

Industrial Engineering and Management Sciences

Robert R. McCormick School of
Engineering and Applied Science
Northwestern University

FALL 2010

Research Shows New York is Getting Less Homeland Security Funding than Optimal

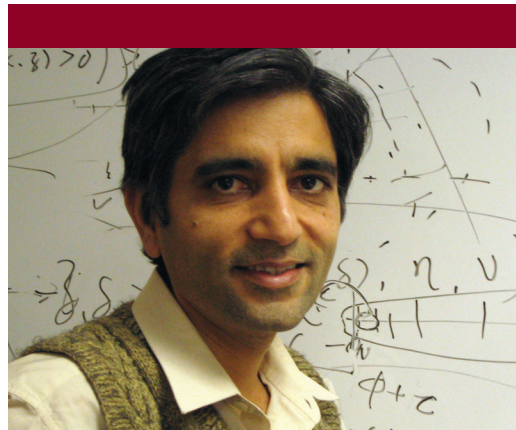
New budget allocation models developed at Northwestern University suggest that New York City appears underfunded for protection against terrorist threats. The study also shows Chicago as underfunded while Los Angeles appears overfunded.

The research team analyzed budgets for five fiscal years (2005 to 2009) for 10 major U.S. urban areas under a variety of terrorist-attack scenarios. The researchers found the funding received by New York in 2009 was around 30 percent of the total money allocated by the U.S. Department of Homeland Security to the 10 areas. According to the Northwestern models, the funding should have ranged between 33 and 49 percent.

This would translate to a net increase of anywhere between \$15 million to \$92 million above the actual level of funding New York received in 2009.

“Our new methodology, called robust-weighted sum optimization, offers a different perspective on how Homeland Security funds might be allocated,” said lead researcher **Sanjay Mehrotra**, noting his team only used publicly available data in its study. “Ultimately, we would like to bring this method to the decision-making processes of Homeland Security and other organizations.”

Mehrotra, professor of industrial engineering and management sciences, worked with graduate student Jian Hu and University of Illinois at Chicago professor Tito Homem-de-Mello on the research.



Sanjay Mehrotra

The researchers looked at the optimal allocation of the Homeland Security budget under its Urban Areas Security Initiative (UASI) program, which is designed to enhance regional preparedness in major metropolitan areas. They focused on the 10 urban areas that received the most funding.

To determine optimal budget allocations, the researchers built top-down budgeting models that considered different factor-weight scenarios and risk considerations, such as potential fatalities, property losses and disruptions of air and bridge traffic in the event of a terrorist attack.

In addition to the New York findings, the research results suggest that in 2009 Chicago should have received between \$10 million and \$17 million above its actual level of funding and Los Angeles should have received between \$27 million and \$36 million below its actual level of funding.

The other cities in the list are in the ballpark, says Mehrotra, with the funding they received coming close to what the Northwestern models suggest.

The National Science Foundation and the Office of Naval Research funded the research.

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Letter from the Chair



A challenge for any department is maintaining core strengths while exploring the periphery for emerging areas of research and education (that may eventually become part of the core). We have never been a department that chases the latest fad; we pride ourselves on having rigorous, relevant and lasting research and educational programs. Over the last couple of years I have seen two emerging areas make strong cases for becoming core, and one of our core educational programs demonstrating its lasting value. A bit on each of these follows.

Seeded by a generous grant from alumnus David Sachs, and fellowship and administrative support from the McCormick School, Professors **Irina Dolinskaya** and **Karen Smilowitz** have established a timely and exciting research program in humanitarian operations research that focuses on logistics for disaster relief. As one part of this work they hosted a very successful forum entitled "Humanitarian Logistics: A View from Haiti" that featured two doctors from Northwestern's Feinberg School of Medicine who participated in Haitian relief activities. Karen and Irina have already secured additional funding from the Center for the Commercialization of Innovative Transportation Technology for their proposal "Decision Making Tools for Distribution Networks in Disaster Relief."

This year we instituted a new PhD major in "Health Care Engineering and Decision Sciences," which was just one aspect of a significant investment by the department in health care operations and policy. We have always had strength in health care decision analysis but are now addressing a much broader agenda. New PhD-level courses were introduced by Professors **Sanjay Mehrotra** and **Benjamin Armbruster**, and Sanjay also developed an undergraduate elective IEMS 385 Introduction to Health Systems Engineering. In addition, Sanjay and Professor **Gordon Hazen** were awarded Northwestern University Clinical and Translational Sciences Institute Engineering into Medicine mini-sabbaticals. The purpose of the mini-sabbaticals is to accelerate the involve-

ment of engineers in biomedical translational research at Northwestern University. These mini-sabbatical enabled Gordon and Sanjay to be in residence for an academic quarter in a Feinberg School of Medicine laboratory collaborating on a focused translational research project. I look forward to reporting on their outcomes in a future newsletter.

Our long-standing Master of Engineering Management (MEM) program was featured in the July 25, 2010 issue of *Financial Times* in an article entitled "Rise of the Business-savvy Engineer." The article noted that while MBA applications and placement are down, both numbers are on the rise for engineering management. This is evidence for something that we have believed for years: In a technology-driven world, if you want a great manager you should start with a great engineer. MEM is a founding member of the Master of Engineering Management Programs Consortium (www.mempc.org), along with similar programs at Cornell, Dartmouth, Duke and Stanford. This elite consortium is doing an outstanding job raising the visibility of engineering management literally around the world. MEM is directed by Professor **Bruce Ankenman**.

Some Other Items of Note

In April a second "Job Search Boot Camp" was presented by the IEMS Advisory Board to over 40 IEMS undergraduates. The boot camp provided students with strategies for finding a job that does not come through the university placement office. This is an outstanding service to our students, and certainly contributed to our excellent placement statistics even in a down economy. At the Advisory Board meeting that took place after the boot camp, David Sachs, senior partner of Ares Management, was presented with the IEMS Distinguished Alumnus Award. David spoke on "The Universal Relevance of IEMS" using his experience in the investment world as an illustration. The Advisory Board reorganized itself and elected Craig Asher as its first president.

I am pleased to report that **Seyed Irvani** was promoted to full professor. Seyed's research and teaching interests span optimization of queueing systems, improving performance of service operations and professional work systems, manufacturing and supply chain management, analysis of integrated production and maintenance policies, flexibility in manufacturing and service operations systems, and operations management in non-profit supply chains. **Mike Marasco** was reappointed director of the Farley Center for Entrepreneurship and Innovation; Mike is a "clinical faculty member," a category I believe you will see grabbing more attention in top departments that want to maintain industrial connections and relevance, while still being at the very cutting edge of research. The Farley Center under Mike's direction is a real McCormick success story. Finally, **Ismail Civelek**, a recent PhD graduate from Carnegie Mellon University whose adviser was our own graduate Bahar Biller, will be spending the year in IEMS as a visiting faculty member teaching simulation, operations research, and statistics.

Continued on page 6

Faculty and Alumni Awards

FACULTY AWARDS

The Executive Council of American Supply Association's Industrial Piping Division awarded **Donald R. McNeeley**, president and CEO of Chicago Tube and Iron Corporation and MEM faculty member, the IPD Award of Excellence, which was established to honor a member for achievement specifically related to the industrial and mechanical PVF segment of the PHCP-PVF industry.

Barry L. Nelson was named a Walter P. Murphy Professor in the McCormick School

Two IEMS professors, **Verinder Syal** (adjunct lecturer) and **Paul Leonardi**, were named to this year's Faculty and Administration Honor Roll, conducted by the Associated Student government. More than 1,000 students voted.

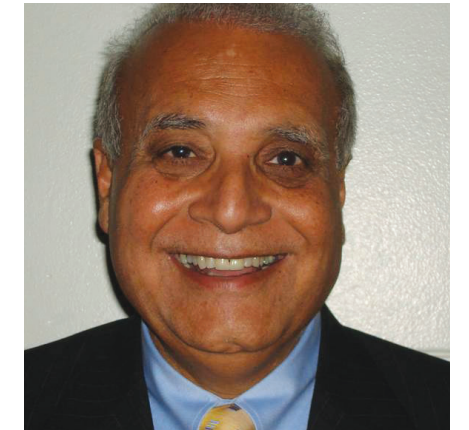
Ajit Tamhane was elected as a fellow in the Institute of Mathematical Statistics. The fellowship is a way of honoring the outstanding research and professional contributions of IMS members; contributions which help keep the Institute of Mathematical Statistics in a leading role in the field of statistics and probability.

ALUMNI AWARDS

Jonathan Owen (PhD, IEMS '98) was promoted to GM technical fellow.



Donald R. McNeeley



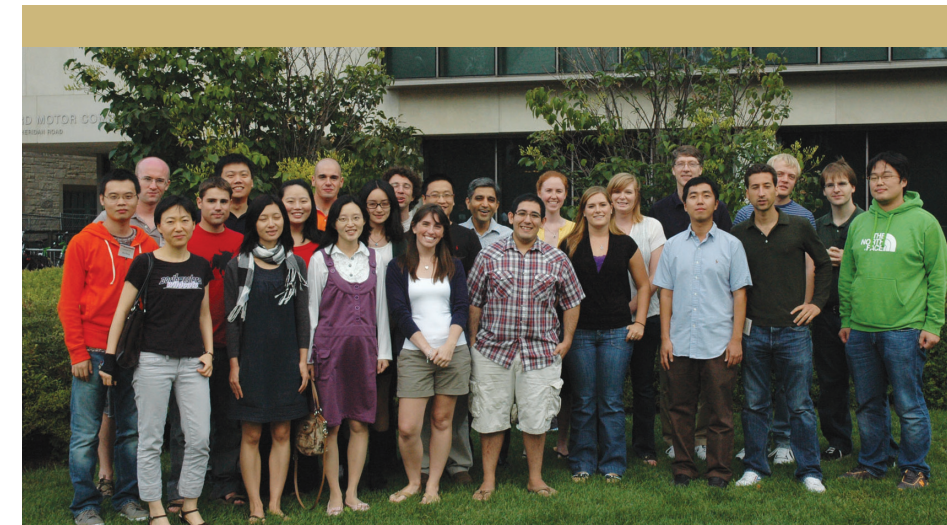
Verinder Syal



Paul Leonardi



Ajit Tamhane

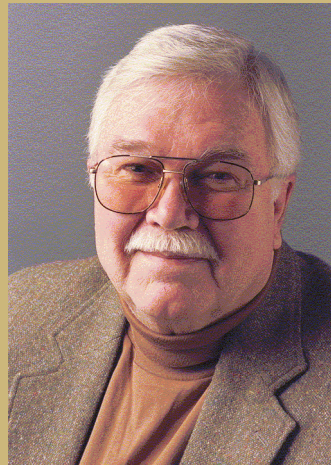


Faculty, staff, and graduate students welcome incoming PhD students for fall 2010

Professor Donald Frey Dies at 86

Donald N. Frey, 86, a Northwestern University engineering professor who, along with others, came up with the concept and design of the Ford Mustang, a car that became an American icon, died March 5 at Evanston Hospital.

Frey, professor of industrial engineering and management sciences, enjoyed a long and illustrious industrial career — with Ford



Frey enjoyed a long and illustrious industrial career — with Ford Motor Company, General Cable Corp. and Bell & Howell Company — before joining Northwestern in 1988.

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Frey was an elected member of the National Academy of Engineering and, in 1990, received the National Medal of Technology from President George H.W. Bush.

“It is sometimes easy to get lost in abstraction — having Don at Northwestern grounded us in reality,” said Julio M. Ottino, dean of Northwestern’s McCormick School of Engineering and Applied Science. “It was always good to have someone around who had carried a project to the very end.”

ity, Frey established the annual Margaret and Muir Frey Prize in 2001. Named for Frey’s late parents, the prize recognizes design creativity in the best senior capstone projects — projects that are designed by a student or team of students and are related to known problems or credible new products or processes.

In Frey’s mind, the roles of innovator and educator were indivisible.

“I teach from experience,” he said in a Northwestern magazine article in 2004. “I have a lifetime of industrial innovation. For me, teaching and innovation depend on one another. I don’t know how to separate them.”

Frey’s industrial career began at Ford in 1950. He became vice president and chief engineer at the company in 1964. While

At Northwestern, Frey taught graduate courses in innovation and entrepreneurship and information systems as well as Engineering Design and Communication to first-year engineers “to keep my foot in reality,” he said. Frey also mentored several doctoral students.

To reward McCormick undergraduates for interdisciplinary innovation and creativ-

at Ford, he was project manager for what would become the icon vehicle of an era, the original Ford Mustang. In April 1964, the car made its debut at the World’s Fair in New York.

He resigned from Ford in 1968 to become the president of the General Cable Corp.

In 1971, Frey was appointed president and chief executive officer of Bell & Howell, a position he retained for 17 years. In 1975, while at Bell & Howell and as a director of 20th Century Fox, he was responsible for the first high-volume integrated manufacture of videocassettes for the Hollywood movie industry. In 1985, under Frey’s leadership, Bell & Howell produced the first successful CD-ROM-based information system, initially designed for General Motors dealer service operations. He retired from the company in 1988 and then joined Northwestern.

During World War II, Frey served as an officer in the U.S. Army (1942-1946). He received his doctorate in metallurgical engineering at the University of Michigan, where he had also earned his bachelor’s and master’s degrees.

Frey lived in Evanston. He is survived by five children and a number of grandchildren.

Humanitarian Logistics

For **Karen Smilowitz** and **Irina Dolinskaya**, the term “industrial engineering” is a bit of a misnomer. It evokes the image of the engineer in a factory with a stop watch in hand, making sure production is as efficient as possible.

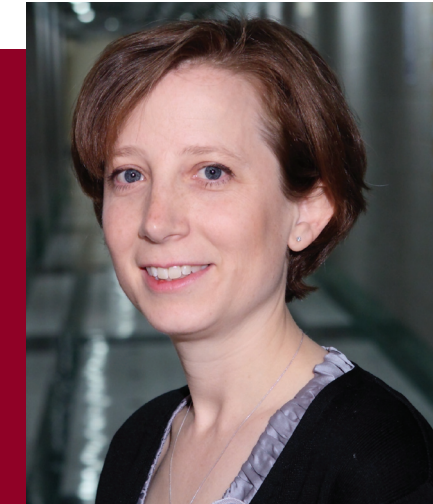
Some industrial engineers still do that. But these days, the term has grown beyond the factory and into the world of business. Smilowitz has taken it one step further — into nonprofits.

Smilowitz, associate professor of industrial engineering and management sciences and William A. Patterson Junior Professor in Transportation, has studied ways to optimize how freight is moved: how to reduce the distance of trucking routes, for example, or how to get companies to pool their resources and lower costs. More recently, however, she has taken that work and applied it to nonprofits, including finding the most efficient way to route library books and improving operations for a mobile asthma-care organization.

Now, she and Dolinskaya, assistant professor of industrial engineering and management sciences, are working together to use their operations research in a new area: disaster relief. It’s a field known as humanitarian logistics, and — as we’ve seen with disasters in New Orleans and Haiti, where workers faced roadblocks in distributing provisions to survivors — it could have far-reaching implications.

When Dolinskaya came to Northwestern in 2009, she and Smilowitz — whose offices are next door to each other — began to talk about collaborating. Smilowitz had done some work in disaster relief, and Dolinskaya’s had worked with the U.S. Navy in charting optimal courses for sea vessels using real-time data to continually update the route based on radar data about the sea’s roughness.

When the earthquake hit Haiti in January, Dolinskaya and Smilowitz started to think about how their research could apply to the relief efforts. They knew they had strengths in transportation and vehicle routing, so they began talking to relief organizations like FEMA and the Red Cross to get information on how disaster relief



Karen Smilowitz



Irina Dolinskaya

efforts usually work. “It seemed like a very natural coming together,” Dolinskaya says. “Karen was working on the distribution of goods. In order to distribute them, you’re trying to get to a destination, and you are learning about the environment as you are traveling — like what roads are impassable. I am interested in dynamically reevaluating a path as new information becomes available. It was a good fit.”

Their research program, which is just getting off the ground, consists of identifying best practices in relief-chain management and developing new design and operating policies that can complement those practices. They are particularly interested in last-mile relief distribution, creating optimization models that can help drivers choose routes and allocate inventory once supplies have been delivered to their destination.

“When a disaster happens, you have a set of aid recipients that are geographically dispersed,” Smilowitz says. “There is uncertainty: Maybe a road is no longer reliable, and you don’t know how long it’s going to take to get somewhere. How do you schedule visits? How do you build models that incorporate these uncertainties and take into account supplies, infrastructure, and the needs of the recipients? We don’t just want to solve one problem for one organization in

one disaster. We want to create models that incorporate baseline disaster scenarios.”

Smilowitz and Dolinskaya hope to not only come up with optimization models based on baseline disaster scenarios but also to create rules of thumb that workers can use on the ground. “Relief workers can’t use a model that they have to dynamically update and optimize every day,” Smilowitz says. “I think it’s one of the fun challenges to pare down these models into simple guidelines.”

Smilowitz and Dolinskaya are both affiliated with Northwestern’s Transportation Center and hope to work with professors there, including center director Hani Mahmassani, on extending the initiative to evacuation and disaster relief. Smilowitz says McCormick’s humanitarian logistics work is attracting graduate students with a background in quantitative research who are interested in using it for the greater good. “It is a way of approaching a problem, and students are learning it is one of the ways you can make an impact in the world,” she says.

Dolinskaya is learning that, too.

“I always wanted to help, but I never really thought I could use my industrial engineering degree to change the world,” she says. “The realization that I can is really exciting.”

Chair's Letter, continued

It is with sadness that I note the passing of Professor **Don Frey** on March 5, 2010. Don enriched our department in more ways than seem possible for any one individual. He taught students at all levels and was particularly influential in the MEM Program. His PhD students went on to careers in industry and academia. As a true titan of industry, Don provided a touchstone to practical reality in an academic department, yet he was a scholar in every sense of the word. He provided useful advice and provocative conversation to all who encountered him.

IEMS' educational programs continue to rank highly in *U.S. News & World Report*: 8th for the undergraduate program and 4th for the graduate program (both up one position from last year). But what pleases me more is that we are producing students who are sought after and successful in industry and academia.

IEMS will be trying to hire two new faculty members this year, emphasizing research and teaching in optimization and systems engineering. You will find a job announcement elsewhere in this newsletter.

Please remember to share your news with us, and come see us if you are in the Chicago area.

Barry L. Nelson, Department Chair

Applications Invited for a Faculty Position

We invite applications for two full-time, tenure-track professorial appointments, one at the assistant-professor level, and the other at the associate or full-professor level, to begin September 2011. Applicants should hold an earned PhD (or should be near completion of their doctoral studies in the case of assistant professor applicants) with a demonstrated research potential in industrial engineering and operations research. Individuals with research interests in optimization; logistics and health-care operations; energy; financial engineering; and systems engineering are

especially encouraged to apply. Industrial experience is desirable; a strong commitment to rigorous and relevant research is essential.

Applications must be submitted electronically to www.iems.northwestern.edu/career/. Materials to be uploaded include a cover letter and a curriculum vitae detailing educational background, research and work experience. For assistant professor candidates letters of recommendation from three references should be mailed or e-mailed directly to the address below; candidates currently holding associate or full-professor rank should provide complete contact information

for three references. To receive full consideration, all materials should be received by December 31, 2010, but earlier application is encouraged.

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Update from the IEMS Advisory Board

On April 30, 2010, the IEMS Advisory Board decided to "reengineer" itself to increase our effectiveness in supporting the IEMS department. We took the following actions:

- We strongly agreed to continue to support an annual "employment bootcamp," where we help improve the job search for IEMS students. We look forward to our next bootcamp in spring 2011 just before our advisory board meeting.
- We would like to offer ongoing support via mentoring to IEMS students in other areas where we have expertise, such as in doing effective consulting, starting businesses, hiring a team, and filing patents. We need to figure out how to setup this mentoring in a way that will attract the interest of students.
- We decided to have a president of our board. I accepted the role of president for the next year.
- We supported instituting three-year service terms for board members, with the option for the board member to continue serving if the board member is active.

We hope to be able to take on other projects to support the department starting at our next advisory board meeting.

Craig Asher, board president

Students Receive Hurter Academic Excellence Awards

Hurter Academic Excellence Awards were initiated in 2002 to honor Professor **Arthur Hurter**, who retired in 2001 after 38 years of teaching of which he was the department chair for 20 years from 1969 to 1989.

The awards are funded from an endowment established by donations from the students and colleagues of Hurter. Two awards are given each year; one to the best graduating senior and the other to the best first year graduate students.

In addition to academic performance, independent project work and leadership is considered. Each award consists of a certificate and a check for \$500.

Undergraduate finalists are identified by having the top GPA. The faculty then vote on the student they feel is most deserving of the award. For the best graduating senior, the award was given to **Theppahain Asvatanakul**.

For the best first year graduate student, the award was shared by **Dong Jae Lim** (advised by professor **Vadim Linetsky**) and **Changyheok Lee** (advised by professor **Sanjay Mehrotra**). First year graduate students in the PhD program are evaluated on their performance during the year. The entire faculty is invited to vote during the annual student review meeting.

IEMS also gives a \$100 award to the best graduate teaching assistant from the same endowment. Undergraduate students are invited to nominate their favorite TA and then the undergrad student body votes on those nominated. This year's award was given to **Ashley Davis** (advised by Professor **Sanjay Mehrotra**).

Congratulations to all award winners!

The Center for Sustainable Analytics

IEMS, under the direction of associate professor **Diego Klabjan**, will be laying the ground work for a center in analytics. Analytics, the science of arriving to decisions based on existing data, is at the forefront in many industries, from entrenched ones like transportation and consumer packaged goods to newer ones like those oriented around sustainability.

The Center for Sustainable Analytics (SAY) will bring together scholars from various disciplines and departments within Northwestern and industry partners with the focus on analytics and sustainability. The latest research developments and findings in sustainable analytics will be shared and applied on sponsored projects through industry collaborations. The industry members and IEMS participants will also enjoy opportunities to network through workshops

and meetings. SAY will provide an overarching umbrella for faculty, students, and industry representatives sharing experience, knowledge, and expertise in the analytics areas: data mining, optimization, statistics, forecasting, and simulation. The joint projects, exchanges of ideas, business needs, and best practices will provide the synergy among all of the involved parties. Member companies will be able to gain direct access to our students and a firsthand experience in up-to-date industrial and research innovations.

This is definitely an exciting opportunity to apply analytics in such emerging areas as renewable energy, green transportation, and the smart grid. IEMS has always had a very strong presence in the areas of operations research and analytics. With SAY we are taking a step further in bridging the gap between theory and practice by exploring the untapped value of IEMS faculty members. We are very excited and looking forward to establishing this prominent center.



The latest research developments and findings in sustainable analytics will be shared and applied on sponsored projects through industry collaborations.

McCormick

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Jie Xu Named Doctoral Dissertation Winner



Jie Xu received the third annual Geroge L. Nemhauser Dissertation Prize for his thesis, "Industrial Strength Theory and Algorithms for Discrete Optimization via Simulation and The Impact of Supply Chain Structure on Product Line Architecture." The award is given to the best doctoral dissertation in the department.

Xu, who received his PhD in 2009 and was advised by professors Wallace Hopp and Barry Nelson, will receive a cash award and a certificate.

"It is certainly a great honor for me to be awarded this prize," he says. "As a researcher, learning and researching is a lifelong experience. The prize will be a reminder for me to keep up the work and continue working on interesting and challenging research problems in the future."

Xu's thesis has two parts. The first part focuses on developing locally convergent algorithms that can solve discrete optimization via simulation problems of practical size. The second part explores the impact of a manufacturing firm's supply chain on its product line design architecture. Xu now works for United Airlines.

IEMS Hosts Statistics Conference

The Spring Research Conference on Statistics in Industry and Technology will be held at Northwestern on June 22-24, 2010.