throughput Evaluation,” SRC, Gerald Mackulak, John Fowler
“US-Mexico Partnership on Education & Technology Transfer for the Aerospace Industry,” USAID, Rene Villalobos, John Fowler, Esma Gel
“Arizona State University Affiliation with the Center for Engineering Logistics & Distribution (CELDi),” NSF, Rene Villalobos, Ron Askin, Esma Gel
“CELDi Membership: Forecast and Capacity Planning for Nogales’ Ports of Entry (Nogales POEs Traffic Study),” ADOT Research Center, Rene Villalobos

Operations Research

“Predicting and Prescribing Human Decision Making Under Uncertain and Complex Scenarios,” AFOSR, Ronald Askin
“Multi-Product Cycle Time & Throughput Evaluation via Simulation on Demand,” SRC, John Fowler, Teresa Wu
“Collaborative Research: Developing and Engineering Virtual Organization for Discrete-Event logistics Systems,” NSF, John Fowler, Teresa Wu
“Customer Relationship Management at Tyco Electronics,” Tyco Electronics, John Fowler
“Factory Capacity Allocation Solver for Rapid within Shift Re-Planning,” Intel, John Fowler
“Mayo Clinic Center for Clinical and Translational Research,” Mayo Foundation, John Fowler
“EPNES: Integrated MEMS & Advanced Technologies for the Next Generation Power Distribution System,” NSF, Esma Gel
“Improving Airline Schedule Planning at Swift Aviation Group,” Swift Aviation Group, Ahmet Keha
“Pricing & Profit Optimization for Financial Services,” Response Analytics, Teresa Wu

Information & Management Systems

“Distributed Decision Support Framework for Adaptive Supply Chains,” IBM, John Fowler, Teresa Wu
“Fabrication Environmentally Conscious (Benign) Manufacturing into Engineering Education,” UTEP, Teresa Wu, Rong Pan
“Models of Quality of Service and Quality of Information Assurance Towards Their Dynamic Adaptation,” DOD-Air Force Research Labs, Nong Ye
“SoD: Design of Service-Based Software Systems with QoS Monitoring and Adaptation,” NSF, Nong Ye

Industrial Statistics

“Regression-Based Quality Improvement in Complex Systems with Consideration of Data Uncertainty,” NSF, Jing Li
“Economical Concrete Mix Designs Utilizing Blended Cements, Performance-Based Specifications, and Rational Pay Factors,” ADOT Research Center, Douglas Montgomery, Connie Borror
“An Interdepartmental Computing Environment for Statistical Research,” NSF, Douglas Montgomery, George Runger, Connie Borror, and faculty across ASU campus

“Collaborative Research: Hierarchical Modeling of Yield & Defectivity to Improve Factory Operations,” SRC, Douglas Montgomery
“Collaborative Research: Blind Discovery of Variation Sources for Visualization by Multidisciplinary Teams,” NSF, George Runger
“Self-Learning of Decision Rules for Process Control,” NSF, George Runger
“Credit Risk Analytics,” Desert Schools Fed Credit Union, George Runger
“Data Mining Pilot on Intel Factory Data,” Intel, George Runger
“Integration of Health Outcomes Information—A Partnership with Arizona Department of Environmental Quality,” ADEQ, George Runger
“Feature Selection with Ensembles for Complex Systems,” NSF, George Runger

Engineering Education

“Collaborative Interdisciplinary Research Community (CIRC),” NSF, Mary Anderson-Rowland
“Collaborative Research: Maricopa Engineering Transition Scholars (METS),” NSF, Mary Anderson-Rowland
“Collaborative Interdisciplinary Research Community Maricopa Engineering Transition Scholars (CIRC/METS),” NSF, Mary Anderson-Rowland
“NACME Scholars Program,” NACME, Mary Anderson-Rowland
“Academic & Professional Development for Upper-Division Computer Science, Engineering and Mathematics Students,” NSF, Mary Anderson-Rowland
“Academic & Professional Development for Lower-Division Computer Science, Engineering and Mathematics Students,” NSF, Mary Anderson-Rowland
2007-2008 Ph.D. Degrees Granted

Summer 2007

Jing Hu
Change Detection with Supervised Learning
Advisor: George Runger
Placement: SRP

Fall 2007

Napatkamon Ayutyanont
Statistical Characteristics and Models of Cyber Attack and Norm Data for Cyber Attack Detection
Advisor: NongYe, Randall Eubank
Placement: Banner Health Alzheimer Institute

Sandipan Ganguly
Compromise Based Design: A Penalty Function Approach to Distributed and Collaborative Optimization in Design
Advisor: Teresa Wu, Ahmet Keha
Placement: Expedia.com

Darshit B. Parmar
Mitigating Supply Chain Disruption Risk Using Sense and Respond Framework
Advisor: Philip Wolfe, Teresa Wu
Placement: IBM

Yang Sun
Strategic and Operational Product Allocation in Semiconductor Supply Chains
Advisor: Dan Shunk, John Fowler
Placement: California State University, Sacramento

Spring 2008

Jennifer M. Bekki
Cycle-Time Quantile Estimation with Discrete Event Simulation
Advisor: John Fowler, Gerald Mackulak
Placement: Arizona State University, Polytechnic campus

Ozgun B. Bekki
Dynamic Price and Lead Time Quotation Strategies
Advisor: Esma Gel
Placement: independent contractor

Michael Chiaramonte
Competitive Nurse Rostering and Rerostering
Advisor: Jeffrey Cochran, Teresa Wu
Placement: U.S. Air Force in Japan

Arife B. Colak
Hybrid Algorithms for Combinatorial Optimization Problems
Advisor: Ahmet Keha
Placement: Central New Mexico Community College

Hugo C. Garcia
A Framework for the Self Reconfiguration of Automated Visual Inspection Systems
Advisor: René Villalobos
Placement: Freescale Semiconductor

Eric C. Maass
Modeling the on Time Delivery and Inventory for Semiconductor Supply Chains
Advisor: John Fowler, Murat Kulahci
Placement: Motorola

Myrta R. Sigufuentes
Evaluation and Construction of Optimal Experimental Designs for Fitting Response Surface Models
Advisor: Douglas Montgomery, Connie Borror
Placement: Tecnológico de Monterrey, Hermosillo Campus

Hugo Garcia, Ph.D., at Spring 2008 graduation.
Bioinformatics uses and develops techniques from disciplines such as statistics, machine learning, and data mining, to find solutions to biological problems. Large amounts of data are collected on public health, environmental, and genomic information. When that data is analyzed with modern analytical methods, the new knowledge can point to causes and aid in prevention or treatment. To solve such problems in bioinformatics, Dr. George Runger is teaming up with researchers across Arizona State University and the greater Arizona community. Applications of data mining and statistics in bioinformatics are already showing promising results that will improve public health.

In one such project, the group is developing new methods to monitor public health data on occurrences of staph infections to detect changes in the community health status. Methicillin-resistant staphylococcus aureus (MRSA) is a strain of bacteria that is resistant to broad-spectrum antibiotics. Saylisse Davila, an industrial engineering graduate student researcher working with Dr. Runger, said that by “leveraging substantial experience with multidimensional monitoring of large industrial data sets, the plan is to conduct analyses spatially, temporally, and with additional covariates (such as demographics, service provider, etc.) with sensitivity to changes that occur only for local regions and/or subpopulations.”
Their hope is to show relationships in the analysis that will point to methods of reducing infection.

Linking data is also showing correlations between local instances of asthma and air quality. Dr. Runger is a researcher involved in the children’s health project, a collaborative partnership among the United States Environmental Protection Agency (USEPA), Arizona Department of Environmental Quality (ADEQ), Arizona Department of Health Services (ADHS), the ASU Center for Health Information and Research (CHIR), ASU Mechanical and Aerospace Engineering, and ASU Industrial Engineering. The study’s goal is to first, “explain the relationship between asthma in children and air quality particulates and then develop an enhanced warning system.”

Extensive health data from CHIR and ADHS provided information on thousands of asthma incidents. This data needed to be linked to environmental air quality data from multiple sensors with important spatial and temporal components. Because asthma has a strong seasonal component, the case-crossover method and other analytical tools to control for long term trends, seasonal effects, epidemics, and other covariates that change slowly with time were used. Nuttha Lurpongulkana, an industrial engineering doctoral student researcher on the project, said, “We discovered statistically significant relationships between air quality and asthma incidents in children.”

Researchers said that the project provided an example of a complex analysis with a large team to relate health effects with environmental factors. “The project also demonstrated the capability for various organizations to collaborate and link data, plan studies, cooperate for analysis, and communicate findings. We disseminated to other stakeholders, such as the asthma coalition, the University of Arizona medical school, and CHIR data partners.” The work also led to development of new bioinformatics tools for these types of analyses.

New bioinformatics tools are also an aid in genomic research. The research team from the Department of Industrial Engineering, is collaborating with the Center for Ecogenomics, Biodesign Institute at Arizona State University to help investigate the inherent variety of cells and relationships with diseases such as cancer. One research endeavor in the center is the development of single-cell imaging technologies to measure oxygen consumption rates, because of the strong correlation with cell function.

New bioinformatics tools are being developed to study the relationships between oxygen consumption rate, gene expression and cell state. The rich data set will provide multiple empirical distributions of oxygen measurements for several time intervals. New feature extraction algorithms are planned to characterize these empirical distributions to relate oxygen consumption rates to gene expression and cell condition. Furthermore, the time element of the data potentially enables one to enhance the feature extraction methods with the temporal patterns as well.

This is a unique data set with supervised information and temporal components that requires dimensionality reduction. Even for a large starting set of candidate features, it is computationally fast to select the most predictive of mRNA abundance or cell condition that could lead to relevant information to understand diseases. These capabilities will be used to detect features important either individually or involved in interactions.

Doctoral student researcher, Wandaliz Torres-Garcia, explained that, “Despite the increasing molecular knowledge and the technological advances to gather data from biological processes, there remain areas for innovation in data analysis to achieve suitable biological interpretations. Cell pathways are still unclear for many diseases and understanding is critical for successful treatments.”
Optimization has a history that goes back to World War II and has made significant contributions to important, real-world problems faced by organizations in government and private industry. Blending optimization with modeling, engineers create airline flight schedules, production plans, and even urban planning designs that maximize customer satisfaction while using only the available resources and satisfying organizational and technological constraints. Even so, the world is unpredictable. Historically, the development of optimization has assumed the world to be known; in reality, we encounter unexpected events every day. Solutions are needed that provide good results for all possible futures. Robust optimization is a new paradigm shift to address this issue for large problems.

“Uncertainty is one of the important issues to consider when people make decisions,” says Dr. Muhong Zhang, assistant professor in the Operations Engineering group. “Robust optimization approach is one of the methodologies to handle this aspect.” Simple approaches, such as just planning for the expected or most likely scenario, can lead to very bad decisions under some possible events.

“Unlike traditional stochastic programming, robust optimization does not assume the probability distributions of the uncertain parameters. Instead, we
consider a range of possible values that the uncertain parameters can take. The advantage of such approach is that the problem size will not increase dramatically, compared to traditional stochastic programming, to achieve a high-quality decision. However, the reformulated problem, what is called the robust counterpart, may not be an easy problem, either. “

Dr. Muhong Zhang chose to research solutions to such problems with random variables because of a broadened view of robust optimization in recent years. Zhang’s past and present research has been on developing techniques in robust optimization, transportation, and distribution in logistics, mixed-integer programming, combinatorial optimization, and network flows.

“Currently, I am working on the general network problem with uncertain parameters. One goal is to apply such techniques to practical problems, for example, production planning in the semiconductor industry. Second, in such network problems, there are problems that can be solved efficiently. I am characterizing such problems and developing efficient algorithms for them.”

She is now studying the two-stage, robust network flow and design problem with demand uncertainty, when applied to supply chain and logistics problems. In her research, robust optimization happens in two stages, which allows a company to go ahead and schedule one stage of production, even without a full picture of what the eventual demand will be. In the second stage, after decision makers observe actual outcomes, updated information can be used to schedule shipment of the completed products to the retailers. Using the algorithms she develops will hopefully decrease computational time and offer decision makers the supporting information they need to make critical decisions. Dr. Zhang is looking to apply her robust optimization methodology to other real-world problems that can be modeled as flow across a network.

Muhong Zhang joined the Operations Research (OR) group after completing her Ph.D. at the University of California, Berkeley, and serving as a lecturer there for one year. She previously earned a Master’s degree in Operations Research from the Applied Mathematics Institute, Chinese Academy of Sciences; and a Bachelor’s degree in Applied Mathematics from Beijing University of Chemical Technology.
Dr. John Fowler and his colleagues and students have been involved in using deterministic scheduling methodology for a wide range of applications. The applications are as diverse as scheduling semiconductor manufacturing operations and surgical delivery systems (aka operating rooms).

Scheduling involves making decisions about the allocation of limited resources to operations over time. These decisions play a crucial role in determining the competitiveness (and in some cases the survivability) of manufacturing or service enterprises. Manufacturing companies have to meet shipping dates to their customers, as a failure to do so would result in a significant loss of good will. Service companies must provide their services in reasonable time or customers will find other service providers. Both must schedule their operations in order to effectively utilize expensive resources (e.g. machines or surgical rooms). Scheduling problems are technically quite challenging. The difficulties encountered are similar to the difficulties encountered in other branches of combinatorial optimization and stochastic modeling. Even for problems that seem quite simple, the time required to determine the optimal solution can be very long, unless special structure in the problem can be found and exploited.

Dr. Fowler joined the Industrial Engineering (IE) department at ASU in 1995 after spending 5 years at SEMATECH, an R&D consortium of semiconductor manufacturers. In 1997, he was awarded a 3-year grant, jointly funded from the National Science Foundation (NSF) and the Semiconductor Research Corporation (SRC), entitled “Wafer Fab Operations: Modeling, Analysis and Design”. He and his research colleagues from MIT and the University of Illinois focused on the development of operational modeling tools and techniques (including scheduling) to improve the efficiency of wafer fabrication. As part of this effort, one of Dr. Fowler’s Ph.D. students, Scott Mason (now an Associate Professor at the University of Arkansas), developed a shifting bottleneck-based approach to scheduling wafer fab operations. Following that project, Dr. Fowler led a team
of researchers, including ASU colleagues Professors George Runger and Esma Gel, Professor Mason, and three colleagues from German institutions, on a proposal to the Factory Operations Research Center, funded by SRC and International Sematech, entitled “Scheduling of Semiconductor Wafer Fabrication Facilities.” Over two years, the PIs worked together effectively to:

- Develop viable shifting bottleneck-based wafer fab scheduling and rescheduling methodologies;
- Develop and test wafer fab-specific subproblem solution procedures for parallel machines requiring auxiliary resources (steppers needing reticles), batch processing machines (diffusion ovens), and machines characterized by sequence-dependent setups (implanters);
- Investigate the utility of statistical operations control in determining appropriate rescheduling “triggers,” such as deviation from expected job completion time; and
- Create an AutoSched AP-based testing environment to evaluate scheduling approaches in a dynamic, simulation-based environment in order to accommodate real-world fab models.

Experimental results demonstrated the efficacy of scheduling wafer fabs to maximize delivery performance of customer orders in an acceptable amount of computation time. The goal of the experimentation was to find scheduler parameters that maximize on-time delivery performance of orders from customers of varying importance/priority (i.e., total weighted tardiness or TWT) while running at a bottleneck utilization of 95%. The TWT results of the scheduler were compared to those obtained using classical dispatching approaches like: first in, first out (FIFO); earliest due date (EDD); apparent tardiness cost with setups (ATCS); critical ratio (CR); and operational due date (ODD). The new scheduler TWT results were between 1% and 25% of the corresponding best dispatching results. In summary, the results demonstrated that a deterministic scheduling-based wafer fab scheduling system has the potential to improve the on time delivery performance of wafer fabs without loss of throughput. This research has motivated several commercial software companies to begin to develop deterministic scheduling systems.

More recently, Dr. Fowler has turned his attention to scheduling surgical services. Surgical services require the coordination of many activities, including patient check-in and pre-procedure preparation, the surgical procedure, and recovery. ASU IE Ph.D. student, Serhat Gul, and Dr. Fowler teamed up with Todd Huschka and Dr. Brian Denton from the Mayo Clinic in Rochester, MN, to develop a simulation model of an outpatient procedure center (OPC). Through the use of the model, they demonstrated how surgeries are scheduled has an impact on the competing objectives of mean patient waiting time and the amount of overtime of the OPC. In particular, they found that arrival time schedules substantially influence expected overtime and patient waiting time, while surgery allocation and sequencing heuristics have a smaller effect. Furthermore, they found that surgery mix on a particular day is an important factor affecting performance measures, indicating that the optimization of daily surgical mix may be a promising opportunity for improving scheduling efficiency in an OPC. In addition, the model developed for the OPC has become the starting point for a model that is being used to help design a new outpatient procedure center. In the continuation of their National Science Foundation projects (DMI-0620573 (Denton) and DMI-0620504 (Fowler)), they will continue to use the model to study how to improve OPC operations.

In addition to the project described above, ASU IE Ph.D. student Qing Li and Dr. Fowler have worked with colleagues at ASU to improve the capacity planning and day-to-day scheduling of patients for cardiac catheterization procedures. Based on an in-depth study of a major healthcare facility in Arizona, they developed a good understanding of the scheduling problem. By block-scheduling, an initial schedule is generated and then adjusted by a real-time scheduling algorithm. The decision makers can trade-off between multi-objectives and make decisions depending on the importance of different objectives in the healthcare, i.e. patient waiting, facility utilization and staff overtime. The approach was shown via simulation to improve the performance of the scheduling in all measurements. The approach has been implemented in the healthcare facility and shown improvements in the pilot study.
Created to improve processes, industrial engineering is especially relevant for today’s companies to address the “dynamic, globalized and customer-driven markets” in which they do business, says Dr. Teresa Wu, associate professor in the Information and Management Systems group of the Department of Industrial Engineering. Expectations from a demanding global customer drives the search for technology and strategies that will help meet cost, quality and delivery goals. One strategy of modern enterprises is called Collaborative Product Development (CPD), where partnerships are developed in an effort to improve product quality, and reduce manufacturing costs and production time. “CPD is pressing hard to...form a virtual enterprise, in which partners collaboratively respond to the changes of customer demand in a swift manner,” says Dr. Wu.

An important component of a successful CPD is reliable communication through a web-based, collaborative information system, which the researchers say “ensures the right information is quickly provided to the right place, at the right time, in the right format.” Another aspect of CPD is the effective decision support system, which helps collaborating engineers develop products quickly and cost-effectively. As the Internet facilitates the changing of information management systems from traditional, centralized systems to distributed systems, it
enlarges the set of potential collaborators and increases the dynamics of a partner’s relationship—bringing about opportunities and threats.

While extensive research has addressed methodologies and Internet applications to CPD, some challenging questions remain unanswered. Dr. Wu and her collaborators are asking: “What foundation of understanding is necessary for collaborating engineers to design and develop a world-class product? In what framework can engineers across the globe actively participate and proactively develop world-class products?” Specifically, the research aims to determine how a company should pre-qualify partners to perform the constituent responsibilities of a business initiative, including what is a suitable methodology to analyze conflict among engineers and what is an appropriate mechanism for engineers to converge to an agreeable design.

The goal of her current research is to “design and implement a Virtual Product Development Environment (VPDE) to address these questions.” The research team is exploring the modular product development problems, for example, the design of electro-mechanical artifacts. The contributions of VPDE are expected to: first, develop an Internet-based engineering information system that can handle both public and private information, particularly the secured communication of collaborators’ private information; and second, to develop a distributed decision support system, integrated with partner pre-qualification, including a dynamic analysis that will help partners go from conflict to negotiation to resolution. Researchers expect that “VPDE will speed the product development process, reduce cost and increase productivity.”

Along with student researchers in her Intelligent Decision Systems laboratory (IDS), Dr. Wu is working on CPD with researchers across the nation. Collaborators include Tom Thurman and M.C. Jothi of Rockwell Collins; James Andary of Nasa Goodard Space Flight Center; Kemper Lewis of the University of New York, Buffalo; and Zhouzi Zhao of GE. Their research is “multidisciplinary, including design optimization, decentralized decision making, reliability-based design optimization, and information technology used to facilitate the communication among different disciplines. So far, the project has mainly focused on product design, yet, it has great potential for system design. We believe this research has great potential to be used to design reconfigurable systems, such as healthcare and urban systems.”

VPDE will speed the product development process, reduce cost and increase productivity.
Douglas Montgomery

Regents’ Professor
Co-Director, Executive Committee on Statistics
Ph.D., 1969, Virginia Polytechnic Institute and State University

Statistical design of experiments, optimization and response surface methodology, empirical stochastic modeling and industrial statistics
Quality and Reliability Engineering Laboratory (Q&RE lab)

Douglas Montgomery is Regents’ Professor of Industrial Engineering and Statistics and the ASU Foundation Professor of Engineering at Arizona State University. He received a Ph.D. in engineering from Virginia Polytechnic Institute and State University.

His research interests focus on designed experiments for product/process design and development, empirical model-building, and process monitoring and control. Dr. Montgomery is an author of 11 books that have appeared in over 30 English editions and numerous foreign language editions and over 200 archival journal papers. He has mentored 50 Ph.D. students and over 40 M.S. students. He is a recipient of the Shewhart Medal, the Brumbaugh Award, the Lloyd S. Nelson Award, the William G. Hunter Award, and the Shewell Award (twice) from the American Society for Quality. He is also a recipient of the Ellis R. Ott Award. He is a former editor of the Journal of Quality Technology and is the currently one of the Chief Editors of Quality & Reliability Engineering International. He serves on the editorial boards of several other professional journals. Dr. Montgomery is a Fellow of the American Statistical Association, a Fellow of the American Society for Quality, a Fellow of the Royal Statistical Society, a Fellow of the Institute of Industrial Engineers, an Elected Member of the International Statistical Institute, and an Elected Academician of the International Academy for Quality.

Selected Publications


Leadership Activities

Ronald G. Askin is a Professor and Department Chair of Industrial Engineering at Arizona State University. He has authored or co-authored over 80 professional publications, primarily on the application of operations research and statistical methods to the design and analysis of production systems. His current research concentrates on developing integrated models for operational planning including facilities design, production planning, scheduling, material flow, and quality assurance. Other research interests include project management, team formation, and human decision making. Dr. Askin co-authored the texts *Modeling and Analysis of Manufacturing Systems* (1993) and *Design and Analysis of Lean Production Systems* (2002), both of which received the IIE Joint Publishers Book of the Year Award (1994 and 2003, respectively).

Dr. Askin is a Fellow of the Institute of Industrial Engineers (IIE), and an active member of the Institute for Operations Research and Management Science (INFORMS) and the Society of Manufacturing Engineers (SME). He is past Chair of the Council of Fellows for IIE and currently serves on the IIE Board of Trustees.

Other awards he has received include the *IIE Transactions on Design and Manufacturing* Best Paper Award (twice as co-author), the Shingo Award for Excellence in Manufacturing Research, *IIE Transactions* Development and Applications Award (co-author), the ASEE/IIE Eugene L. Grant Award (co-author), and the National Science Foundation Presidential Young Investigator Award.

Selected Publications


Leadership Activities

John Fowler
Professor
Ph.D., 1990, Texas A&M University
Deterministic scheduling, discrete event simulation methodology, semiconductor manufacturing systems analysis, healthcare systems analysis and applied operations research
Modeling And Analysis For Semiconductor Manufacturing Laboratory (MASM lab): ie.fulton.asu.edu/research/masm-lab


Leadership Activities
Area Editor–Manufacturing, SCS Transactions on Simulation; Area Editor–Planning & Scheduling, Computers and Industrial Engineering; Associate Editor, IEEE Transactions on Electronics Packaging Manufacturing; Associate Editor–Factory Modeling and Control, IEEE Transactions on Semiconductor Manufacturing; Editorial Board, IIE Transactions; Editorial Board, Journal of the Chinese Institute of Industrial Engineers; Editorial Board, Journal of Simulation; Guest Editor–eManufacturing in the Semiconductor Industry, IEEE Transactions on Automation Science and Engineering.
Gary L. Hogg is currently a Professor of Industrial Engineering at Arizona State University. He holds an M.S. and Ph.D. from the University of Texas in Operations Research, and B.S.M.E. from Texas A&M University.

His graduate training and subsequent research has been in the area of applying operations research, particularly simulation and optimization, to the design and control of production and service systems. He has taught a broad range of operations research and industrial engineering courses during his 35-plus year academic career, published widely, and conducted research for NSF, NASA, USAF, DOE, EPRI, DOT, DOD and the DOC. He has also served as a consultant to over twenty-five Fortune 500 corporations, but also many smaller manufacturers. The bulk of his industrial experience is in high tech manufacturing, particularly aerospace and electronics.

He served as Program Head of IE, Interim Head of the IE Department and Associate Dean for Research and International Programs at Texas A&M. From 1995 through 2005 he served as the Chair of Industrial Engineering at Arizona State University. He is a Fellow of the Institute of Industrial Engineers and has served on the IIE Board of Trustees, Chair of the Council of Industrial Engineering Academic Department Heads, VP of Technical Societies, Director of the OR Division and President of the Arizona Chapter of IIE as well as the Brazos Valley Chapter (Texas).


**Leadership Activities**

Department Editor, *Journal of Quality Technology*; Associate Editor, *Journal of Mathematical and Management Sciences*. 

George Runger, Ph.D., is a Professor in the department of Industrial Engineering at Arizona State University. His research is on real-time monitoring and control, data mining, and other data-analysis methods with a focus on large, complex, multivariate data streams. His work is funded by grants from the National Science Foundation and corporations. In addition to academic work, he was a senior engineer at IBM. He holds degrees in industrial engineering and statistics.
Dan Shunk

Professor, AVNET Chair
Ph.D., 1976, Purdue University
Agile, enterprise and CIM systems, group technology, planning systems, economics of computer-integrated manufacturing (CIM), strategy and strategic role of technology
Supply Network Integration Laboratory (SNIL)

Dan Shunk came from industry to ASU in 1984 as an associate professor of industrial engineering. From 1984 to 1994, he served as the CIM Systems Research Center Director. He is currently serving as the AVNET Chair of Supply Network Integration.

His principal research interests are in material, information, knowledge supply network integration, computer integrated manufacturing, electronic commerce progression, time compression, cultural acceptance of change and enterprise integration.

Shunk is a senior member of the Institute of Industrial Engineers and a senior charter member of the Computer Aided Systems Association of the Society of Manufacturing Engineers. He is also a member of the Alpha Pi Mu and Tau Beta Pi honor societies. He currently serves on the editorial boards and the International Journal of Flexible Automation and Integrated Manufacturing, International Journal of Logistics, and the International Journal of Product Development.

Selected Publications


Leadership Activities

Dr. Ye’s past and current research activities—garnering over $9M external funding and producing seventy-six journal papers, two books, including *The Handbook of Data Mining*, and one U.S. patent—fall into the following two areas: data and modeling, and optimization and quality control of system operations. Her research in data and modeling involves applications in computer and network data, cognitive behavior data, and biomedical data. Research in optimization and quality control of system operations involves computer and network systems, and manufacturing and supply chain enterprises.

Ye’s interdisciplinary research is bringing industrial engineering theories and techniques into the scientific understanding and engineering of information systems. Applications of her research are establishing scientific understanding of information systems and the human brain, and developing engineering technologies for secure and dependable information systems.

**Selected Publications**


**Leadership Activities**

Mary Anderson-Rowland

Associate Professor
Ph.D., 1966, University of Iowa
Statistics and probability for quality control, academic scholarship programs for all engineering students with an emphasis on women and underrepresented minority students

Mary Anderson-Rowland is an associate professor in the Department of Industrial Engineering in the Ira A. Fulton School of Engineering at ASU. Anderson-Rowland received her B.A. in mathematics from Hope College in 1961, and her M.S. and Ph.D. in mathematics/statistics from the University of Iowa in 1963 and 1966, respectively.

Anderson-Rowland came to ASU in 1966 as a lecturer in mathematics and became the first woman faculty in engineering in 1974. She served as a statistical consultant to a variety of industry from 1973 until 1993, when she became the first woman appointed as an associate dean in the engineering school. She served as the associate dean of Student Affairs for 11 years. She is currently serving as the director of three academic scholarship programs and a fourth project for transfer students.

Anderson-Rowland was heavily involved in the creation of the Women in Engineering Program as well as the Minority Engineering Program. She serves as a mentor for women and underrepresented engineering students as well as supporting research that increases the recruitment, enrollment, and retention of engineering students with over 150 publications.

Anderson-Rowland has been the recipient of six national awards and recognitions: American Society for Engineering Education, Fellow, 2001; Distinguished Engineering Educator Award, Society of Women Engineers, 2002; National Engineering Award, 2003, the highest award given by the American Association of Engineering Societies; SHPE National Educator of the Year Star Award, 2005; Minorities in Engineering National Award, American Society of Engineering Education, 2006; and Society of Women Engineers, Fellow, 2006.

Selected Publications


Leadership Activities
2007 WEPAN Proceedings Chair; 2006-2008 PIC IV Chair, Board of Directors, American Society of Engineering Education; 2005 Women in Engineering Division Chair, American Society of Engineering Education; Women in Engineering Recruitment and Retention Expert, National Academy of Engineering.
Esma S. Gel

Associate Professor
Ph.D., 1999, Northwestern University
Applied probability, stochastic processes, queuing theory, stochastic modeling and control of manufacturing systems

Esma Gel researches and teaches courses in the area of operations research, specifically focusing on production systems control and supply chain management.

Her research focuses on the use of applied probability techniques for management and design of production systems and supply chains. Some of her recent work has been on workforce agility and management, dynamic price and lead time quotation to manage congestion in make-to-order systems, queueing approximations for performance evaluation of manufacturing systems, and economic impact of inventory record inaccuracies in retail environments. Gel has presented her work in national and international conferences, and published in leading archival journals of her area. Her research has been funded by the National Science Foundation (NSF), as well as industrial partners such as Intel, IBM, and Infineon. Her latest grant from NSF involves the development of a framework for the integration of price, lead time, order selection, and inventory decisions to match supply with demand.

Gel is a member of the Institute for Operations Research and the Management Sciences (INFORMS), the Institute of Industrial Engineers, American Society of Engineering Education (ASEE), and the Operations Research Society of Turkey.

Selected Publications


Leadership Activities

Associate Editor, *Journal of Flexible Services and Manufacturing*
Gerald Mackulak
Associate Professor
Ph.D., 1979, Purdue University
Simulation methodology, simulation output analysis, automated production systems, material handling design and analysis

Gerald Mackulak is currently participating in sponsored research from the SRC/International Semitech. His collaborative research project is investigating multi-product cycle time and throughput evaluation via simulation on demand, sponsored by Force II/SRC.

In previous years, he has participated in sponsored research from the Semiconductor Research Corporation, Anteon Corporation, Asyst, NSF, PRI Automation, the Federal Highway Commission, the McDonnell Douglas Corporation, the Hughes Missile Systems Company, the Institute for Manufacturing and Automation Research, the Allied-Signal Corporation, and Motorola.

Mackulak has written more than 75 journal and conference papers. He was recently a member of the editorial board of International Journal of Simulation and Probability Modeling; a past associate editor for Simulation: Transactions of the Society for Modeling and Simulation International; and in 2003 edited a special issue of the journal. He has received several Engineering Teaching Excellence Award nominations. He currently serves as the General Chair for the Winter Simulation Conference in 2011.

Selected Publications


Leadership Activities
Associate Editor, Transactions of the Society for Modeling and Simulation International; Editorial Board, International Journal of Simulation and Process Modeling; General Chair 2011, Winter Simulation Conference.
René Villalobos came to ASU in 1999 from the Mechanical and Industrial Engineering Department at the University of Texas at El Paso where he had been serving as an associate professor. Prior to academia, Villalobos served as an industrial engineer for Packard Electric and a project engineer for Renault Company. Sponsors of Villalobos’ research include the National Science Foundation, Texas Advanced Technology Program, the Arizona Department of Transportation, U.S. Army and private industry, totaling an excess of $3 million dollars. He was the recipient of the 1993 IIE Doctoral Dissertation Award and a 1995 NSF Career Grant.

He is a member of Alpha Pi Mu, the Institute for Operations Research and the Management Science, and the American Society for Engineering Education. He is also a member of the Technical Advisory Board for International Journal of Interactive Design and Manufacturing.

Selected Publications


Teresa Wu
Associate Professor
Ph.D., 2001, University of Iowa
Information systems, supply chain management, multi-agent systems, data mining, Petri nets, Kalman filtering
Intelligent Decision Systems Lab: swag.fulton.asu.edu

Teresa Wu came to the Ira A. Fulton School of Engineering in 2001. In 2003, she was the recipient of the National Science Foundation’s Faculty Early Development (CAREER) Award. Her research interests include collaborative product development, supply chain management, distributed decision support and information systems. Wu’s CAREER project is the “Design and Implementation of a Virtual Product Development Environment.”


Wu is a member of the Institute of Industrial Engineers (IIE), the Society of Manufacturing Engineering (SME) and the Institute for Operations Research and the Management Science (INFORMS).

Selected Publications


Leadership Activities

Ahmet Keha

Assistant Professor
Ph.D., 2003, Georgia Institute of Technology

Computational and theoretical aspects of integer programming and combinatorial optimization, modern heuristics techniques, logistics and scheduling
Logistics, Optimization and Control Laboratory (LOC Lab)

Ahmet B. Keha joined the Ira A. Fulton School of Engineering in 2003, after receiving his Ph.D. from the Georgia Institute of Technology. His research interests include computational and theoretical aspects of integer programming and combinatorial optimization, application of integer programming, and modern heuristic techniques and scheduling.

Keha has presented papers at the INFORMS National Meetings, International Symposium on Mathematical Programming and Industrial Engineering Research Conferences. Some of the journals that he has published are Operations Research, the European Journal of Operational Research, and Operations Research Letters.

Selected Publications


Jing Li
Assistant Professor
Ph.D., 2007, University of Michigan
Applied statistics, process control, data mining, causal modeling and inference
Quality and Reliability Engineering Laboratory (Q&RE lab)

Jing Li joined the Industrial Statistics research group in Fall 2007. Li’s research interests include applied statistics, data mining, causal modeling and inference for process control. Her recent research focuses on modeling and analyzing massive high-dimensional datasets in complex systems for improving the quality of products and processes. Her work has been applied to manufacturing and public health problems.

She recently received an IERC Best Paper award for “Causation-Based T2 Decomposition for Multivariate Process Monitoring and Diagnosis,” co-authored with Judy Jin and her advisor, Jan Shi, at the 2006 IIE Conference.

Li is a member of the Institute for Operations Research and the Management Sciences (INFORMS) and the Institute of Industrial Engineers (IIE).

Selected Publications


Rong Pan joined the Department of Industrial Engineering in the Ira A. Fulton School of Engineering in 2006. He received his B.S. in Materials Engineering from Shanghai Jiao Tong University, China, in 1995; his M.S. in Industrial Engineering from the College of Engineering of Florida A&M University and the Florida State University in 1999; and his Ph.D. in Industrial Engineering from the Pennsylvania State University in 2002. Before coming to ASU, Pan was an assistant professor of Industrial Engineering at the University of Texas at El Paso.

Pan’s research interests include statistical quality control, reliability engineering, time series analysis and control, and supply chain management. Journals he has published in include *Journal of Quality Technology, Journal of Applied Statistics, International Journal of Production Research,* and *Quality and Reliability Engineering International.* His current research project, funded by the National Science Foundation (NSF), is on modeling and analysis of profiled reliability testing using computation-intensive statistical methods. His previous projects were funded by U.S. Department of Education (DoEd), Texas Department of Transportation (TxDOT) and GM.

Pan is a senior member of American Society of Quality (ASQ), and a member of the Institute for Operations Research and the Management Sciences (INFORMS), Institute of Industrial Engineering (IIE), and Institute of Supply Management (ISM). He is currently serving as an associate editor of *Journal of Quality Technology.*

Selected Publications


Leadership Activities

Associate Editor, *Journal of Quality Technology*
Muhong Zhang

Assistant Professor
Ph.D., 2006, University of California, Berkeley

Integer programming, robust optimization, computational optimization, and network optimization

Muhong Zhang joined the Department of Industrial Engineering in 2007 after completing a lecturer appointment at the University of California, Berkeley. Her past and present research work has been on developing techniques for robust optimization, transportation, and distribution in logistics, mixed-integer programming, combinatorial optimization, and network flows. Her work has been studying the two-stage robust network flow and design problem with demand uncertainty.

In the first stage, integer capacity decisions and flows on a subset of the arcs are determined. The recourse flow is determined in the second stage, after the realization of the uncertain demands. The robust network flow and design problem has many potential applications in telecommunication, hub location, production, and distribution logistics. Her research on two-stage robust network flow/design problem is for the general problem; currently, she is working on applications of this work to problems with special network structures.

Selected Publications


Burak Büke earned his Ph.D. in operations research and industrial engineering from The University of Texas at Austin in December, 2007. He has an M.S.E. in operations research and industrial engineering and a B.S. in industrial engineering. His research interests include: queueing and fluid networks; makespan and holding cost problems in complex manufacturing environments; applications of stochastic programming; stochastic optimization algorithms; revenue management problems arising in airlines, hospitality and entertainment industries; and pattern recognition and statistical data analysis.

**Selected publications:**


Alla Kammerdiner earned her Ph.D. in industrial and systems engineering from the University of Florida in May, 2008. She has an M.S. in Mathematics, 2004, also from University of Florida, and a B.S. in Probability Theory and Mathematical Statistics, 1999, from National Taras Shevchenko University of Kyiv, Ukraine. Her research interests include data mining and its applications in biomedicine, global and combinatorial optimization, financial engineering, Bayesian networks, probability theory and mathematical statistics.

**Selected publications:**


2007 Publications

Referred Journal Articles


Conference Proceedings, Book Chapters


Books Authored


Conference Proceedings


Anderson-Rowland, M.R., Bernstein, B.L., & Russo, N.F., "The Doctoral Program in Engineering and Computer Science: Is It the Same for Women and Men?" Proceedings of the 2007 WEPAN Conference,


Montgomery, G., Invited Presentation: Data Mining Research, Wyeraheuser Research Meeting, August, 2007, Seattle, WA


Villalobos, J. R., “Productivity Improvement Opportunities in Industry,” Presentation to industry and students, Texas State University, San Marcos, TX, November 9 2007.

Villalobos, J. R., “The Stock Game,” Presentation to Industrial Engineering students, Texas State University, San Marcos, TX, November 9 2007.


IE FACULTY

Mary R. Anderson-Rowland, Ph.D.
Statistics and probability for quality control, academic scholarship programs for all engineering students with an emphasis on women and underrepresented minority students.

Ronald G. Askin, Ph.D.
Design and operation of discrete manufacturing systems, production systems, decision analysis, applied operations research, facilities planning, industrial statistics and applied optimization.

Linda Chattin, Ph.D.
Discrete optimization, stochastic processes and probabilistic modeling, emergency service location.

John W. Fowler, Ph.D.
Deterministic scheduling, discrete event simulation methodology, semiconductor manufacturing systems analysis, applied operations research.

Esma S. Gel, Ph.D.
Applied probability, stochastic processes, queuing theory, stochastic modeling and control of manufacturing systems.

Gary L. Hogg, Ph.D.
Applied optimization, simulation, manufacturing planning and control.

Ahmet B. Keha, Ph.D.
Computational and theoretical aspects of integer programming and combinatorial optimization, modern heuristics techniques, logistics and scheduling.

Jing Li, Ph.D.
Applied statistics, process control, data mining, causal modeling and inference.

Gerald T. Mackulak, Ph.D.
Simulation methodology, simulation output analysis, automated production systems, material handling design and analysis.

Douglas C. Montgomery, Ph.D.
Statistical design of experiments, optimization and response surface methodology, empirical stochastic modeling and industrial statistics.

Rong Pan, Ph.D.
Industrial statistics, reliability analysis and time series modeling.

George C. Runger, Ph.D.
Statistical learning, process control and data mining for massive, multivariate data sets with numerous-discipline applications.

Dan L. Shunk, Ph.D.
Agile, enterprise and CIM systems, group technology, planning systems, economics of computer-integrated manufacturing, strategy and strategic role of technology.

J. René Villalobos, Ph.D.
Manufacturing systems, automated visual inspection, real time quality control and intelligent manufacturing systems.

Teresa Wu, Ph.D.
Information systems, supply chain management, multi-agent systems, data mining, Petri nets and Kalman filtering.

Nong Ye, Ph.D.
Information and systems assurance, security and dependability of computer and network systems, data mining and modeling, systems engineering and management.

Muhong Zhang, Ph.D.
Integer programming, robust optimization, computational optimization, and network optimization.

EMERITUS FACULTY

James E. Bailey
David Bedworth
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Charles Elliott
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