

## **Operations Research Center**

The Operations Research Center (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 55th year of operation in 2007–2008. The ORC administers its own graduate programs and a varied research program of methodological and applied projects. It maintains a reading room with a small library as well as state-of-the-art computational workstations and a conference room equipped with distance-education equipment.

This report summarizes AY2007–2008 activities and briefly reviews its educational, research, and outreach programs.

### **Faculty, Students, Staff**

During AY2007–2008, Professors Cynthia Barnhart and Dimitris Bertsimas served as codirectors.

This year, the ORC had 48 affiliated faculty and senior staff, with faculty drawn from the MIT Sloan School of Management and the Departments of Electrical Engineering and Computer Science, Civil and Environmental Engineering, Economics, Mathematics, Aeronautics and Astronautics, Mechanical Engineering, Nuclear Science and Engineering, and Urban Studies and Planning.

The ORC offers two interdepartmental graduate degree programs, a PhD and a master's degree. During the past year, these programs enrolled 54 students—42 PhD candidates and 12 SM candidates. The ORC conferred eight master's degrees and six PhDs. Several other PhD theses were in the final stages of completion in summer 2008.

### **Academic Programs**

The ORC's academic programs continue to be recognized as ranking among the very best nationally and internationally. Moreover, the programs are repeatedly cited as achieving an excellent balance between application and methodological domains.

### **Research Activities**

Research activities spanned a wide spectrum of methodological topics and applications, ranging from small, unsponsored projects involving one faculty member supervising a student's thesis to larger sponsored programs involving several faculty, staff, and students.

Methodological research includes topics such as linear, nonlinear, and combinatorial optimization; solution methods for integer programming; interior point methods for linear and nonlinear programming; dynamic programming; cluster analysis; parallel and distributed computation and algorithms; network flow algorithms; network design; probabilistic combinatorial optimization; deterministic and stochastic facility location; queuing theory, including queuing networks; risk analysis; stochastic processes; classical and Bayesian statistics; game theory; and decision analysis and statistical decision theory.

ORC faculty are currently contributing to application domains as wide ranging as manufacturing, communications, transportation, public services, logistics, marketing, financial services, health care, and nuclear engineering. Current projects address topics such as air traffic control, epidemiology, AIDS testing, life-cycle modeling of municipal solid waste, safety, risk analysis and network design in air transportation, telecommunication network design, supply-chain management, production scheduling, transportation logistics, and diseases and disasters.

Several organizations sponsored research projects at the ORC during 2007–2008, including the National Science Foundation (NSF), Draper Laboratory (several projects and Draper fellowships), General Motors, Lincoln Laboratory, Logistics Management Institute, Office of Naval Research, and the Singapore/MIT Alliance Program.

### **Outreach and Professional Service**

During the past year, the ORC implemented a number of initiatives that we had long identified as goals for the Center.

*ORC Newsletter:* The ORC reinstated the tradition of a biannual newsletter, “News from the ORC,” and circulated our first newsletter to the ORC community (alumni, faculty, and students). The second edition of “News from the ORC” will be distributed during the end of summer 2008. We received positive feedback from our alumni regarding the newsletter, and this has helped us to reconnect.

*Developing Distance-Education Capabilities:* With funding from the Provost’s Office and faculty donations, the ORC installed state-of-the-art distance-education equipment in a recently renovated conference room at the Center. Our plan is to offer short executive education courses within the upcoming year. The ORC has already contacted key faculty and begun to develop the associated logistical plans.

*Renovating the ORC to Create Student Office Space:* Because of the increasing number of students matriculating to the Center, the ORC expanded its current facilities to include an additional area to house students. A new student room was created and is able to accommodate eight students.

*Reviewing Statistics Courses at MIT:* Navigating the MIT course catalogue in search of statistics subjects has for years been a challenge for Operations Research students and faculty. With recent hires at MIT in engineering, management, and economics, to name a few, the statistics landscape is changing rapidly. To assist MIT students and faculty interested in statistics, the ORC took the lead in cataloguing subjects with significant statistics content and provided this information to the MIT community. The project was undertaken by two ORC doctoral students, Margrét Bjarnadóttir and David Czerwinski, and involved data gathering—contacting department heads to determine which subjects they use to satisfy statistics requirements, searching the MIT course catalogue for courses in statistics, etc.; and creating a “virtual” website that listed the courses offered in statistics at MIT, with accompanying materials including syllabi, names of faculty who teach or conduct research in statistics, etc. The website can be found at <http://scripts.mit.edu/~statistics/>. We plan to expand this website to include additional

information of importance to the field of statistics, including statistical software. The funding for this project was generously provided by the School of Engineering.

*Ensuring the Continued Ability to Support Graduate Students:* The ORC has increased its efforts to submit research proposals to obtain significant sized, collaborative research grants. The ORC submitted two large proposals to NSF last year, and one of them (a team composed of Cynthia Barnhart, Dimitris Bertsimas, Amedeo Odoni, and Georgia Perakis together with Constantine Caramanis from the University of Texas at Austin ) on “the national air-transportation system as a re-configurable engineered system” received \$2 million from the NSF for the next four years. In addition, the ORC received funding from the Air Force Office of Scientific Research through a grant submitted by Professors Retsef Levi and Thomas Magnanti.

*Distinguished Seminar Series:* The ORC has initiated a tradition of inviting a very senior person in the field of operations research to spend two weeks at MIT and interact with our faculty and students. Our distinguished speaker during 2007–2008 was Michael Ball from the University of Maryland. Professor Ball stayed at the ORC for several days and presented and participated in a number of seminars and meetings during his stay.

*Seminar Series:* The ORC Weekly Seminar Series was privileged to have many distinguished speakers from industry and academia this year. The operations research professionals who made presentations included Damon Wischik (University College London), Eitan Bachmat (Ben-Gurion University), Rekha Thomas (University of Washington), Shang-Hua Teng (Boston University), Eva Lee (Georgia Institute of Technology), Pascal Van Hentenryck (Brown University), Jorge Vera (Catholic University of Chile), Matthew Jackson (Stanford University), Roman Kapuscinski (University of Michigan), Thomas McCormick (University of British Columbia), Gérard Cornuéjols (Carnegie-Mellon University), Michael Ball (University of Maryland), John Liechty (Pennsylvania State University), Peter Glynn (Stanford University), John Birge (University of Chicago), Mahesh Nagarajan (University of British Columbia), and Jonathan Kelner (MIT).

The ORC also offered, during January independent activities period, a full-day session entitled “Commercial Operations Research” in which several talks were presented on operations research in marketing and finance. Speakers included Michael Braun, Chris Johnson, Srinivas Bollapragada, Kete Chalermkraivuth, Dr. Jason Black, and Dr. Jens Alkemper.

## **Future Plans**

The ORC program is currently in a stable condition and does not face any unusual challenges. Still, a number of issues were identified over the last year that we will need to explore in the future. These include:

- Identifying new, important application domains for operations researchers
- Raising funds for ORC’s newly established Future Fund and Fellowship Fund
- Building stronger connections with alumni

- Improving and streamlining course offerings
- Increasing the visibility of the ORC both internally and externally and increasing its impact
- Increasing diversity and representation of minorities
- Revisiting the ORC master's program
- Evaluating the participation of the ORC in international initiatives

## Diversity

The ORC has always attempted to build diversity and to provide an environment that is responsive to the varied professional and personal needs of MIT's operations research community. The staff of the ORC is composed of two support staff members and one administrative officer. Of these three staff, two are women and one is African American. As for the student population, 12 of our graduate students are women and one doctoral student is an underrepresented minority. Over the past years, we have made efforts to attract qualified women and underrepresented minorities to our graduate programs by targeting information to math departments in liberal arts colleges and by sending information to historically black colleges.

## Professional Activities

### ORC Faculty

Hamsa Balakrishnan was the recipient of an NSF CAREER Award in February 2008. She also received the T. Wilson Career Development Chair from the Department of Aeronautics and Astronautics in July 2007.

Arnold Barnett won the Excellence in Teaching Award from the Sloan School of Management for the undergraduate course he taught, 15.075, Applied Statistics.

Cynthia Barnhart received the Roger-Charbonneau Prize for best book published, *Handbook in Transportation* (with coeditor Gilbert Laporte from HEC Montreal), in 2007.

Dimitris Bertsimas became an INFORMS Fellow.

Robert Freund received the Longuet-Higgins Prize of the IEEE Computer Society (for computer vision and pattern recognition).

David Gamarnik will serve as a plenary speaker for the Sixth International Conference on Matrix-Analytic Methods in Stochastic Models (MAM6) Beijing, P. R. China, June 11–14, 2008.

Richard Larson received the honor of being selected to serve as a member of the Institute of Medicine's Board on Health Sciences Policy.

Retsef Levi won the Outstanding Teaching Award from the Sloan School of Management for MBA teaching for 15.760, Introduction to Operations Management, the core MBA class in operations management.

John Little received the honor of “Classic Hit.” A paper by Peter Guadagni and John Little published in 1963 and titled “A Logit Model of Brand Choice Calibrated on Scanner Data,” was reprinted in a “Classic Hits” issue of *Marketing Science* in January 2008.

Thomas Magnanti received an honorary doctoral degree from Technion University in June 2007. In addition, he was awarded the Harold Lardner Prize, Canadian Operations Research Society, in May 2008.

James Orlin was a cowinner of the INFORMS Computing Society Prize for the best publication on the interface of operations research and computer science in 2007. The winning paper was “On the Sum-of-Squares Algorithm for Bin Packing” coauthored with Janos Csirik, David Johnson, Claire Kenyon, Peter Shor, and Richard Weber. Jim was also a cowinner of the Leonard G. Abraham Prize, given annually to the best original paper published in *IEEE Journal on Selected Areas in Communications* in the past year. The award is for the paper “Preconfiguring IP-over-Optical Networks to Handle Router Failures and Unpredictable Traffic,” coauthored with Murali Kodialam, T. V. Lakshman, and Sudipta Sengupta.

Asuman Ozdaglar was awarded the 2008 AACC Donald P. Eckman Award. This award is “for contributions to optimization theory, game theory and its applications to congested markets, and learning in large networks with applications to human and social networks.”

Georgia Perakis and her former PhD student Guillaume Roels (ORC alumnus) received honorable mention for the TSL Best Paper Award for their paper “An Analytical Model for Traffic Delays and the Dynamic User Equilibrium Problem” that appeared in the journal *Operations Research* 54(6): 1151–1171, November–December 2006.

Andreas S. Schulz’s paper “Efficiency and Fairness of System-Optimal Routing with User Constraints” (with N. E. Stier Moses) received the Glover-Klingman Prize for the best paper published in the journal *Networks* during the year 2006. The prize was awarded in 2007.

John Tsitsiklis became an INFORMS Fellow.

### **ORC Students**

Megan Gaudet received the New England University Transportation Center Outstanding Student of the Year awarded by the United States Department of Transportation on January 12, 2008. This award is in “recognition of outstanding achievement in and contribution to transportation research and education.”

Thibault Le Guen received the Robert Guenassia Award from MIT in May 2008. He was also honored as “best French student in double degree exchange” by Ecole Centrale, Paris, in December 2007.

Michael Metzger received the Martin Fellowship for Sustainability in September 2007. Mike also came in second place at the National Academy of Sciences Graduate Student Conference. Last but not least, Mike received second place in a poster session at the Department of Homeland Security University Network Summit.

Karima Nigmatulina was awarded first place for her presentation at the Student Forum on Science and Technology Policy (organized by the National Academy of Sciences) in January 2008.

Pamela Pei received an honorable mention for the Manufacturing and Service Operations Management Society (MSOM) Student Paper Competition in November 2007.

Alex Rikun received an NSF honorable mention in 2008.

Premal Shah received the best student paper award for the Financial Services Section at INFORMS in November 2007.

Nelson Uhan received first place at the INFORMS George Nicholson Student Paper Competition in November 2007. The competition is held each year to honor outstanding papers in the field of operations research and the management sciences written by a student.

### **ORC Alumni**

Rajan Batta received the David F. Baker Distinguished Research Award from the Institute of Industrial Engineers (IIE) in May 2008. This is the highest available research award from IIE.

Timothy Chan received first place in the INFORMS George B. Dantzig Dissertation Award in November 2007. The George B. Dantzig Award is given for the best dissertation in any area of operations research and the management sciences that is innovative and relevant to practice.

Thomas M. Cook and Marshall L. Fisher received the George E. Kimball Medal, which is awarded for recognition of distinguished service to the Institute and to the profession of operations research and the management sciences.

Craig Kirkwood received the Frank P. Ramsey Medal, which is the highest award of the INFORMS DAS. It was created to recognize distinguished contributions to the field of decision analysis.

Edward A. Silver, ScD 1963, was selected in 2007 as the recipient of the Harold Larnder Memorial Prize of the Canadian Operational Research Society. The prize honors individuals for distinguished international achievement in operational research.

Melvyn Sim (National University of Singapore) and David Brown (Duke University) received first place in the paper competition for the INFORMS Junior Faculty Interest Group.

Garrett Van Ryan received a MSOM Distinguished Fellows Award.

Stefanos A. Zenios (and Chris P. Lee) received the Pierskalla Best Paper Award, which recognizes research excellence in the field of health care management science.

**Cynthia Barnhart**  
**Codirector**  
**Professor of Civil and Environmental Engineering**

**Dimitris Bertsimas**  
**Codirector**  
**Boeing Professor of Operations Research**

*More information about the Operations Research Center can be found at <http://web.mit.edu/orc/www/>.*