

Industrial & Systems ENGINEERING

THE ALUMNI MAGAZINE FOR THE STEWART SCHOOL OF ISyE AT GEORGIA TECH

FALL 2009



ON THE MOVE

*Transportation Logistics at
the Stewart School of ISyE*

Georgia
Tech



College of
Engineering

H. Milton Stewart School of
Industrial & Systems Engineering

FROM THE CHAIR



The logistics industry, the industry that moves and warehouses freight, generates more than 8 percent of our nation's gross domestic product and, from a country perspective, is one of the world's most efficient systems for getting goods to the right place at the right time safely and inexpensively. Roughly two-thirds of the logistics cost are due to freight transportation. Additionally, safe, fast, and reliable logistics increase the efficiency of supply chains, particularly just-in-time supply chains. The logistics industry is the focus of the H. Milton Stewart School's Supply Chain & Logistics Institute, and many of the articles in this issue of *Industrial & Systems Engineering* describe some of the research and development contributions that the Stewart School is making to improve the productivity of this key industry.

Our feature article in this issue summarizes our faculty and student work in the transportation sector. Our alumni interview is with Chris Lofgren, president and CEO of Schneider National, Inc., who discusses current challenges and recent innovations in the trucking industry. In keeping with the theme, you will read a feature story on the work of a Senior Design team that redesigned

the infrastructure of UPS's Direct Ship service and the efforts of undergraduates from Professor John Bartholdi's class to track major package carriers against one another in a race across the globe. We also include several articles featuring the work of our faculty that describe the impact of their research in different areas of the transportation sector. These articles address the optimization of linehaul networks among less-than-truckload (LTL) carriers, the application of operations research to air transportation networks, and our work in optimizing transportation for containerized ocean cargo. In this issue, you will meet PhD candidate Ashlea Bennett, who has created an automated scheduling system for home health nurses, and read about alumna Ann Campbell, who has worked on designing a delivery network for UPS capable of satisfying customers' needs for expedited shipments.

In addition to hearing about our work in the transportation sector, you will learn about some of the Stewart School's emerging research directions and professional programs. We highlight several of our projects rooted in public service that range from humanitarian logistics to sustainability. We also update you on the Supply Chain & Logistics Institute's (SCL) online course offerings that lead toward a Supply Chain & Logistics Certificate and about the grand opening of SCL's new Trade, Innovation, & Productivity Center in Costa Rica. You will also be introduced to Theresa Foran, an alumna of the eighteen-month Executive Masters in International Logistics & Supply Chain Strategy (EMIL-SCS) program, as she describes her experiences abroad in Europe, Latin America, and Asia. Finally, don't miss an interview with alumnus Shane Kimbrough for a unique perspective on his mission to the International Space Station.

As you may have heard, the Stewart School was recently named the nation's top graduate program in industrial engineering for the nineteenth consecutive year by *U.S. News & World Report*. With the strong support of our alumni and friends, we will continue to provide innovation in the applications of industrial and systems engineering. Thank you again for your investment in our efforts to expand the frontiers of human knowledge by creating an educational base for the next generation of scholars. As an alumni or friend of the School, you provide a valuable connection to us. Please stay in touch.

Chelton C. White III

*H. Milton and Carolyn J. Stewart School Chair and
Schneider National Chair of Transportation and Logistics,
H. Milton Stewart School of Industrial and Systems Engineering*

Named to *The Princeton Review's* Green Honor Roll, Georgia Tech is committed to environmental sustainability programs. Visit www.gatech.edu/greenbuzz for news, education, and events that promote green practices on our campus.

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On the cover: Alan Erera, Chris Lofgren, Chelsea C. White III, and Martin Savelsbergh. Photo by Rob Felt.

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On the back cover: Graduate students from the Stewart School. Kneeling, from left to right: Adaora Okwo and Dylan Shepardson; Middle row, from left to right: Pengyi Shi, Cauvery Patel, Jessica Heier, Alejandro Toriello, and Juan Pablo Vielma; Back: Paul Jana

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The Stewart School Welcomes New Advisory Board Members

Joseph C. Mello (IE 1980), **Marie Rey** (MS IL 2002), **David Riviere** (IE 1987), **R. Jamie Spriggs** (IE 1990), and **Timothy L. Waldee** (ME 1989) recently joined the H. Milton Stewart School of Industrial and Systems Engineering Advisory Board for the 2009–2013 term.

Joseph C. Mello and R. Jamie Spriggs each bring more than a decade of experience in the healthcare industry to the board. The manufacturing background of Timothy L. Waldee as a general manager for GE Energy proves timely in today's market. Maria Rey is a 2002 graduate and adjunct faculty member of the EMIL program. David Riviere rounds out the new board members with more than twenty years of consulting experience.

"We are delighted to welcome our newest members to the ISyE Advisory Board. Their commitment and dedication to the Stewart School is extremely valuable to ISyE's continued success," said School Chair Chelsea C. White III.

The board is comprised of distinguished professionals and community leaders. Members serve as a sounding board for the school chair and assist with the School's development goals. Each member brings extensive industry knowledge and unique expertise to this role and will serve a five-year term.



Joseph C. Mello



Marie Rey



David Riviere



R. Jamie Spriggs



Timothy L. Waldee

"We are delighted to welcome our newest members to the ISyE Advisory Board. Their commitment and dedication to the Stewart School is extremely valuable to ISyE's continued success."

—Chelsea C. White III



Distinguished Lecture Brings Prominent Speakers to Campus

Since 2008, the Distinguished Lecture Series at the H. Milton Stewart School of Industrial and Systems Engineering has brought nationally prominent speakers to campus.

On September 23, 2010, the distinguished lecturer will be Bradley Efron, PhD, Max Stein Professor of Statistics and Biostatistics at Stanford University. Efron is a member of

the U.S. National Academy of Sciences and the recipient of the 2005 National Medal of Science. His lecture, entitled “Learning from the Experience of Others,” will explore what we can learn about player A’s batting ability from observing the batting averages of players B, C, and D. In his presentation, Efron will present several statistical examples that demonstrate how this works in practice and will indicate some of the surprising theoretical ideas involved.

The most recent Distinguished Lecture featured Lawrence Wein, PhD, Paul Holden Professor of Management Science at the Stanford Graduate School of Business. Wein delivered a lecture entitled “Operations Research and Homeland Security: From Models to Implementation” to a crowd of more than one hundred students, faculty, and alumni on March 5, 2009. He addressed topics related to his research in public health and homeland security, including the preparedness for a bioterror anthrax attack, infection control for a pandemic influenza, and the use of biometrics in preventing terrorists from entering the country. During the presentation, he also drew lessons about policy implementations from these and other

homeland security examples.

The inaugural Distinguished Lecture in 2008 honored William Pulleyblank, PhD, vice president of the Center for Business Optimization at IBM Business Consulting Services. Pulleyblank leveraged his technical background when he spoke on “Computing, Business, and Operations Research: The Next Challenges.” In his lecture, he identified and discussed five technical problems that must be solved to enable companies to meet business challenges of the future. In particular, he enumerated the requirements for operational systems to match the sophistication of long-term planning systems and instructed how to adapt these capabilities to the emerging networked business world.

The annual lecture series provides a forum for the students, faculty, and alumni of the Georgia Tech community to interact with distinguished lecturers who have made a significant contribution to society through research areas of interest to the Stewart School.

Videos of the 2008 and 2009 Distinguished Lectures are available online through the SMARTech repository. For more information, please visit www.isye.gatech.edu/news-events/dls.

U.S. News & World Report: ISyE Remains Number One

The H. Milton Stewart School of Industrial and Systems Engineering continued its unparalleled run of excellence in both the 2010 Best Colleges and the 2010 Best Graduate Schools rankings from *U.S. News & World Report*, again obtaining the number one ranking in the nation.

“We are pleased to report that the H. Milton Stewart School of Industrial and Systems Engineering is ranked first in industrial and manufacturing engineering in the annual *U.S. News & World Report* Best Colleges issue and *U.S. News & World Report* Best Graduate School guide,” said Chelsea C. White III, ISyE school chair. “Although we are aware of the issues surrounding such

rankings, we take pride in the fact that our hard work and dedication to excellence in education and research continues to be recognized by our peers.”

For the nineteenth consecutive year, the Stewart School maintained its position as the number one graduate program for industrial engineering in the 2010 America’s Best Graduate Schools issue of *U.S. News & World Report*. Also ranked among the top ten in their fields were Georgia Tech’s biomedical (#2), aerospace (#4), environmental (#5), civil (#6), electrical (#6), mechanical (#6), computer (#7), nuclear (#8), and materials science (#8) engineering programs.

U.S. News & World Report released its America’s Best Colleges rankings in August. This issue marks the fifteenth year that the Stewart School has ranked as the foremost program of its kind in the nation at the undergraduate level within the industrial/manufacturing engineering category. The report recognized Georgia Tech as the number seven public university

in the nation and as having the number five engineering program in the nation. Georgia Tech’s College of Engineering, the largest in the nation, had seven of its schools ranked among the top five in their respective disciplines. In addition to housing the nation’s top industrial engineering program, Georgia Tech was recognized for its aerospace (#2), biomedical (#3), civil (#3), mechanical (#4), electrical (#5), environmental (#5), computer (#6), materials science (#7), and chemical (#9) engineering programs. The College of Management also rose from #35 last year to #31 in the rankings this year.

Each year, the publication collects data from educational institutions and ranks the nation’s top programs in each discipline using indicators such as program size, external reputation, student selectivity, faculty honors, and research activity.

Stewart School Addresses Societal and Economic Challenges

Projects rooted in public service have always had a presence in the Stewart School, but over the past several years, the number of projects with societal impact has increased significantly.

“One of the goals of the Stewart School is to have an even greater impact on problems of significant real-world importance,” said School Chair Chelsea C. White III. “We are continuing to strengthen our work in healthcare and have, over the last couple of years, begun to apply greater focus on areas such as humanitarian logistics, energy, sustainability, finance, and security.”

Health: The Stewart School has offered a master’s in health systems and has conducted health-related research for more than thirty years. Today, the scope of health-related activities at ISyE has broadened to include four key areas: health systems, health logistics and supply chain management, biostatistics and bioinformatics, and public health. Research ranges from modeling infectious diseases and evaluating intervention strategies to predicting health interventions and treatment outcomes. ISyE’s health-related research centers include the Center for Operations Research in Medicine and HealthCare, under the direction of Professor Eva Lee, and the Center for Health Care Logistics, led by Professor Martin Savelsbergh.

Humanitarian Logistics: Professors Ozlem Ergun, Pinar Keskinocak, and Julie Swann lead ISyE’s humanitarian logistics research, education, and outreach efforts, focusing on disaster response and long-term development, including preparedness, effective response techniques, event recovery, and infectious disease prevention. Their projects include creation of positioning strategies for emergency supplies, development of an emergency water distribution plan for drought conditions, and a pandemic flu simulation model that optimizes the distribution of limited resources, such as food. Other projects have employed forecasting models and inventory management to reduce costs for circulating vaccines. Working with industry leaders such as The Home Depot and Waffle House, the team is also preparing case studies on disaster preparedness and response. The Stewart School hosted the 2009 Humanitarian Logistics Conference, which fosters collaboration among key figures in academic, nongovernmental, military, and private organizations.

Energy and Environment: Anderson Interface Associate Professor Valerie Thomas is leading efforts to evaluate environmental impacts of renewable fuels and electricity, as well as the costs of new electricity production. Thomas and her team are examining policies and technologies to reduce greenhouse gas emissions, to review potential trade-off among food and bioenergy production, and to maintain ecosystem services. They are examining market mechanisms for reducing greenhouse gas emissions and for allocating biomass and other renewable energy resources. They are also evaluating environmental footprints of product supply chains and developing reverse-logistics approaches for recycling electronics and other products.

Undergraduate Courses: At the undergraduate level, all ISyE seniors are required to take a capstone course called Senior Design. Under the guidance of an adviser, each student team is paired with a company or nonprofit organization to solve a real-world problem. Many of the past student teams have chosen humanitarian or health-focused projects, such as working with the Centers for Disease Control and Prevention to eradicate malaria in Sudan or with the World Food Programme to help extend the reach of their fight on world hunger.

This fall Professors Keskinocak and Thomas are teaching brand new undergraduate courses that introduce students to some important problems with societal impact. The courses are designed to engage students early on, creating awareness toward societal issues and encouraging students to transform that awareness into positive action. Undergraduate interest has surged. Sixty students pack Thomas’ “Energy and Environmental Analysis,” while Keskinocak has an enthusiastic class, with students eager to begin work on individual and group projects, ranging from recycling to animal rescue in India.

Graduate Courses: The School also offers a range of graduate courses focusing on societal problems. In most of these courses, students are required to complete a research/design project collaborating with a government or nonprofit organization. One example includes a class taught by Professors Ergun and Keskinocak entitled “Health and Public Applications of Operations Research/Management Science,” in which students examine infection control in health facilities, analyze and optimize patient flow in hospitals, optimize the supply chains of disaster relief items, evaluate debris collection strategies after disasters, model infectious diseases, and evaluate intervention strategies and costs.

Another course that focuses on societal problems is “Energy Technology and Policy,” offered by Professors Thomas and Marilyn Brown. Co-offered through the Stewart School and the School of Public Policy, this course provides a fundamental understanding of energy systems, including supply and demand, resources and technologies, and related economic, global climate change, and security issues. Students examine policies and technologies associated with different energy systems, including plug-in hybrid electric vehicles, ethanol and other transportation fuels, smart buildings and advanced lighting, industrial energy efficiency, solar and wind systems, and the next generation of nuclear energy.

The Stewart School combines a requirement for rigor with expertise and creativity in looking at new kinds of solutions for new kinds of problems. Whether conducting current relevant research or educating the next generation of leaders, the School is finding better solutions to existing social and economic problems.



An Introduction to **TRANSPORTATION** Research and Education at the Stewart School

By Alan Elera and Martin Savelsbergh

The modern global economy functions in part due to the availability of efficient and reliable transportation systems that enable the mobility of people and freight locally, regionally, and globally. Focusing on the United States, the scale of many of these transportation systems is staggering: in 2006, 1.7 trillion vehicle-miles were traveled by passenger cars on our nation's highways, 700 million passengers were transported by airlines, 1.8 trillion ton-miles of freight were moved by railroads, and 2.6 billion tons of freight passed through seaports.

Large-scale, complex transportation systems pose significant challenges in terms of design and control. Many of these challenges, however, are well suited to analytical techniques of operations research and industrial engineering that form the core expertise of the faculty in the Stewart School. Operations research has a long history of successful application to transportation planning problems of a tactical nature. Such problems (including network design, service scheduling, fleet sizing and positioning, and resource and crew scheduling) have traditionally been modeled as large-scale deterministic optimization problems. More recently, researchers have addressed planning problems with models that explicitly consider inherent uncertainty in such systems. In response to continual improvements in computing power and information technology, the focus today has expanded to include problems of operational control where models can support decisions in real time.

Faculty and student researchers within the Stewart School have been active participants in the application of operations research to problems of transportation system design and control, and they continue that tradition to date. The group of industry sponsors and collaborators who have worked recently with faculty and student research teams includes industry leaders such as UPS, Schneider National, Norfolk Southern, Delta Airlines, ExxonMobil, Yellow-Roadway, and the Georgia Ports Authority.

Research and industry-sponsored educational activities in the area of transportation systems take a variety of forms at the Stewart School. Researchers are supported by federal grants from the National Science Foundation (NSF), the Federal Highway Administration (FHWA), and the Department of Homeland Security, as well as funds from the State of Georgia through the Center of Innovation for Logistics and from the Alfred P. Sloan Foundation Industry Studies Program. Large industry-funded collaborations are typically managed by contracts through Georgia Tech's

Office of Sponsored Programs. Other industry collaborations are formalized as Leaders in Logistics projects through the Georgia Tech Supply Chain & Logistics Institute (SCL). Finally, transportation problems are frequently the focus of undergraduate Senior Design projects.

NSF funded a \$1.1 million, three-year project titled "Collaborative Logistics," supporting the work of ISyE faculty members John Bartholdi, Ozlem Ergun, Pinar Keskinocak, Anton Kleywegt, George Nemhauser, Martin Savelsbergh, and their PhD students. The study, which concluded in 2007, covered a wide-range of topics, including inventory pooling in supply chains, collaborative procurement of truckload transportation services, dynamic pricing with buyers' learning, and carrier alliances and resource sharing. Another recent NSF award, to study "Risk Mitigation for Strategic Ports," provided \$3.6 million in funding to support a large interdisciplinary research team led by Georgia Tech to investigate how to protect critical seaport infrastructure from major operational disruptions. Investigator Alan Erera is developing berth and quay crane scheduling optimization methods for this project to understand how to best recover operating capacity when some port components are damaged.

FHWA has supported ISyE research through a \$1.4 million, multi-year grant to fund the "Transportation Research Center for Freight, Trade, Security, and Economic Strength." Co-directed by School Chair Chelsea C. White III and Erera, the center supported a diverse set of transportation-related research activities. On one project, the co-directors, along with faculty member Hayriye Ayhan, developed technology to improve route-finding for commercial vehicles given highway congestion, and efforts are underway to deploy this technology for rail container drayage trucks in the Kansas City area as part of the Cross-Town Improvement Project. Another project, led by faculty members Christos Alexopoulos and Dave Goldsman, focuses on developing



Martin Savelsbergh, Schneider National Professor at the Stewart School of ISyE and director of industry research at the Supply Chain & Logistics Institute (SCL), and Alan Erera, associate professor at the Stewart School of ISyE and co-director of SCL's Center for Global Transportation.

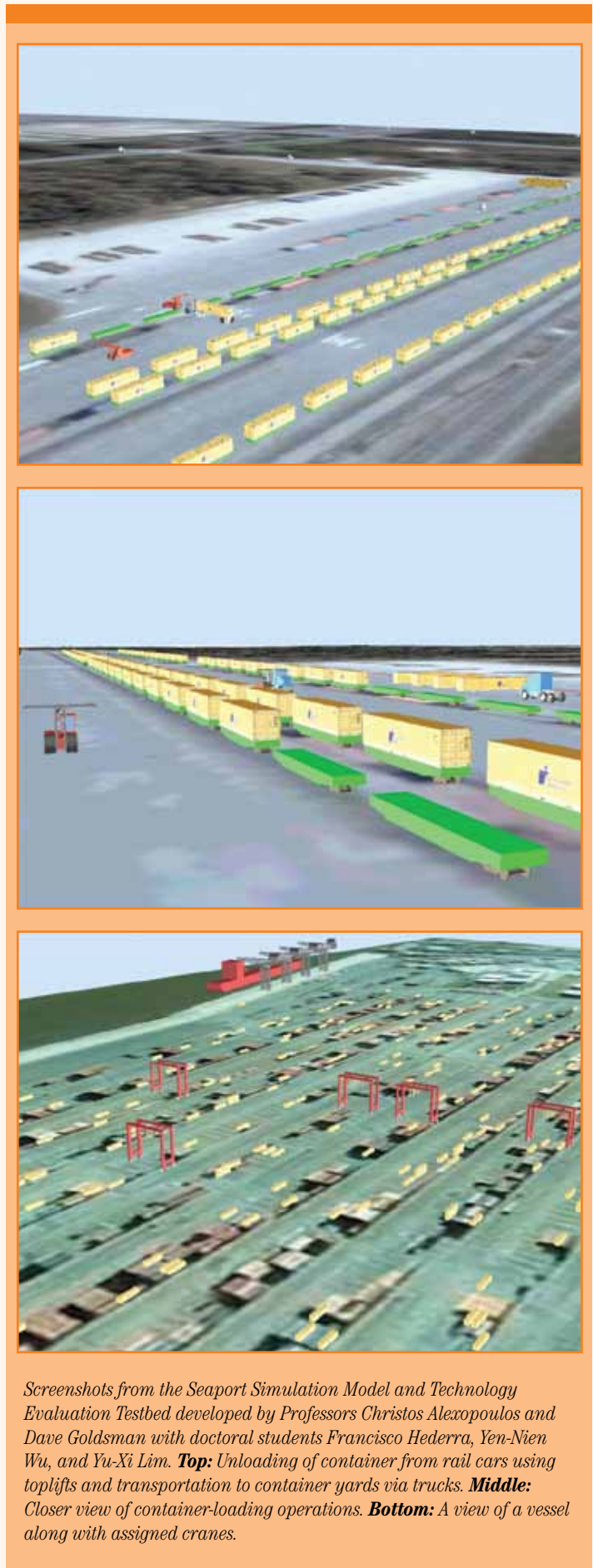
a detailed simulation of operations at the Georgia Ports Authority's Savannah container port facility. Matching support for this research was provided by the Georgia Center of Innovation for Logistics.

In addition to government funding, ISyE researchers are often supported directly by companies through research grants. Two large contract research programs focused on transportation problems have been led by George Nemhauser and Savelsbergh. The first, funded by DayJet Corporation through 2008, focused on the development of various scheduling algorithms to support the operations of an airline offering per-seat, on-demand air transportation using a large fleet of very light jets. Unlike traditional airline planning problems where resource schedules can be planned in advance, the on-demand business model requires scheduling engines that can be used in real-time to determine whether to accept or reject a customer flight request and that can optimize resource schedules overnight for the next day's operation. A second ongoing project, funded by ExxonMobil, focuses on maritime routing and inventory management. Optimization technology is being developed for cost-effectively routing a pool of vessels and timing the loading, transporting, and discharging of bulk products to and from multiple ports.

Many companies choose to establish a research relationship with ISyE faculty through SCL's Leaders in Logistics program. An article in this issue ("Optimizing the Linehaul Network of Less-than-Truckload Carriers," page 11) describes the results of work conducted by Erera and Savelsbergh and a team of graduate students for two large national less-than-truckload (LTL) carriers, YRC Worldwide and Saia. One of the longest industry partnerships under this program supported the work of Savelsbergh with the industrial gas producer Praxair. The various research projects conducted over the years all focused on effectively exploiting the distribution flexibility offered by Praxair's vendor managed inventory resupply agreements with its customers.

Every research project described above has involved one or more graduate students in our School, typically those pursuing a PhD. By working on applied research, these students benefit by developing a solid understanding of how operations research and industrial engineering methodologies are used in practice and when and how existing tools must be extended to tackle new problems or enhanced to provide better solutions to old problems. Undergraduate students in our Senior Design program also have a chance to interact directly with faculty on problems faced by the transportation industry. Over the years, many projects have been sponsored by companies seeking to improve transportation activities; recent examples include projects from UPS on truck scheduling and auction-based procurement ("Senior Design Team Optimizes Auctions for UPS Service," page 10), from RaceTrac on routing and scheduling for fuel resupply at service stations, and from The Home Depot on managing the daily operations of a private fleet of trucks.

Transportation research and education activity is clearly alive and well within the Stewart School.



*Screenshots from the Seaport Simulation Model and Technology Evaluation Testbed developed by Professors Christos Alexopoulos and Dave Goldsman with doctoral students Francisco Hederra, Yen-Nien Wu, and Yu-Xi Lim. **Top:** Unloading of container from rail cars using toplifts and transportation to container yards via trucks. **Middle:** Closer view of container-loading operations. **Bottom:** A view of a vessel along with assigned cranes.*



PERSPECTIVE:

Chris Lofgren on Challenges and Trends in Freight Transportation

ISyE: What is the biggest challenge that you face in transportation logistics today?

CL: Clearly, it is that the current state of the economy has created a set of challenges that is fairly unprecedented in terms of volume downturns and pricing pressures, which ultimately require you to take cost actions and to rethink a number of the basic tenets on how you have managed in downturns in a cyclical industry. These are things beyond what most people have experienced.

ISyE: How is the economy affecting the way you do business?

CL: We have a saying that the important thing is to keep the important thing the important thing. We have spent a significant amount of time examining ways to take cost out of the business without changing the ability to serve the customer safely and in a sustainable way. Right now, everybody understands that there is massive pricing pressure. With that, you also have to be selective about what things you can continue to do and the people for whom you can continue to do them. Essentially, you either have to do more with less or simply do less.

ISyE: Are there other challenges that you face now?

CL: Regulations were very favorable for the industry twenty years ago, but they are starting to challenge productivity. For example, regulations on the hours of service of drivers—regardless of whether they were right or wrong—have

fundamentally taken productivity out of the industry. The changes that are being made to the engines to meet new regulations on emissions have also driven significant cost back into the industry. In return, we benefited from lower emissions of both particulates and nitrous oxide. The benefits, though, came at a pretty significant cost and were inflationary to the industry at a time when it has been difficult to recover increasing costs in terms of price.

Another emerging issue is that of compaction. For example, when Procter & Gamble takes water out of its detergents and is able to put the same number of washes in a smaller package, the total number of shipments required goes down, which reduces volume in the industry. New lightweight flat-screen TVs are another example. Essentially, product reconfiguration due to technological advancement is taking volume out of the industry. This is not going to be a high-growth industry in the near future. Actually, volumes may shrink in terms of consumer non-durables and the retail supply chain.

One last thing is that there is a de-leveraging of the American consumer. We've undergone a radical change in terms of saving rates for the average U.S. household. What are the consumption patterns going to be in the future? They probably aren't going to be what we saw three years ago, so what does that mean for volumes of freight and the number of different packaging alternatives? I've said that freight transportation and logistics is the "power train" of our country's physical economy. That power train demands less horsepower right now, and our industry will be impacted as U.S. citizens reconfigure their demands.



Christopher "Chris" Lofgren (PhD IE 1986) is president and chief executive officer at

Schneider National, Inc., a premier provider of transportation and logistics services. He joined Schneider Logistics in 1994 as vice president of engineering and systems. He later served as chief information officer and chief operating officer before being named president and chief executive officer of Schneider National in 2002.

In October 2009, Lofgren was inducted into the National Academy of Engineering. He currently serves on the Board of Directors of CA, Inc., on the Advisory Boards of the Stewart School and the College of Engineering at Georgia Tech, on the Executive Committee and the Board of Directors of the American Trucking

Associations, Inc. (ATA), and on the Board of Directors of the American Transportation Research Institute, a research trust affiliated with the ATA. He previously served as a board member of the Green Bay (Wisconsin) Symphony Orchestra and the Green Bay Boys & Girls Club.

Before joining Schneider National, Lofgren held positions at Symantec Corporation, Motorola, and CAPS Logistics. He holds a bachelor's and a master's in industrial and management engineering from Montana State University and a doctorate in industrial and systems engineering from Georgia Tech.

ISyE: What has been the most important technological innovation in your industry recently?

CL: We had to develop new engine capabilities in response to the emissions requirements, and that's been a pretty significant change and will continue to be one. We had to reduce emissions dramatically, and this really required a significant change in the design of the engine and the supporting components. I think we're going to continue to face challenges here as we receive further requirements for emissions reduction, but the next hurdle hasn't been placed out there in front of us yet.

Technologically, I think it's more about winning little battles. The tire manufacturers continue to work to achieve both longer wear and better miles per gallon (mpg) performance out of the tires. The tractor manufacturers continue to look for ways to figure out how to take out weight while adding strength, stability, wear resistance, and improved aerodynamics to the design. I think we're at a place now where we're not looking at big breakthroughs. I do think there is a lot of work being done today to figure out how to create technologies that promote safety. There are a whole series of things under investigation, such as looking at blinking patterns of eyeballs of drivers within the cab to try to identify fatigue.

ISyE: Are there any other green or sustainable efforts besides the lowering of the emissions that are going on in your industry?

CL: I think both the industry and our company have done a phenomenal job in terms of that. I'm a little bit jaded on some of this green stuff; I think in some cases it has been somewhat faddish for people who have chosen to do it. I think good companies in many different industries have done it because, number one, it's the right thing, and number two, there are ways to do it such that it doesn't come as a negative impact to your financials.

For example, we've long had a policy of giving drivers bonuses for improving their mpg performance. So, don't accelerate too fast. Don't idle your tractor when you don't have to because idling is the least fuel-efficient and the highest pollution cycle in the engine. We've made

investments in a heat sync to allow the sleeper berth in the tractor to stay warm without requiring the use of the engine. Now, we're trying to figure out a technology to do that on the cooling cycle because you always want to ensure that a driver receives good rest.

In some cases, I don't think the industry has gotten the credit it deserves. After you add these technologies to the tractor, you face a higher cost for which you then have to pay a higher federal excise tax, and you lose some payload because it adds weight to the tractor. I've always been of the mindset that this ought to be an industry in which the government looks to incentivize and encourage, rather than to regulate and tax. A lot of things happen not because somebody made the industry do them but because the industry was committed to doing the right things. We as a company have been committed to doing the right thing, but how do you get credit for it? It's the "carrot and stick" dilemma in some regards. I think it would be more interesting if we spent more time thinking about how to create more carrots rather than grabbing another stick.

ISyE: You are, and have been, a strong supporter of the Stewart School. You have supported the School in a variety of capacities, including being the chair of the School's Advisory Board. What do you find most rewarding about your work with Georgia Tech?

CL: Well first off, Georgia Tech has been very good to me. Clearly, the wonderful opportunity to be there and to learn there has been very instrumental in the kinds of opportunities I ended up having in my career. I continue to grow more grateful for all that I've been able to have because of my experience at Tech. It is a special place. It is a place that combines the highest standards in academics and research, but it does so with a spirit that is incredibly human. I think the warmth of its people and the aspects of the heart and the mind are what make Tech unique. We may have some strong competitors in terms of training people with the mind, but the students and faculty members who have the opportunity to be a part of Georgia Tech also become enriched in the heart. And that enriching of the heart is just as important as the enriching of the head.

Standing left to right: Katie Buckler, Patrick Odneal, Jay Hennington, and Professor Joel Sokol. Seated left to right: Richard Ward, Carlanna Cunningham, and Kevin Kitchens



Senior Design Team Optimizes Auctions for UPS Service

Less than a decade ago, UPS Supply Chain Solutions began offering a ground shipping service called Direct Ship to serve large retail clients in the United States. Direct Ship clients who previously shipped small packages through UPS sortation hubs at both the origin and destination were now able to combine packages into full-truckload (FTL) shipments directly from a warehouse to a UPS hub near the packages' destination. At the hub, individual packages would be sorted and sent to their final destinations via UPS Ground. Skipping the UPS sortation hub at the package's origin zone led to quicker shipment times and lower costs, and Direct Ship was used by dozens of major retailers on hundreds of lanes.

Rather than use its own fleet for the FTL shipments from warehouses to hubs, UPS subcontracted each lane to an FTL carrier. Carriers would bid for the right to carry shipments on each lane, with UPS awarding lanes to the low bidders or, in some cases, to incumbent carriers with strong performance records. The resulting shipping network used a hodgepodge of almost fifty carriers, including national, local, and niche carriers of different sizes and varying reliability.

In practice, UPS found its Direct Ship network to be unwieldy. Managing and coordinating the myriad shippers was difficult, and the on-time service performance for some of the lanes was worse than UPS's 98 percent target.

In the spring of 2008, UPS decided to rebid its network and reassign lanes to carriers. To aid in the process, they turned to ISyE's Senior Design program. A team of six ISyE undergraduate students (Katie Buckler, Carlanna Cunningham, Jay Hennington, Kevin Kitchens, Patrick Odneal, and Richard Ward) worked with UPS to provide not just a new selection of carriers but also a new way of approaching the entire process of choosing a carrier for each lane. While still hoping to minimize the total network cost, UPS had several characteristics they wanted in a new carrier assignment:

- (1) Reduce the total number of carriers, preferably to eight to ten of the largest and most reliable.
- (2) Balance assignments of lanes to carriers with respect to mileage and revenue.
- (3) Attain 98 percent or higher on-time service for the largest twenty-five Direct Ship customers.

At the same time, the ISyE Senior Design team realized that UPS might pay more than necessary to its carriers by bidding out each lane separately. For example, a carrier bidding on lanes from Atlanta to Chicago and Chicago to Atlanta might run the risk of winning just one of the two and having to deadhead drivers on the return trip. To mitigate that risk, the carrier would need to place a higher bid on each lane. But if the carrier were allowed to place a bid for the pair of lanes together, the risk would be removed and the price UPS pays could be lower. Also, carriers would mix-and-match combinations of lanes that fit best within their networks, offering UPS lower prices in return for the benefit of getting the set of lanes they want. Called combinatorial (or combinational) bidding, these types of auctions have been used in many areas from transportation lane assignments to cell phone frequency sales, resulting in millions of dollars in benefits.

With this design in mind, the ISyE Senior Design team created a user-friendly tool for UPS to run its auctions. The Java-based tool reads auction and carrier data from UPS's Excel files and gives UPS the opportunity to add custom restrictions, define tolerances for mileage and revenue balance, and create differing total-carrier and service-level scenarios. Then, it creates and solves an optimization problem to find the lowest-cost carrier assignments that satisfy UPS's desired characteristics.

In addition to providing a single solution based on each of UPS's scenario inputs, the tool also does a what-if sensitivity analysis to point out which bids would be most valuable for negotiation and on which lanes it might be very valuable for UPS to accept a small niche carrier's bid.

Overall, based on the bids received by UPS in 2007, the ISyE Senior Design team's approach was able to save UPS about \$1.3 million per year in carrier costs, while reducing the number of carriers in the Direct Ship network from forty-six to eight, balancing mileage and revenue among the carriers, and increasing the service level above the desired 98 percent.

For questions or to become involved in the Senior Design program, contact Joel Sokol at joel.sokol@isye.gatech.edu or visit www.isye.gatech.edu/seniordesign.



Optimizing the Linehaul Network of Less-than-Truckload Carriers

By Alan Erera and Martin Savelsbergh

Less-than-truckload (LTL) carriers collect freight from various shippers and consolidate that freight to fill trailers for travel to common destinations. LTL carriers run high-volume operations, often spending millions of dollars in transportation and handling costs in a single week. An LTL motor carrier transports shipments that

typically occupy only 5 to 10 percent of trailer capacity. As a result, LTL carriers collect and consolidate freight from various shippers to increase trailer utilization, referred to as the load factor. Consolidation does come with a cost; by transferring freight between trailers, the carrier incurs a handling cost and increases the total time and distance a shipment requires to reach

its destination. Supporting these operations is a system of terminals, tractors, trailers, dockworkers, and drivers—collectively called the linehaul network. As competition increases and shippers raise their expectations for service, LTL carriers must optimize their linehaul networks to remain viable.

Researchers in the Georgia Tech Supply Chain & Logistics Institute (SCL) have been working together with two major U.S. less-than-truckload carriers, Saia and YRC Worldwide, for a number of years on developing a suite of decision support tools to optimize the linehaul network.

The suite of decision-support tools contains, among other modules:

- An optimization model that determines the appropriate role of a terminal in the network, i.e., should a terminal be used as an entry and exit point for freight into the system “end-of-line terminal” or should it be used as a major consolidation point where freight from various end-of-lines is cross-docked “breakbulk (hub) terminal”
- An optimization model that determines optimal freight paths for all origin-destination combinations, i.e., a set of freight paths respecting service commitments leading to the highest utilization of trailer capacity
- An optimization model that determines the minimum number of tractors required to ensure that all freight moves through the linehaul system on time
- An optimization model that schedules the drivers to move freight through the network, respecting hours-of-service regulations and company policies
- An optimization model that determines driver domiciles, i.e., terminals where drivers should be located to most cost-effectively move freight through the network

One of the most critical decisions in operating a linehaul network is how to route freight from origin to destination as it directly impacts consolidation opportunities. Shipments are quoted a service standard from origin to destination in business days. Historically these standards were long enough (often five business days) that service only loosely constrained how a carrier chose to route a shipment from origin to destination. In today’s environment, service standards of one, two, and three days are common, and service must play a significant

role in a shipment’s path. At the same time, shorter service standards reduce consolidation opportunities due to the handling time and circuitry that consolidation requires. As a result, carriers need optimization techniques for designing load plans that accurately model how short service standards constrain freight routing and the consolidation opportunities that exist. An integer programming heuristic has been developed that constructs high-quality, service-feasible load plans.

To be able to compete on price, carriers have to find ways to increase the utilization of their current infrastructure. One possible way to do so is to relax some of the self-imposed rules that constrain how freight flows through the system. For example, a traditional load plan assumes the same freight routing decisions are made every day. However, a load plan that accounts for predictable daily freight variations by allowing for different freight routing decisions on different days may substantially increase utilization. In general, as information technology infrastructure improves, a carrier can consider different rules of operation. Yet without load plan design technology that is adaptable to changing operational constraints, it is difficult for a carrier to quantify how changing or relaxing these operational constraints will affect business. An analysis reveals that savings of up to 4 percent can be achieved by allowing day-differentiated load plans.

One of the most complex decision problems faced by an LTL carrier is scheduling its drivers. This is due to the various rules governing the feasibility of driver duties. Hours-of-service regulations imposed by the Department of Transportation to ensure the safety of drivers and others on the roads, for example, specify that drivers cannot drive more than eleven hours and cannot work more than fourteen hours before a mandatory rest of at least ten hours is required. LTL driver scheduling is further complicated by the fact that trucking moves are not pre-scheduled. The decision technology developed for LTL carriers combines greedy search with enumeration of

time-feasible driver duties and is capable of generating in a matter of minutes cost-effective driver schedules covering 15,000 to 20,000 loads satisfying a variety of real-life driver constraints. A comparison with real-world dispatch data indicates that the technology produces driver schedules of very high quality.

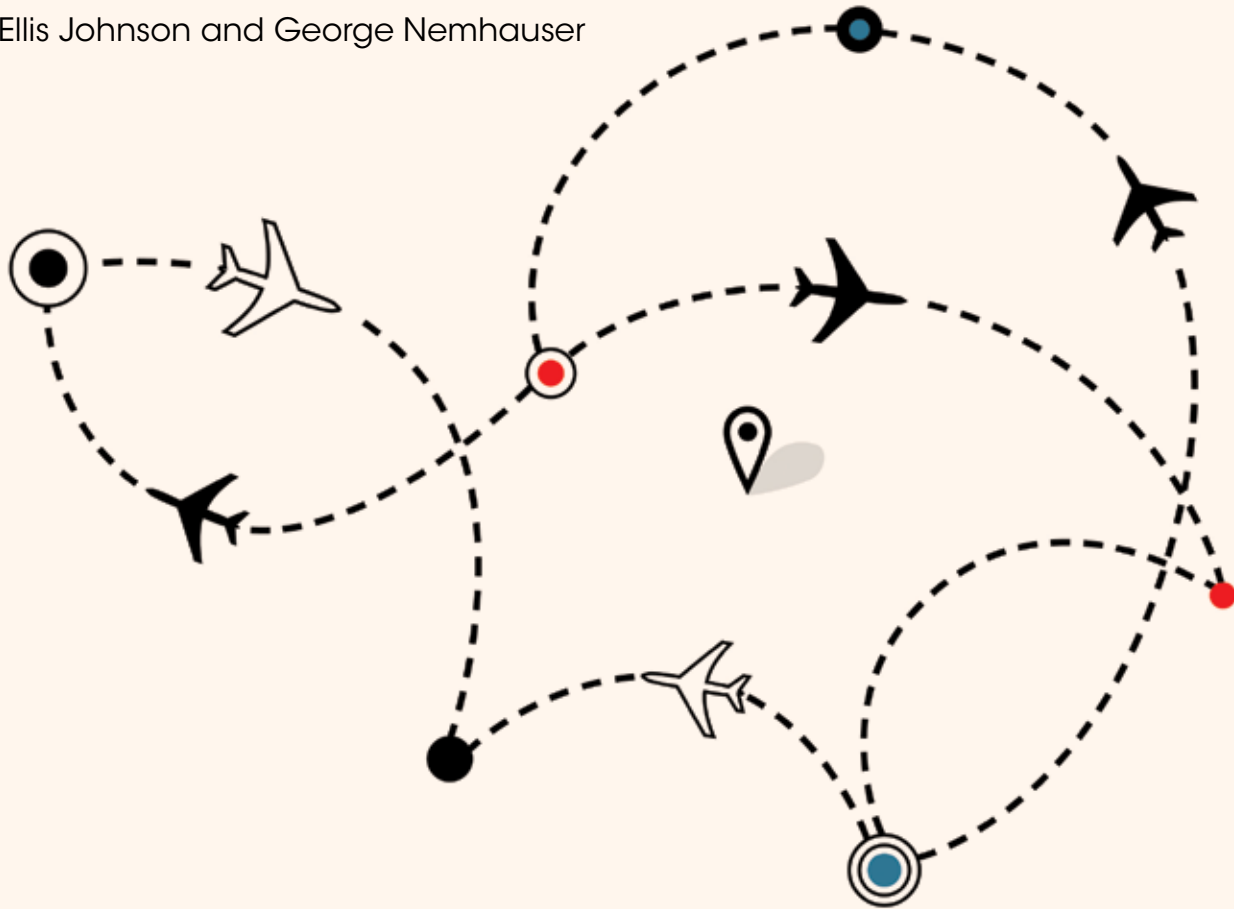
The driver scheduling technology is embedded in an iterative scheme to determine the best possible home locations, or domiciles, of truck drivers for an LTL carrier. Domiciling decisions are complex, in part due to regulations and union rules restricting driver schedules, but have a significant impact on the operating costs of LTL carriers. In each iteration of our scheme, drivers are allocated to terminals and drivers’ bids are determined so as to satisfy union requirements. An analysis of the resulting driver schedules is used to guide the next iteration. Computational experiments demonstrate the value of the iterative scheme and also quantify the impact of union rules on the number of drivers required (and thus on operating costs).

The LTL industry is essential for our economy, and the research conducted at SCL aims to increase the industry’s efficiency and effectiveness. The research of Professors Alan Erera and Martin Savelsbergh has involved a number of PhD students, several of whom have written their PhD theses focusing on optimization problems in linehaul networks.

Funding for this LTL research was provided by Saia and YRC Worldwide through the Leaders in Logistics program, which is part of the Georgia Tech Supply Chain & Logistics Institute, and by the Alfred P. Sloan Foundation’s Trucking Industry Program.

Airline Optimization in ISyE

By Ellis Johnson and George Nemhauser



We first entered the field of airline optimization about twenty years ago with a project on fleet assignment for Delta Airlines. There is an amusing story about how this work for Delta began. At the time, Delta was using a new crew scheduling system that was based on the polynomial time linear programming algorithm developed by Narendra Karmarkar at AT&T Bell Labs and implemented in the KORBX optimization system, an eight processor Alliant computer. The system reputedly cost \$8.9 million and, not surprisingly, only two such systems were ever sold. Delta bought one of them to solve crew scheduling. The important point to note is that crew scheduling is an integer programming problem, which is hard to solve, and KORBX could only solve linear problems, which are much easier relatively. So, the AT&T folks could only provide a heuristic for converting linear solutions to integer solutions.

We had some new ideas for solving crew scheduling problems; however, our attempts to contact Delta fell on deaf ears until Mike Thomas, then school chair, had a brilliant idea. Ron Allen, an ISyE graduate, class of 1964, had recently been appointed CEO of Delta. Thomas arranged a dinner at which Allen would be honored, and we would get a chance to suggest to him that we could help Delta with scheduling. The evening went well except for the end. Atlanta had just started car emission checks, and because of the low fee paid

to the stations that could perform them, there were very long lines. A black market emerged for the emission stickers that were attached to license plates.

When we left the Alumni House at the end of the dinner, we discovered that each of the cars that previously held these stickers were missing the part of their license plate where the sticker had been. Allen's car was one of them. Nevertheless, from Allen we got an inroad to Delta's IT group. Because of their work with KORBX, they were not interested at the time in help with crew scheduling. But they decided to work with us on plane scheduling, which is called fleet assignment in the industry.

Given a schedule that lists the time, origin, and destination of all flights, fleet assignment addresses the question of what type of aircraft should be assigned to each flight. The answer is driven by demand and the network structure of all of the flights. Large planes should be assigned to high-demand legs. However, if a large plane is assigned to a flight from A to B, then there should be a flight from B that departs soon after the A-to-B flight that also has large demand and so on. The optimization model minimizes flying costs and the costs of lost demand. Cindy Barnhart, then an assistant professor in our group, now a professor and associate dean at MIT and a leading international expert in airline research, got her start on the Delta project. We successfully completed this project and then went on to do research sponsored by almost all of



the major domestic carriers, including American, Northwest, United, and US Air, as well as the National Science Foundation.

By the mid-1990s, we began to tackle harder problems including systems optimization and uncertainty. Traditionally, fleet assignment was done before crew scheduling since crews are scheduled by aircraft type. However, an optimal solution for fleet assignment could lead to very costly crew schedules. For example, a crew might spend more than twenty-four hours simply waiting for the next airplane they could fly. We developed technology for optimizing fleet and crew assignments together.

Schedules were developed assuming no disruptions. But weather, equipment problems, and many other causes led to delays that propagated throughout the system. We developed some of the first technology for fast reoptimization or recovery of crew and fleet schedules when the current schedule was broken. We provided technology for producing robust schedules that make it easier to recover from these disruptions. To evaluate the quality of schedules in an uncertain environment, we developed SIMAIR, which allowed operations to be simulated for millions of days to evaluate the performance of different schedules.

Most of this work was done in collaboration with Sabre Decision Technologies, led by Barry Smith, and United Airlines, where Eric Gellman headed the operations research group. This work led to many publications, about ten dissertations, and some national awards to the students. Some of these students are now in operations research groups in the airline industry, and several others are faculty at other universities and continue to do good work on airline optimization.

Recently, our focus has shifted to on-demand air transportation, which involves unscheduled airlines where service is requested simply by origin—destination pairs and time windows. There are many ways of delivering this type of service including charter, fractional ownership, and air taxi. Professors Ellis Johnson and Ozlem Ergun have an ongoing project with Citation Shares to fulfill requests from individuals or companies that have fractional ownership rights to a fleet of planes. A business model that potentially can be widely used in place of standard airline transportation is an air taxi service. Anyone can request a seat on a plane

by providing the earliest departure time from origin, latest arrival time at destination, and number of passengers. The planes can fly to and from very small airports. The cost can be made nearly competitive with commercial service. The convenience of such a service can be very appealing to business people, especially those who do not live close to a major airport. In many situations, it is an attractive alternative to car trips of several hours. Professors George Nemhauser and Martin Savelsbergh worked with DayJet, which at the time was the leading company providing this service using lightweight Eclipse jets. Unfortunately, the recent economic downturn has caused DayJet to terminate operations.

Air transportation networks have always been a fertile field for optimization applications and will continue to be so as we begin to work on new problems involving online optimization and optimization under uncertainty.



ABOUT THE AUTHORS:

George Nemhauser (right) is the A. Russell Chandler III Chair, and Ellis Johnson (left) is the Coca-Cola Chair, both at the Stewart School of ISyE. Together, they founded the Computational Optimization Center in the 1980s and have worked on several applications of large-scale mixed-integer programming in the airline industry.



Moving the World with Ocean Cargo

By Alan Erera and Ozlem Ergun

Beginning in the latter stages of the twentieth century, the forces of globalization that reshaped industrial supply chains were influenced by two primary factors: the very large differential in labor costs between developed and developing countries and the availability of high volume, inexpensive international freight transportation.

When it comes to moving finished goods and intermediate products between continents to consumers and businesses, the dominant mode of transportation is containerized ocean cargo. In fact, since the early 1990s, the use of container shipments worldwide has grown more than three times the rate of the global GDP. Despite the recent economic downturn that has significantly cooled international trade, it is likely that ocean container cargo will continue to be important for years to come.

Researchers within the Stewart School have been active in ocean cargo research throughout the past decade. In this article, we highlight two recent research efforts supported by both the National Science Foundation and the Singapore Economic Development Board.

Professor Ozlem Ergun and Richa Agarwal (PhD IE 2007) recently completed a set of work culminating in Agarwal's thesis, "Network Design and Alliance Formation for Liner Shipping." Today's large ocean carriers, like Maersk, Hapag Lloyd, and NOL, face challenging problems in service network design, the task of determining which routes or services to operate and at what frequencies and how to assign ships to these services. An important

new challenge is that most transoceanic routes today are operated jointly by a number of different carriers working together within an alliance. Thus, the research also focuses on how to jointly plan the operations of multiple collaborative carriers, including how to allocate the capacity of different services among carriers.

To solve these problems, Agarwal and Ergun developed a new integrated optimization model to solve the ship scheduling problem and the cargo routing problem simultaneously—the first such model to incorporate transshipment ports (where cargo is transferred from one service to another). Since the model is too large to be solved directly with commercial optimization solvers, the team developed various customized heuristic and exact solution approaches and demonstrated their applicability on realistically-sized problems.

In the second part of the study, Agarwal and Ergun focused specifically on alliance formation among liner carriers, using techniques from optimization and algorithmic game theory to propose an approach to design a collaborative service network. To manage interactions among participating carriers, their approach determines appropriate prices for capacity exchange between carriers to induce participants to follow an optimal collaborative strategy.

Professor Alan Erera and Aykagan Ak (PhD IE 2008) have recently studied another important aspect of ocean container operations: scheduling problems at seaports. Ak's thesis, "Berth and Quay Crane Scheduling: Problems, Models, and Solution

Methods," is an integrated study that investigates how to optimally plan ship loading and unloading operations at container seaports. Managing berthing space and the large dockside quay cranes that are used to service vessels is a critical operational challenge; efficiency gains here allow ports to maximize container throughput while meeting the service requirements of carriers.

Berth allocation is the problem of determining where to moor a sequence of arriving vessels over time, while quay crane allocation and scheduling problems focus on which quay cranes to assign to berthed vessels. At large modern seaports, it is possible to simultaneously berth multiple vessels of varying lengths along long linear berthing areas with a shared set of cranes, which can be moved from one vessel to another (without passing each other) at any time, thus leading to very complex scheduling problems.

Ak's work was among the first to consider joint planning of berth allocation and quay crane scheduling, and he developed very fast solution heuristics based on tabu search to quickly find near-optimal solutions to these problems. His methods are currently being used as part of a large research effort focused on risk mitigation at U.S. seaports to simulate how port operators might re-optimize operations if cranes or berth sections are damaged.

Alan Erera is associate professor and co-director of SCL's Center for Global Transportation; Ozlem Ergun is associate professor and co-director of SCL's Center for Humanitarian Logistics.

The Great Races: Students Track Package and Container Routes for Speed and Efficiency

How hard is it to get a package to say, Khartoum, Sudan, or to Split, Croatia, or to transport a shipping container filled with medical supplies to a hospital in Ghana? Undergraduate students from Professor John Bartholdi's class know, as they discovered in two fascinating and fun class projects: The Great Package Race and the new Great Container Race.

The Great Package Race

Running in this race are four of the major package carriers —DHL, FedEx, UPS, and USPS. Since 2003, Bartholdi and his students have tracked packages going to designated locations to analyze the routes and determine which carrier can get a package to the final destination first and in the best condition. Because each carrier has its own freight network through which a package travels, the experience of each package depends on the structure of the network.

This is not an easy race; destinations are intentionally chosen to challenge package carriers. All packages leave from the same location on Georgia Tech's campus, but are shipped to various thematic locations. One year they may ship to off-the-beaten-path exotic locales, another year to great centers of commerce around the globe, and yet in another year, students may ship packages to their mothers who reside around the world.

"It is remarkable that most packages eventually reach their destinations, even under difficult circumstances, but there have been some dramatic lapses," Bartholdi noted. "One package was carried back and forth across the Atlantic Ocean nine times before delivery. Another was sent to Costa Rica instead of Croatia. One carrier claimed that the destination country did not exist. It does."

There have been dramatic finishes as well. In 2006, one carrier beat another to Croatia by a mere three minutes. A race to Singapore ended in a tie when delivery personnel from two of the carriers arrived at the door simultaneously, even though the packages had taken completely different routes to get there.



Students stuff packages in preparation for the Great Package Race.

The Great Container Race

Last year, Bartholdi broadened the scope of his Great Package Race to create the Great Container Race. This time, running in the race were two international shipping containers filled with medical supplies. For the first Great Container Race, the class tracked and then analyzed the routes of the two containers as they traveled by alternate routes and carriers to the University of Cape Coast Hospital in the West African nation of Ghana. In an international shipment, a container might travel by any combination of transportation modes. This requires carefully choreographed handoffs, from truck to port and then from port to ship, for example. Each handoff brings a chance of delay. Speed also depends on schedules of shipping companies, throughput capacities at ports, and precision of scheduling pickups and drop-offs.

For this first race, one container traveled by rail to Savannah, took a French ocean liner to Le Havre, transshipped to Tema, and then continued by truck 100 miles to Cape Coast. The other traveled by truck to Savannah, took a Danish liner to Algeciras, Spain, transshipped to Tema, and then traveled by truck to the final destination of Cape Coast, Ghana.

Or at least that was the plan. What actually happened was that the container was stuck in Algeciras for a month due to congestion at the port. Meanwhile, the other container was also stuck, but in customs at Tema. Eventually congestion dissipated, customs worked its way through the complex bill of lading, and both shipments were delivered safely. But then, this is what global freight transport is all about: Dealing with the unexpected.



Students gather at MedShare to document the first sealed container filled with medical supplies as it departs for the railhead on time.



Effective utilization of nurses is crucial in meeting the demand for home care, which is expected to double by 2030 according the National Health Policy Forum of The George Washington University.



FOCUS ON: Ashlea Bennett Vehicle Routing and Scheduling Models for Home Healthcare Nurses

Ashlea Bennett, PhD candidate in the Stewart School, was awarded a prestigious National Science Foundation Graduate Research Fellowship in 2003 that provided support for academic research of her choice within her doctoral studies program. Bennett, along with her faculty advisor Alan Erera, had an interest in synthesizing concepts from logistics with applications in healthcare. Drawing from Erera's existing work in freight transportation and Bennett's desire to make systems and processes more efficient within healthcare, they decided to pursue the topic of routing and scheduling models for home health nurses.

According to Bennett, the home health nurse routing and scheduling problem is complex. For each patient, it must be determined which nurse will visit the patient, what days the patient will be visited on consecutive weeks throughout his or her prescribed episode of care, and what times the visits on those days will occur. The result culminating from each of these patient-scheduling decisions is a set of nurse routes, where each nurse leaves home at the beginning of the day driving his or her own vehicle. The nurse then visits a pre-determined sequence of patients at precise visit times, and returns home at the end of the day, without working more than the maximum allowable hours. Further complicating the problem is that many patient requests for home health services must be scheduled on the same day the patient is discharged from the hospital.

Bennett is designing automated scheduling mechanisms that focus on improving nurse utilization and customer service when creating nurse schedules. "Nurse utilization can be improved by leveraging advanced routing heuristics

that use predictive information regarding expected future patients when creating nurse schedules," said Bennett. "By decreasing the time that nurses spend traveling and waiting between patient visits, the nurse has more time available to visit patients. Customer service is improved by providing patient visit schedules that are repeatable from week to week."

To ensure that theoretical components of their research were grounded in providing solutions to problems encountered in the real world by actual home health agencies, Bennett and Erera partnered with Visiting Nurse/Hospice Atlanta (VNIHA), the largest nonprofit provider of home care in the metropolitan Atlanta area. Mark Oshonock, President and CEO of VNIHA, states that "if nurse utilization could be improved by 10 percent, or one half-visit per day, we could visit an additional 1,200 patients per year without increasing the size of our workforce."

Because of the positive response from this project, VNIHA has agreed to fund Bennett's education after her fellowship tenure expires.

Bennett earned her bachelor's in industrial engineering from the University of Arkansas in 2003. She became interested in logistics during an undergraduate internship with the Engineering Services department at the corporate headquarters of J.B. Hunt Transport, LLC, in Lowell, Arkansas. After receiving her master's in industrial and systems engineering from Virginia Tech in 2005, she came to Georgia Tech to pursue a doctoral degree. Bennett will graduate in December 2009 and has accepted a faculty position with the University of Arkansas starting in January 2010.



FOCUS ON: Ann Melissa Campbell

Examining new network design problems

Ann Melissa Campbell (PhD OR 2000) is an associate professor in the Tippie College of Business at the University of Iowa. Her research interests include routing and related distribution problems, including new network design problems based on challenges faced by UPS and new delivery pricing problems inspired by e-grocers. She also studies stochastic routing problems and efficient ways to solve them.

One of the problems she examined for UPS involves how to design a delivery network to move ground shipments from their origins to their destinations in a cost-efficient manner that satisfies promised delivery time commitments. This is a problem that has become increasingly challenging for companies such as UPS, as more customers are opting for the shorter delivery times that many ground freight companies now offer. At the same time, completely redesigning a company’s delivery network based on these new delivery times is a very expensive proposition.

Campbell and co-authors Barrett Thomas (also at the University of Iowa) and Hui Chen (a former PhD student at Iowa and now a senior analyst at Northwest Airlines) have focused on a version of the problem where none of the hubs move, since the hubs would be the most expensive part of the network to change. Each “connection” represents a truck and a driver carrying ground freight from one hub to another. From each hub, there may be connections going to a single hub or to many other hubs. The number of connections has a significant impact on cost, as a truck and a driver represent a substantial investment, and on the ability to satisfy all promised delivery time commitments. Thus,

Campbell, Thomas, and Chen specifically examine how to find the best possible set of connections that satisfy delivery time commitments given a limit on the total number of connections that may be used.

For many potential scenarios, there is not a feasible network that satisfies all delivery time commitments, so they measure the amount of violation of these commitments and seek to minimize either the maximum violation or the total sum of violations. For the maximum violation version of the problem, they have developed algorithms that solve several versions of the problem exactly. For the total sum version, exact solutions are not possible, but the authors have created some clever heuristics that capitalize on the solution structure.

In their computational experiments based on different ground networks in the United States, they found the solutions to problems with lower budgets always took on the appearance of connecting each hub to a “superhighway” going across the country. As budgets increase, the superhighway remains but with additional connections added. This solution structure reveals the importance of having high-flow lanes and prioritizing movement of freight on these lanes to promote service quality and customer satisfaction.

Campbell received a prestigious NSF CAREER grant in 2003 and was awarded a Hesse Fellowship at the University of Iowa in 2004. She was named an associate editor of *Transportation Science* in 2007 and has authored twenty journal articles and four book chapters.

For an online course demo, visit www.scl.gatech.edu/online.



Earn Your Supply Chain & Logistics Certificate Online

The Georgia Tech Supply Chain & Logistics Institute (SCL) offers online versions of its entire Supply Chain Management Series, allowing busy executives to study course material at their own pace and schedule, while avoiding the travel costs generally associated with training.

Designed for logistics professionals from across the entire supply chain, the series includes four courses:

- **World-Class Inventory Planning and Management**

Inventory availability is the most important aspect of customer service, and inventory carrying costs are typically the most expensive and riskiest aspect of logistics and supply chain management. In this course, participants learn how to manage inventories more effectively in order to increase fill rates and inventory turns.

- **World-Class Logistics and Supply Chain Strategy**

World-class logistics systems improve customer service, reduce operating expenses, and minimize capital investments. In this course, participants will learn how to develop a comprehensive supply chain strategy to improve business performance.

- **World-Class Transportation and Distribution**

Driven by more frequent and increasingly time-definite shipments, complex security and regulatory requirements, increased fuel and labor costs, and severe shortages in labor and capacity, transportation management has become a critical corporate function. In this course, participants learn how to interpret shipment activity, optimize routes, and manage total transportation for better service and reduced logistics costs.

- **World-Class Warehousing and Material Handling**

Warehousing minimizes the effects of supply chain inefficiencies, improves logistics accuracy and inventory management, and allows product accumulation, consolidation, and customization. This course focuses on ways to design warehouses to maximize supply chain efficiency and benchmark warehouse performance.

These courses can be taken individually or as part of a certificate program. Participants who complete all four courses will qualify for the Supply Chain & Logistics Certificate. By the end of the series, attendees will have received a broad but intense education covering:

- customer service and order processing
- inventory planning and management
- supply chain integration and transportation
- warehousing
- distribution
- logistics performance measures
- benchmarking procedures
- logistics information systems architecture and implementation
- third-party logistics strategies
- logistics organization design

“This online learning experience was a great way to expand into every aspect of logistics, and I was able to complete it at my own pace,” said Mark Lamarre, manufacturing manager at Raytheon. “It was straight forward and informative, not trying to be harder than it really is with tricky questions on the exams, like other programs I have done.”

The series is taught by Edward Frazelle, PhD, who is known by his students for putting “logic back into logistics.”

Each course is divided into nine to twelve sections with an online quiz at the end of each section.

“The online format is perfect for the busy professional as it affords them the flexibility to progress through the course material at their own pace,” said Frazelle, author of the book *Supply Chain Strategy*. “Our online participants have the option of starting and stopping a course as often as they like as long as they complete the course within a twelve-month period.”

Online course materials are presented using streaming video presentations synchronized with PowerPoint slides, extensive course notes, and photo galleries that highlight the operation of important logistics systems. The series is offered through a WebCT interface in a point-and-click format. It can be accessed from anywhere, by anyone capable of using a Web browser such as Internet Explorer.



Top left: Georgia Tech President G.P. “Bud” Peterson reflecting on Georgia Tech as a global university

Top right: President of the Republic of Costa Rica Dr. Oscar Arias-Sanchez; Sridhar Narasimhan, senior associate dean and professor of information technology management at Georgia Tech’s College of Management; and Harvey Donaldson, associate school chair for industry and international programs for the Stewart School and managing director of SCL

Bottom left: Donald Ratliff, executive director of SCL and the TIP Center, with Marco Ruiz, minister of trade, Republic of Costa Rica

Bottom right: Sebastian Urbina (left), managing director of the TIP Center, moderating a panel discussion on IT productivity

Georgia Tech Trade, Innovation & Productivity (TIP) Center Opens in Costa Rica

The Costa Rican trade industry will be able to increase trade across borders and make existing trade more productive thanks to a new Trade, Innovation & Productivity (TIP) Center that opened in the capital city of San Jose on August 20, 2009. The new TIP Center in Costa Rica is the latest addition to a network of centers established by Georgia Tech around the world that utilize research, innovation, and education. The Center, a member of the Productivity for Progress Institute, is a joint development of the Supply Chain & Logistics Institute, the Stewart School of ISyE, and the College of Management at Georgia Tech in partnership with the Foreign Trade Corporation (PROCOMER) and the Chamber of Industries in Costa Rica.

“We are delighted to have a presence in Costa Rica that gives our faculty and students an opportunity to participate in this exciting activity,” said Georgia Tech President G.P. “Bud” Peterson. “One of Georgia Tech’s strengths is working with business and industry around the world to apply scientific principles and to provide needed education to help meet business challenges. Through the Trade, Innovation & Productivity Center, we will utilize our strengths in

technology research to develop innovative solutions and enhance logistical productivity, keeping business moving.”

Dr. Steve Salbu, Dean of the College of Management, hosted the inauguration ceremony, which featured special guest speakers Marco Vinicio Ruiz, Minister of Foreign Trade of Costa Rica, Tech President Peterson, and Dr. Oscar Arias-Sanchez, president of Costa Rica.

“Today is a memorable day for the Costa Rican people,” said Arias-Sanchez. “The first link of a chain that will bring prosperity and knowledge to hundreds of companies in our country is forged today . . . Today, as a nation, we change the course of our history by changing the course of our trade-chains. The TIP Center will not be just a marginal consulting or advising firm. It will be an open university, a place for our small entrepreneurs and for our big business men to train and re-train, with the speed demanded by a world where any university degree becomes outdated before the paper turns yellow.”

The next day, the Center hosted an International Commerce & Logistics Seminar featuring a keynote presentation from Dr. H. Donald Ratliff, executive director of SCL and the TIP Center, on the role of innovation and

technology pertaining to international supply chains.

“The TIP Center will utilize a combination of research, education, and innovation to improve logistics productivity within Costa Rica and trade productivity between Costa Rica and other countries, particularly the United States,” said Ratliff. “This is a great opportunity for us to collaborate with enterprises in Costa Rica to address issues that are critical for economic growth in all of Latin America. Good supply chain and logistics capabilities are essential in order to be competitive in global markets.”

Following the keynote presentation, there were three panel discussions on logistics challenges in Latin America and strategies that might improve productivity, international commerce expansion, and information technology. The first panel discussion focused on defining what supply chain and logistics productivity means and issues that contribute to and detract from improved supply chain productivity for Costa Rica domestically, regionally, and globally. Chelsea White III, Stewart School chair, moderated the discussion. Participants included Dr. Juan Blyde, economist at Inter-American Development Bank; Maria Alexandra Feoli, country logistics manager at Intel; and Sara Hagigh, deputy director at the U.S. Department of Commerce.

The second panel discussion, moderated by Sebastian Urbina, managing director of the TIP Center, focused on international commerce expansion and Costa Rica’s strategy of growth through trade. The panel examined the costs

associated with expanding exports, discussed the challenges of maintaining security across the supply chain, and focused on the issue of food safety in international supply chains. Participating on this panel were Tomas Dueñas, former Ambassador of Costa Rica to the United States; Dr. Paul Seligman, regional director of the U.S. Food and Drug Administration; Emanuel Hess, general manager at PROCOMER; and Enrique Ackermann, director at The Coca-Cola Company.

The third panel discussion, moderated by Dr. Sridhar Narasimhan, senior associate dean in the College of Management, focused on technology and productivity. The discussions focused on how IT investments lead to improvements in productivity, why technology diffusing is sometimes so slow, and why the benefits of implementation are not always realized. The panelists included Marco Lizano, director at The Coca-Cola Company; Alicia Avendaño, director of Digital Government’s Technical Secretariat; Roberto Sasso, president of Costa Rica’s Club for Technology Research; and Dr. Sandra Slaughter, Costley Chair and Professor of IT Management at Georgia Tech’s College of Management.

The seminar concluded with an overview of activities from the TIP Center, summarizing how the Center can help to resolve some of the issues raised in the panel session.

For more information, visit www.tip.gatech.edu.

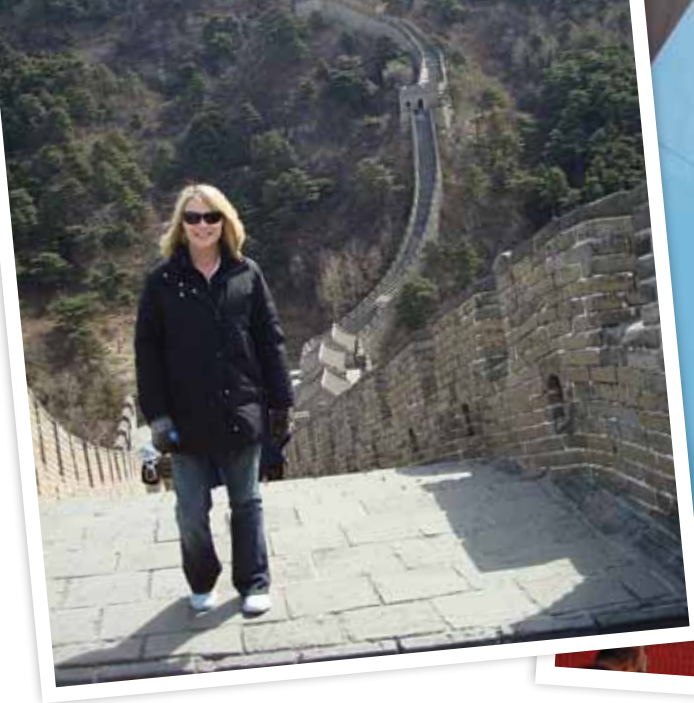


Top left: Manuel Dobles, Consul General Costa Rica in Atlanta; H.G. Pattillo, Chairman of the Board, Pattillo Construction; and William NeSmith, USG Board of Regents

Top right: Georgia Tech Alumnus Houston Staton and Stewart School Chair Chelsea C. White III

Bottom left: College of Management Dean Salbu welcoming the distinguished group to the inauguration ceremonies

Bottom right: Valerie Peterson; Urbina; President Peterson; and Arias-Sanchez



EMIL-SCS: Highlights From My International Learning Experience

By Theresa Foran, MS IL 2008



When I enrolled in Georgia Tech's Executive Masters in International Logistics & Supply Chain Strategy (EMIL-SCS) program, I had been working for DB Schenker's Corporate Logistics group for four years. Barry McNeil, Schenker's vice president of operations who had already graduated from the program, assured me that I was in for a unique experience. And he was right.

Through EMIL-SCS, I have learned about global supply chain issues firsthand. I saw trucks lined up at border crossings from Eastern Europe heading into Western Europe and from Mexico into the United States. I experienced traffic in São Paulo, Brazil. I wound my way through the airport in Guangzhou, China, and watched huge ships navigate the narrow passage through the Panama Canal's locks. In Hong Kong, I stood on the bridge of the world's biggest container vessel as containers were simultaneously loaded and unloaded. I have talked to local business people about their specific supply chain challenges in China, Malaysia, France, Germany, Chile, Brazil, Mexico, and beyond. Going through EMIL-SCS has been an amazing and informative experience.

What is the EMIL-SCS program like? The residence structure is designed for students who work full time. The program is built around five two-week residences in which participants are fully immersed in classes, away from workplace distractions and often in overseas locations. The residences are supported by coursework and assignments, completed by students back at home between sessions. This requires application and commitment from the students, but the program is designed for incorporation around normal work activities. In fact, many of the assignments require students to apply the theory taught in class to the practicalities of their own company and work environments.

Photos, clockwise from bottom left: (1) Touring the Port of Le Havre in Normandy, France. (2) Theresa Foran walking along the Great Wall of China. (3) The class boarded the largest container vessel in the world, The Elly Maersk, which was berthed in Hong Kong. It's a very long way up. (4) Classmate Mike Sullivan experiences life on the United States-Mexico border with Border Patrol, Laredo, Texas. (5) The class takes a break from touring SODIMAC (the local Home Depot equivalent) in Santiago, Chile, for a photo op. (6) The class enjoyed a ride from Panama City to Colon on the Panama Canal Railway train.



The exact details of each residence vary with each class, but here are some highlights from mine.

Residence I—North America: This residence was a very academic baptism by fire into the world of modeling, optimization, finance, and other aspects of technical logistics held on campus at Georgia Tech. This was pretty scary for those of us with liberal arts backgrounds (my undergraduate degree was in French and business studies). The quality of teaching from the likes of Stephen Timme, our charismatic finance professor, and Martin Savelsbergh, who was able to explain optimization to novices (like me) and experts alike, made the eight-hour days in a classroom bearable.

Residence II—Europe: This residence was a complete change in focus from the purely academic to the reality of doing business in Europe. The residence had a mixture of academic classroom sessions (labor relations in Europe, history of the European Union, sustainability in the supply chain, etc.), outside speakers (European trucking operations, discount airline business model), as well as site visits (Port of Le Havre, Kia car factory) in France, Germany, and Slovakia. The residence also involved live case sessions where a host European company outlined a specific relevant supply chain issue the company was facing, and a small group of students worked together to present potential solutions and lead a class discussion with the company about the issue. The live case I worked on was with a French company, Legallais-Boucharde, that was looking to expand into another region of France. My team reviewed and presented several options for a future distribution network that included operational and financial considerations.

Residence III—Latin America: My third residence began with a visit to the Panama Canal. We also took in site tours in Chile and Brazil. Maria Rey, an academically outstanding presenter and previous EMIL-SCS graduate, explained some of the complexities of logistics in the region. Professor John Bartholdi held some lively classroom exercises on warehouse design. Picking paper clips from

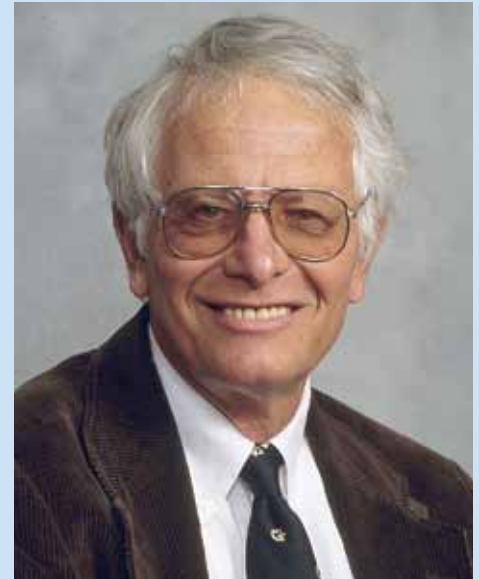
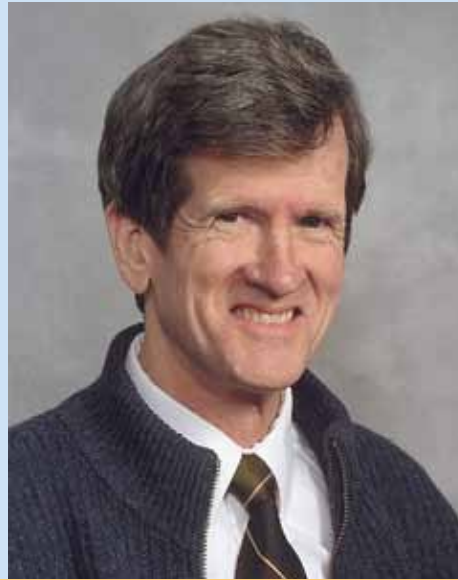
cups with tweezers gave us a hands-on opportunity to understand the benefits of the bucket brigades—a way of organizing workers on an assembly line so that the line balances itself.

Residence IV—Asia: This was probably the most ambitious residence, with visits to Penang, Kuala Lumpur, Hong Kong, a train ride to a manufacturing plant in southern China, Shanghai, and—for a few of us who tagged on an extra weekend—Beijing and the Great Wall. One of the highlights of the residence was a tour of Elly Maersk, the largest container ship in the world, while it was in port in Hong Kong. Others included discussions with Dell, Intel, Jabil, and William Fung on topical supply chain challenges.

Residence V—North America: In our final residence, we came back to the classroom in Atlanta for a week, and then we were off to Laredo, Texas, to experience border operations. Then we headed across the border into Monterrey, Mexico, for discussions on NAFTA and a visit to a *maquiladora* manufacturing site.

While participating in the residences, we also took part in a global project, based on a real-life supply chain opportunity. We were divided into teams and worked on our project throughout the program. During the final residence, we presented the results of our project to the course directors, our classmates, and members of the EMIL-SCS advisory board. I was part of a team that analyzed the routing of products and components from sources in Asia to manufacturing and assembly facilities in North America. We were particularly satisfied to hear that our subject company (a major global manufacturer of computer equipment) had decided to implement some of our recommendations as a pilot project just prior to our presentation.

If you are interested in the program, you can find out more at www.emil.gatech.edu. If you are fortunate enough to participate, have fun! With so much travel involved, it is always an adventure. Traveling together is a great way to network and bond with your fellow classmates.



Professors William Cook, Ellis Johnson, and George Nemhauser were selected as inaugural Fellows of the Society for Industrial and Applied Mathematics (SIAM).

Professors **John Bartholdi III** and **Steve Hackman** revised *Warehouse & Distribution Science*, a text used in programs across the United States and throughout thirty-two countries worldwide.

William Cook, Chandler Family Professor, became founding editor-in-chief of the journal *Mathematical Programming Computation*. Cook also published *Research Trends in Combinatorial Optimization*.

Professors **William Cook**, **Ellis Johnson**, and **George Nemhauser** were selected as inaugural Fellows of the Society for Industrial and Applied Mathematics (SIAM). Fewer than 200 individuals internationally received this honor.

Jim Dai, Edenfield Professor, was awarded the James Riady Distinguished Visiting Professorship to teach at the National University of Singapore from April 2009 to May 2011. He brings an extensive background in stochastic systems to their Department of Decision Sciences.

Santanu Dey joined the Stewart School as an assistant professor in July. Since obtaining his PhD in industrial engineering

at Purdue University in 2007, Dey has worked as a research fellow at the Center for Operations Research and Econometrics (CORE) in Belgium.

Antonius Dieker, assistant professor, received the Gijs de Leve Prize for the best Dutch PhD dissertation written between 2006 and 2008 in the field of operations research. His thesis, "Extremes and Fluid Queues," focuses on the connection between fluid queues and extreme values in random processes.

Paul Griffin, co-director of SCL's Center for Health Care Logistics, accepted an offer to become the new department head of industrial engineering at Penn State University after twenty years at the Stewart School. Penn State's IE department is the oldest in the world and is ranked among the top five in the nation by *U.S. News & World Report*.

Professors **Paul Griffin** and **Pinar Keskinocak** received the IIE Transactions Best Paper Award in Scheduling and Logistics for "Coordination of Marketing and Production for Price and Leadtime Decisions," coauthored with PhD student Pelin Pekgun.

Michael Massimino, adjunct assistant professor, completed two spacewalks aboard the STS-125 mission to service the Hubble Space Telescope in May. Massimino taught in the Stewart School between 1995 and 1996 until he was selected by NASA as an astronaut candidate.

Leon McGinnis, Gwaltney Professor of Manufacturing Systems, received a courtesy appointment in the Woodruff School of Mechanical Engineering. McGinnis has collaborated with ME faculty for several years, and this appointment will enable him to supervise ME students directly.

Yajun Mei, assistant professor, received the 2009 Abraham Wald Prize for "Is Average Run Length to False Alarm Always an Informative Criterion?" The award is given annually to honor the best publication in the journal *Sequential Analysis*.

Arkadi Nemirovski, John Hunter Chair, received an honorary Doctor of Mathematics degree from the University of Waterloo in Ontario, Canada.

William Rouse, director of the Tennenbaum Institute, published a second edition of his *Handbook of Systems*

FACULTY NEWS



Santanu Dey joined the Stewart School as an assistant professor in July.

Engineering and Management. It has been recognized by Amazon.com as a “bestseller in government” and has been widely adopted in a range of industries.

Jianjun Shi, Carolyn Stewart Professor, was elected an INFORMS Fellow for “development of stream-of-variation theory and its contributions to quality improvements in manufacturing and other complex systems and for leadership in education and the INFORMS community.”

Barry Smith has received a second appointment as Edenfield Executive-in-Residence and will continue working with Ellis Johnson, Coca-Cola Professor, on a project for NASA to redesign the National Airspace System.

Robin Thomas, professor in the School of Mathematics with a courtesy appointment in the Stewart School, and three colleagues were awarded the 2009 Fulkerson Prize for “The Strong Perfect Graph Theorem.” Thomas, who was also honored in 1994, is one of four individuals to win the Fulkerson Prize more than once.



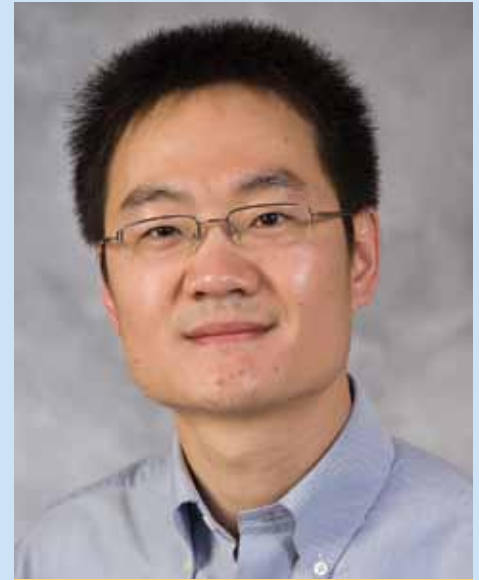
Arkadi Nemirovski, John Hunter Chair, received an honorary Doctor of Mathematics degree from the University of Waterloo in Ontario, Canada.

Valerie Thomas, Anderson Interface Associate Professor of Natural Systems, testified before the U.S. House of Representatives’ Committee on Science and Technology in February. She discussed her idea for a universal product code for product lifecycle management, and the House subsequently passed the E-Waste Recycling R&D Act.

Roshan Vengazhiyil was awarded the Coca-Cola Junior Professorship for a three-year term. He also received the IIE Transactions Best Paper Award in Quality and Reliability for “Optimal Specifications for Degrading Characteristics.”

Chelsea C. White III, Stewart School Chair and Schneider National Professor, delivered a keynote address on service operations, logistics, and informatics at the 2008 IEEE International Conference in Beijing, China. He discussed forces that hinder design of supply chains and broached research initiatives that seek to control supply chains in real time.

C. F. Jeff Wu, Coca-Cola Professor, published a second edition of his textbook *Experiments: Planning, Analysis, and Optimization* to reflect the progress in the



Ming Yuan, assistant professor, was awarded the NSF Career Award.

use of statistically designed experiments for product and process improvement over the past decade.

Ming Yuan, assistant professor, was awarded the NSF Career Award, the National Science Foundation’s most highly-esteemed award for junior faculty members. Yuan is the fourth Stewart School professor to receive the distinction since 2005, following Nagi Gebrael, Seong-Hee Kim, and Roshan Vengazhiyil.

Chen Zhou, associate professor, received the IIE Transactions Best Paper Award in Design and Manufacturing for “Clusters and Filling-Curve-Based Storage Assignment in a Circuit Assembly Kitting Area.” The paper addresses the complexity of a manufacturing process that assembles circuit boards for more than 1,000 different products.

Bert Zwart, associate professor, was awarded the 2008 Erlang Prize by the Applied Probability Society of INFORMS to recognize his “outstanding contributions to several areas in the interface of applied probability, computer science, and communication networks.”



Juan Pablo Vielma (center) was awarded the 2009 Goldstine Postdoctoral Fellowship in Mathematical Sciences. Vielma enjoys a discussion on applied mathematics with advisors Shabbir Ahmed (left) and George Nemhauser (right).



Nick Wellkamp, undergraduate senior, was named a Truman Scholar.

Ali Ekici, PhD student, won the 2009 Society for Health Systems Graduate Student Paper Competition with “Modeling Influenza Pandemic, Intervention Strategies, and Food Distribution.” The paper, co-authored with Associate Professors Pinar Keskinocak and Julie Swann, evaluates the effectiveness of intervention strategies such as quarantine and school closure against a potential pandemic.

Jessica Heier, PhD student, received the Gilbreth Memorial Fellowship for the 2008-2009 academic year. This award was granted by the Institute of Industrial Engineers for Heier’s dedication to scholastic achievements and humanitarian efforts.

Oran Kitterthreapronchai, PhD student, received the Best Student Paper Award at the first International Transportation and Logistics Conference for “Geometric Relationships of a Single-Hub Crossdocking Network.” He defended his PhD thesis in April and now joins the National University of Singapore as a research engineer.

Guanghui Lan, PhD student, was awarded the 2008 INFORMS Computing Society Student Paper Prize for “Efficient Methods for Stochastic Composite Optimization.”

Micajah McGarity, undergraduate senior, was awarded the Fulbright Scholarship to Poland for the 2009-2010 academic year. McGarity will use the nine-month grant to study at Krakow University of Technology, working on a project to improve the city’s sewer system.

Melike Meterelliyoz, PhD student, won the Pritsker Doctoral Dissertation Award and received the first-place cash prize of \$1,000. She was advised by Professor David Goldman and Associate Professor Christos Alexopoulos, both of whom specialize in the field of simulation.

Eden Smith, undergraduate senior, was elected to represent the student body as Ms. Georgia Tech for the 2008-2009 academic year.

Alina Staskevicius, undergraduate junior, was elected student government

president for the 2009-2010 academic year in a run-off election in April. Staskevicius was vice president of administrative affairs for 2008-2009.

Juan Pablo Vielma, PhD student, was awarded the 2009 Goldstine Postdoctoral Fellowship in Mathematical Sciences. He will conduct research in the IBM Watson Research Center in New York before taking up an appointment as an assistant professor at the University of Pittsburgh.

Charles Wang, undergraduate junior, was highlighted in *The Atlanta Journal-Constitution* in May as one of three Atlanta-area college students finding creative ways to be successful in a tough job market. Wang spent the last year developing routes for UPS drivers on the newly-named streets in Dubai.

Nick Wellkamp, undergraduate senior, was named a Truman Scholar and will receive a \$30,000 grant for graduate study. Wellkamp, who served as student government president for the past year, is the first Georgia Tech student in six years to receive the national honor.

ALUMNI NEWS



*Ray Anderson, IE 1956, published *Confessions of a Radical Industrialist*.*

Ray Anderson, IE 1956, published *Confessions of a Radical Industrialist*, his latest book about sustainability and environmental challenges in the twenty-first century. Anderson is the founder and CEO of Interface Inc. and supports the Stewart School through the Anderson-Interface Chair in Natural Systems.

Erik Blasch, MS IE 1995, was named a Fellow of the Society of Photo-Optical and Instrumentation Engineers for contributions in automatic target recognition, information fusion, and robotics. Blasch works as a civilian at Wright-Patterson Air Force Base and continues to work with GTRI in radar and optics.

Wallace Buran, IE 1975 and MS IE 1978, joined KPMG as a partner. He is responsible for supporting clients in supply chain strategy, manufacturing technology, shareholder value enhancement, overhead performance, and enterprise transformation.

Jim Butterworth, IE 1984, received the Academy of Distinguished Engineering Alumni Award from Georgia Tech's College of Engineering. Butterworth is a principal of Greenlight Ventures, which he recently formed to invest in next-generation clean and renewable energy technologies.

John Chapman, IE 1973, was recognized in October 2008 by then-President Bush for outstanding achievements at NASA with a Presidential Rank Award, one of the highest



Tony Dieck, PhD 1984, became president of the University of Monterrey in Mexico.

honors given to career federal employees. He is manager of the Space Shuttle External Tank Project Office at NASA's Marshall Space Flight Center in Alabama.

G. William Cole Jr., IE 1978, is owner and president of Sears Carpet and Air Duct Cleaning in Houston, which was the top Sears cleaning franchise in the country for sales in carpet cleaning and the number two franchise for overall sales. His franchise was also named number one for customer satisfaction.

Laura Cranmer, MS IE 1991, was named vice president of operations at Airvana. In this role, she will join the company's senior management team and oversee manufacturing, quality assurance, fulfillment, and logistics.

J. Gordon Davis, PhD IE 1967, received the Jim O'Brien Lifetime Achievement Award at the annual conference of the Project Management Institute College of Scheduling in Boston. Davis taught at the Stewart School from 1961 to 1971, where he was a co-founder of The Project Management Institute.

Tony Dieck, PhD 1984, became president of the University of Monterrey (UDEM) in Mexico. He previously served as dean of the Graduate School of Business and director of the Virtual University at Monterrey Tech (ITESM).



Mike Duke, IE 1971, was named president of Wal-Mart Stores.

Vincent DiNunno, IE 1987, a manufacturing engineer, published a nonfiction book, *Spartan AC: An American Legion Baseball Team United Through Adversity*.

Tom Dozier, IE 1963, was appointed to the Georgia Construction Industry Licensing Board by Governor Sonny Perdue. As the president of Gold Mech, he is a registered professional mechanical engineer in both Georgia and South Carolina.

Michael Duke, IE 1971, was named president and CEO of Wal-Mart Stores, earning him the #26 ranking in *Newsweek's* Global Elite. Under his leadership as vice chairman from 2005 to 2008, Wal-Mart's international business expanded to 3,200 stores in fourteen markets.

Teresa Ebbs, IE 2001, joined her family's CPA firm, Hungeling & Sons, as director of operations. Hungeling & Sons has operated in the Atlanta area since 1984 and serves a wide spectrum of small businesses.

Paul Edfeldt, IE 1952, is now serving as chair of the Human Resource Committee for the Birmingham Baptist Association. This committee oversees the permanent staff at the association headquarters and serves 140 Baptist churches in central Alabama.



Bill George, IE 1964, received an honorary doctorate degree from Georgia Tech.

Bill George, IE 1964, received an honorary doctorate degree and spoke during the Georgia Tech master's and PhD commencement ceremony in December 2008. George is on the faculty at Harvard Business School and is the author of *True North* and *Authentic Leadership*.

Tracy Hawkins, IE 1985, began working with Professor Pinar Keskinocak to optimize the supply chain of FilterPure, a nonprofit that manufactures and distributes ceramic water filters to families in developing nations.

John Hedrick, IE 1999, was promoted to regional vice president of 7-Eleven. He lives in Windermere, Florida, with his wife Louise, MGT 2001, and two sons.

Eddie Hicks, IE 1963, was elected chairman of the Worldwide Vending Association. Hicks is a past chairman of the National Automatic Merchandising Association, a recipient of the Industry Person of the Year award, and president and CEO of Prestige Services.

Denise Alston Holloman, IE 1983, was promoted to vice president of continuous improvement and manufacturing support at General Mills. Holloman now has responsibility over the system engineering program, maintenance, reliability, technical training, and business simulation.



Andrea Laliberte, IE 1982 and MS IE 1984, received the Academy of Distinguished Engineering Alumni Award from Georgia Tech.

Justin Honaman, IE 1996, published *Make it Happen! Live out Your Personal Brand*, which offers a perspective on personal branding and authentic leadership. Honaman is using the book to raise money for the United Service Organizations.

Duane Hoover, IE 1960, was admitted into Georgia Tech's College of Engineering Hall of Fame. He has served on the Stewart School Advisory Board, and he is currently president of Hoover Investments and Hoover Foods.

David V. Hutton, IE 1967, retired after twenty-seven years of service at Washington State University, where he was Boeing Distinguished Professor of Manufacturing Engineering. He was previously a faculty member at Clemson University and Virginia Tech.

Joseph C. Irastorza, PhD IE 1973, received the Academy of Distinguished Engineering Alumni Award from Georgia Tech's College of Engineering. His professional career includes thirty-two years of consulting services for Kurt Salmon Associates.

Shane Kimbrough, MS OR 1998, was among seven astronauts aboard the Space Shuttle Endeavour as it blasted off for the International Space Station in November 2008.



Juan Carlos Varela, IE 1985, was elected vice president of the Republic of Panama in May 2009.

Alan Knitowski, MS IE 1992, started a company called Phunware that focuses on the enterprise-branded mobile application production market, creating applications for Apple, Research in Motion (BlackBerry), Google, and Palm products.

Andrea Laliberte, IE 1982 and MS IE 1984, received the Academy of Distinguished Engineering Alumni Award from Georgia Tech's College of Engineering. Laliberte is the senior vice president of distributions and consumer service for Coach, Inc. and a serves on both the Georgia Tech and ISyE advisory boards.

Christopher Lofgren, PhD IE 1986, was inducted into the National Academy of Engineering. Lofgren, who chairs the Stewart School Advisory Board, is the President and CEO of Schneider National.

Tywanda Lord, IE 1996, became a partner at Kilpatrick Stockton in January. Lord practices intellectual property law, focusing on patent and trademark litigations, licensing, and prosecution.

James McClelland, IE 1966, was inducted into the Central Indiana Business Hall of Fame this year. He has served as chairman of the board of directors of Goodwill Global and president of Goodwill Industries of Central Indiana since 1974.

ALUMNI NEWS

Jennifer Merritt, IE 1997, was promoted to principal at North Highland Company, a management and technology consulting firm. She and her husband Glen, EE 1995, live in Cartersville, Georgia, with their two children.

Mark Moon, IE 1989, joined the financial consulting firm AlixPartners as a director in its performance improvement practice. Moon previously was a principal in operation services with A.T. Kearney.

Charles Moseley Jr., IE 1965, was appointed as an at-large representative to the board of trustees of the Georgia Teachers Retirement System by Governor Sonny Purdue. Moseley also serves on the board of trustees of the Georgia Tech Foundation and Rabun Gap-Nacoochee School.

Joe McKinney Muncy, IE 1982, opened Muncy, Geissler, Olds, & Lowe, an intellectual property law firm in Fairfax, Virginia.

Chris Pogson, IE 1988, is the plant manager for Chemtrade's sulfuric acid manufacturing facility in Shreveport, Louisiana, after serving three years as a plant manager in Riverton, Wyoming.

Willis Potts, IE 1969, received the Academy of Distinguished Engineering Alumni Award from Georgia Tech's College

of Engineering. He served as the vice president and general manager of Temple Inland until 2004 and was appointed to the Board of Regents of the University System of Georgia by Governor Sonny Perdue in 2006.

Heather Rocker, IE 1998, was named Outstanding Young Alumna for her volunteer work as a North Metro Georgia Tech Club Board member, a Young Alumni Council advisor, and a President's Scholarship Program interviewer. Rocker was also among *The Atlanta Business Chronicle's* 2008 Up & Comers.

Sheila Ryan, IE 1986, will lead fundraising, programs, public affairs, and marketing as director of the Georgia chapter of the March of Dimes. Ryan previously worked with United Way of Atlanta as director of the Tocqueville Society, raising more than \$13 million annually.

William Smith, BEES 1974, was accepted as a PhD candidate in technology management at Indiana State University. He intends to defend his dissertation, "The ROI of Informal Learning Through Social Networks in Organizations," this fall.

Jane Snowdon, PhD IE 1994, received the Academy of Distinguished Engineering Alumni Award from Georgia Tech's College of Engineering. She was also named to the Industrial Advisory Board of Stony Brook

University's new medical division of the Center for Excellence in Wireless and Information Technology.

Don Swann, IE 1967, published his second novel, *Justice for JJ Jenkins*. After twenty-five years at Deloitte Consulting, Swann has created a fictional alter ego named Freddie Chapman who solves business mysteries. He continues to consult with clients and recently served as COO for Bristol Compressors.

Richard Tyler, IE 1990, served as a special advisor to the International Olympic Committee on the Olympic Villages for the 2008 Beijing Olympics in the areas of auditing, photo documenting, and troubleshooting. Tyler lives in Alpharetta, Georgia, and works as a real estate director.

Juan Carlos Varela, IE 1985, was elected in May as vice president of the Republic of Panama for a five-year term. Hailing from the Democratic Change party, he also serves as the Minister of Foreign Relations.

Gabriell Washington, IE 2005, was selected as a Technology All-Star by the National Women of Color Technology Awards Conference in October 2008. Washington also received a Rising Star Award at the 2006 STEM Conference.



Consider a Bequest to Support ISyE's Future

Founders' Council is the honorary society of alumni and friends who have made life-income gifts or estate provisions of at least \$25,000 for the support of Georgia Tech. A bequest to Georgia Tech's H. Milton Stewart School of Industrial and Systems Engineering is a powerful expression of your belief in the Stewart School and its future. To make a bequest for ISyE, please include the following language in your estate plans:

I give and bequeath ____% of the residue and remainder of my estate (or the sum of _____ dollars, \$ _____) to the Georgia Tech Foundation Inc., a Georgia charitable corporation, for the support of the Stewart School of ISyE, Georgia Institute of Technology.

Please contact Nancy Sandlin at 404.385.7458 to discuss how you would like your bequest designated to benefit the H. Milton Stewart School of Industrial and Systems Engineering, whether unrestricted or for the support of a particular program.

**FULL NAME:**

Lt. Col. Robert Shane Kimbrough

OCCUPATION:

NASA Astronaut, U.S. Army Officer

EDUCATION:

- High School—The Lovett School (1985), Atlanta, GA
- BS Aerospace Engineering, United States Military Academy (1989)
- MS Operations Research, Georgia Tech (1998)

CAREER:

- Apache Helicopter Pilot/Platoon Leader in Desert Storm (1991)
- Apache Helicopter Company Commander, Ft. Bragg (1994-1996)
- West Point Statistics and Mathematics Professor (1998-2000)
- Flight simulation engineer at NASA's Aircraft Operations Division (2000-2004)
- Selected for Astronaut Class of 2004
- Mission Specialist on STS-126 Endeavour (November 14-30, 2008)
- Completed two spacewalks totaling 12 hours and 52 minutes outside the vehicle

FAMILY:

Married to Robbie Lynn Nickels with three children

HOBBIES:

Baseball, golf, weight lifting, and running

CONVERSATION

with Lt. Col. Shane Kimbrough

The Stewart School of ISyE has a high level of corporate alumni spread all across the globe. However, one of our alumni has gone well beyond this planet—Lt. Col. Shane Kimbrough, MS OR 1998. He was among seven astronauts on the crew of Space Shuttle Endeavour, which began a fifteen-day mission on November 14, 2008. Kimbrough recently spoke with us about the mission.

How did ISyE prepare you to become an astronaut?

It gave me a foot in the door and a great degree from an outstanding institution. A master's in math, science, or engineering is definitely something that you need in order to be an astronaut. The skills I learned going through the OR program, learning optimization and math skills, really set me up for success for NASA's basic operations and training.

What was one of the biggest challenges you faced while you were in space?

The biggest challenge we faced was when we were conducting spacewalks—we were doing things that had never before been done. We repaired the solar alpha rotary

joint, one of the big joints [on the space station] that allow the solar arrays to track the sun while going around the Earth. This was a real tedious task which involved three spacewalks and about twenty hours to repair the hardware.

What was it like to walk in space?

It was an amazing experience. You are so focused on what you are doing, you don't have a lot of time to look around and enjoy the view. But I had a few minutes on both of my spacewalks to take a peek at the Earth and see how spectacular the view was. I couldn't believe I was standing outside going orbital speed—about 17,500 miles an hour looking down at the Earth. It was pretty amazing.

Of course, I was a bit apprehensive at first, as I think most folks are the first time out of the hatch. It took maybe an hour for me to really figure out how to get around efficiently and not bang into everything like a bull in a china shop. It was mentally challenging and physically challenging. Your hands get really exhausted after about seven hours of work, especially dealing with the pressure of the spacesuit every time you open and close your hands. When you come back in, you are pretty exhausted. For me, my hands were the most fatigued of anything.

How do you train to become an astronaut and do this kind of work?

NASA has a very nice trainer that we use for spacewalks. We use a giant pool that is about 40 feet deep, 200 feet long, and 100 feet wide. We climb into our 300-pound spacesuits, get in the water, and train and train and train and train. I got the same hand fatigue in the pool that I felt in space. So it wasn't something that was new or unexpected. I probably had about fifteen or so of these training events in the pool to prepare me for the two spacewalks that I executed. The mental aspect is a little different. I think we are all focused individuals, but it was still quite a challenge to stay focused continuously for seven hours.

What was it like being up there with other Tech grads?

It was great. Our crew was interesting. There were seven of us: three were Georgia Tech grads and four were MIT grads. It is pretty unusual to have that kind of crew mix. We took a few pictures with each one of our groups, but that was about the only competitiveness. We loved being up there representing Georgia Tech and hearing that they mentioned us at the [Georgia Tech vs. Miami] football game. That was pretty neat.

Was it hard physically to re-acclimate to Earth's atmosphere after you returned?

I think most of us will attest that gravity is not your friend after you've been up in space for a few weeks. In space you are floating around and everything inside your body is floating around too. Back on Earth, everything has to figure out where it's supposed to be again. For instance, my inner ear was affected—it thought I was still going 17,500 miles per hour. I had the sensation of spinning for 9 to 10 hours after landing. I could sit there and talk to you, but I'd need to be holding on to something for stability. My legs were a little bit weak and wobbly for a few hours because I didn't use them for two and a half weeks.

How did you feel after completing your mission?

The first week after we got back, I thought it was a dream still. I couldn't believe that it had actually happened and I did what I did. Our mission was called the "Extreme Home Makeover: Space Station Edition" since we were redoing the inside as well as working on the outside of the space station. It's great to see some of our work extending the life of the space station.

What is next for you?

I'm back in the astronaut office working my technical job. I am currently supporting my colleagues launching on the space shuttle. I am also working on the spacewalking suits and as a Capsule Communicator (CAPCOM) in Mission Control. Hopefully one of these days I will do well enough that the boss will call me in and ask me if I want to go fly in space again.



Army Lt. Col. Shane Kimbrough (MS OR 1998) returned to campus on June 26 to speak about his first flight into orbit aboard the Space Shuttle Endeavour. The mission was popularly dubbed the "Extreme Makeover: Space Station Edition." A crowd of more than 200 Georgia Tech faculty, students, and guests filled the Student Center theater for Kimbrough's presentation. He introduced the audience to the International Space Station's facilities and crew, which included fellow Georgia Tech graduates Eric Boe (MS EE 1997) and Sandra Magnus (PhD MSE 1996). At the end of his presentation, he opened up the floor for a question-and-answer session in which he fielded inquiries about the launch sequence, his spacewalks, his typical workday in space, and his acclimation to low-gravity. Afterward, Kimbrough signed autographs for the audience in attendance, many of whom were local children attending on-campus engineering summer camps.

REALITY IE

Meet three of our alumni as they comment on how they use their industrial engineering skills in their current positions.



Doug Chipman, IE 1996

Georgia-Pacific
Director, Napkin Category
Food Services Solutions
Atlanta, Georgia

“My industrial engineering experience at Tech taught me a great deal about problem solving. In my current position at Georgia-Pacific, I face issues involving manufacturing, logistics, pricing, and R&D on a daily basis. The skills that I learned in the industrial engineering program enable me to break down these problems, analyze their components, and find practical solutions.”



Nicole Stout, IE 2003

Starwood Vacation Ownership
Manager of Product and Service
Alignment
Orlando, Florida

“In my current role at Starwood Vacation Ownership, I am responsible for the project management of process improvements, communications strategies, Six Sigma efforts, and various new product/service initiatives. Operations, whether in a manufacturing plant or an office, are full of processes and systems that constantly need review and improvements. Despite knowing this, I never would have guessed that my industrial and systems engineering degree would land me in roles within theme parks, resorts, and call centers, and that I would still be able to apply the methodologies I learned at Tech. A professor once told me that it wasn't necessarily the exact material we were learning, but a way of thinking—I didn't understand it then, but he was right on target.”



Justin C. Honaman, IE 1996

Coca-Cola Customer Business Solutions
Director, Customer Intelligence
Singer/Songwriter
Author
Atlanta, Georgia

“Whether in my role as director of customer intelligence at Coca-Cola or as a singer/songwriter and author, I use my industrial engineering skills anytime I am breaking down large business challenges into manageable improvement initiatives; managing teams, projects, and programs; and working with stakeholders from all sides of business.”

EMIL Expands Name to EMIL-SCS

In the fall of 2009, the Executive Masters in International Logistics—through the support and guidance of its advisory board, alumni, and staff—elected to expand its name to the Executive Masters in International Logistics & Supply Chain Strategy (EMIL-SCS). This expanded name more appropriately and accurately reflects the comprehensive education provided by EMIL-SCS to senior executives working within the many principles of supply chain management.

For more than ten years EMIL-SCS, through the H. Milton Stewart School of Industrial and Systems Engineering, has provided an extensive curriculum focused on international logistics, business management, and supply chain strategy. By adding supply chain strategy to the program name we are more clearly representing the core teaching of EMIL-SCS and differentiating the program in the eyes and minds of the experienced supply chain professional.

The EMIL-SCS program is a unique eighteen-month master's program designed to fit the busy work schedules of executives, allowing the company to keep key employees on the job while they participate in five two-week residences. The academic curriculum is designed to cover the extended supply chain and regional differences across Europe, Asia, Latin America, and the United States. EMIL-SCS provides participants with the analytical skills and intellectual framework needed to succeed in designing and implementing creative supply chain strategies and global logistics solutions necessary to compete in today's global markets.

The EMIL-SCS program is offered through the number one nationally ranked industrial and systems engineering school at Georgia Tech. Please visit our Web site at **www.emil.gatech.edu** for more detailed information.



Stay in touch! Drop us a line.

The Alumni News section highlights promotions, awards, scholarships, fellowships, and publication of books. Let us hear from you! It's a good way to stay in touch with your classmates.

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