

Operations Research Center

The Operations Research Center (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 57th year of operation in 2009–2010. 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 the center's AY2010 activities and briefly reviews its educational, research, and outreach programs.

Faculty, Students, and Staff

In early fall 2009, professor Cynthia Barnhart announced her decision to step down as codirector of the Operations Research Center and concentrate on her role as associate dean for academic affairs in the School of Engineering. After an extensive internal consultative process, professor Claude Canizares, MIT vice president for research, announced in January 2010 that professor Patrick Jaillet would join professor Dimitris Bertsimas as the new codirector effective June 1, 2010, following his return from sabbatical.

During AY2010, ORC had 46 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.

ORC offers two interdepartmental graduate degree programs: a PhD and a master's degree. During the past year, these programs enrolled 57 students—46 PhD candidates and 11 SM candidates. ORC conferred four master's degrees and six PhDs. Several other PhD theses were in the final stages of completion in summer 2010.

Academic Programs

ORC's academic programs continue to be recognized as 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, 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 such topics 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; online 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 also contributing to application domains as wide ranging as manufacturing, communications, transportation, public services, logistics, marketing, financial services, health care, and nuclear engineering. Current projects are addressing such topics 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, and transportation logistics, diseases, and disasters.

Several organizations sponsored research projects at ORC during 2009–2010, including the National Science Foundation, Draper Laboratory (several projects and Draper fellowships), General Motors, Lincoln Laboratory, the Air Force Office of Scientific Research, the Office of Naval Research, and the Singapore-MIT Alliance.

Outreach and Professional Service

During AY2009, ORC formed two committees: a committee to investigate the restructuring of requirements for the doctoral program, with the ultimate objective of improving the placement of our graduates in academic jobs, and a committee to investigate the restructuring of our master's program, with the ultimate objective of offering a new, enhanced, and larger program that would have a higher impact in the community at large.

The first committee, composed of professors David Gamarnik, Patrick Jaillet, Retsef Levi, Tom Magnanti, Georgia Perakis (chair), and John Tsitsiklis, presented its findings and submitted a report in spring 2009. It praised the doctoral program and made several recommendations for possible improvements, including the possibility of implementing tracks/specializations. During AY2010, ORC followed up and formed three subcommittees charged with evaluating the feasibility of starting such tracks/specializations in three specific areas: the Operations Management Subcommittee, composed of professors Steve Graves, Retsef Levi, Georgia Perakis (chair), and Don Rosenfeld; the Networked Systems Subcommittee, composed of professors Patrick Jaillet (chair), Tom Magnanti, and John Tsitsiklis; and the Economics/Finance Subcommittee, composed of professors Dimitris Bertsimas (chair), Andy Lo, and Asuman Ozdaglar. Following the submission of reports and a spring 2010 faculty meeting where the various findings were discussed, ORC is planning to focus this upcoming year on the detailed implementation of two of these tracks/specializations (operations management and networked systems).

The second committee is composed of professors Steve Graves, Patrick Jaillet, Rama Ramakrishnan, Don Rosenfeld, Andreas Schulz (chair), and Yossi Sheffi. We plan to continue exploring that committee's recommendations on the master's program with the senior MIT leadership.

Ensuring the Continued Ability to Support Graduate Students

ORC has increased its efforts to submit research proposals in order to obtain significant-sized, collaborative research grants. One example is the newly funded SMART (Singapore-MIT Alliance for Research and Technology) “Future Urban Mobility” research program. The goal of the proposed project is to develop, in and beyond Singapore, a new paradigm for the planning, design, and operation of future urban mobility systems. Such systems, aimed at both passengers and freight, will materially enhance sustainability and societal well-being on a global scale. This is a particularly opportune time to address this topic due to a confluence of relevant developments: advances in computing, communications, and sensing technologies; the great progress that has been made in recent years in our ability to model, evaluate, and optimize urban mobility systems; the growing importance of environmental sustainability issues; the aging of physical infrastructure in developed countries and the need for massive new infrastructure in less developed ones; and the vast economic stimulus that can be provided by the modernization and renewal of urban mobility systems worldwide. Three ORC-affiliated faculty are among the 10 main MIT principal investigators for the project: professors Cynthia Barnhart, Patrick Jaillet, and Amedeo Odoni (project director).

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 Stephen Boyd (Stanford University), Srinivas Bollapragada (General Electric Global Research Center), Santosh Vempala (Georgia Tech), Jon Kleinberg (Cornell University), William Hogan (Harvard University), Susan Athey (Harvard University), R. Ravi (Carnegie Mellon University), Ananth Iyer (Purdue University), David Morton (University of Texas at Austin), Wuqin Lin (Northwestern University), Cynthia Rudin (MIT), Alexandre d’Aspremont (Princeton University), Terry Friesz (Penn State), Vineet Goyal (MIT), Garud Iyengar (Columbia University), Paul Glasserman (Columbia Business School), Maria Chudnovsky (Columbia University), Robert Kleinberg (Cornell University), Alexander Barvinok (University of Michigan), and Yinyu Ye (Stanford University).

ORC also offered, during January Independent Activities Period (IAP), a full-day session titled “Operations Research in the Military” in which several talks focused on supply chain optimization and demand forecasting for aircraft parts, risk mitigation for operations around improvised explosive devices, robust planning for military logistics and transportation, and scheduling for force protection. The speakers included Eric Zarybnisky (MIT), Chris Marks (MIT), Steven J. Clark (Analytics Operations Engineering), and Stephan Kolitz (Draper Laboratories).

Future Plans

The ORC program is stable and does not face any unusual challenges, with the possible exception of the operational budget cuts across the Institute. We are, however, confident that we will be able to work out a plan during AY2011 in order to accommodate the requested long-lasting budget reduction.

With respect to academic programs (as discussed above), we plan to implement the recommendations of the various PhD committees and explore the offering of the new enhanced master's program for AY2011. We also plan to explore possible further synergies and collaboration with other units within MIT, in particular the Laboratory for Information and Decision Systems (LIDS), where strong links already exist.

Diversity

ORC has always attempted to provide an environment that is responsive to the varied professional and personal needs of the operations research community at MIT and that builds diversity.

During AY2010, the staff of ORC was composed of two support staff members and one administrative officer. Of these three staff, two are women and one is African American. Eleven of our current graduate students are women.

Over the past several 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

Cindy Barnhart was elected to the National Academy of Engineering (February 2010).

Dimitri Bertsekas received the INFORMS Expository Writing Award (November 2009). This award honors an operations researcher/management scientist whose publications demonstrate a consistently high standard of expository writing.

Gabriel Bitran was named as a Distinguished Fellow of the Manufacturing and Service Operations Management Society (June 2009). In addition, Gabriel received the INFORMS Revenue Management and Pricing Section Historical Award (2009). This award recognizes critical contributions to the science of pricing and revenue management published in English prior to 1999.

John D.C. Little was honored at the "John D.C. Little Festschrift Celebration" at the 2009 INFORMS Marketing Science Conference, held at the University of Michigan (June 2009). A festschrift is a volume of papers written to honor an individual, which in John's case will eventually include about 20 papers and be published in 2010. Among John's achievements, he is well known for Little's Law in queuing, decision calculus models for marketing managers, his paper on marketing decision support systems, and his role in creating marketing science as a field.

Tom Magnanti was officially appointed as the founding president of the Singapore University of Technology and Design (October 2009).

Eytan Modiano received the American Institute of Aeronautics and Astronautics Undergraduate Teaching Award (May 2010).

Georgia Perakis was named the Williams F. Pound professor of operations research and operations management.

Don Rosenfield received the Engineering Systems Division's Joseph A. Martore Excellence in Teaching Award (May 2010).

Cynthia Rudin received the Best Poster Award at the Eighth International Conference on Machine Learning and Applications (2009).

Andreas Schulz was named the Patrick J. McGovern professor of management.

David Simchi-Levi and his coauthor Xin Chen (an ORC alumnus) won the INFORMS Revenue Management and Pricing Section Prize for their papers on coordinating inventory and pricing strategies in the supply chain (October 2009).

John Tsitsiklis delivered the Applied Probability Society Markov Lecture at the INFORMS Annual Meeting (October 2009).

ORC Students

Doug Fearing was awarded the Anna Valicek Medal by the Airline Group of the International Federation of Operational Research Societies (October 2009). This award recognizes original and innovative research in the application of operations research to airline and/or airline-related business problems.

Benjamin Hung received the General Omar N. Bradley Research Fellowship for Mathematics (September 2009).

Dan Iancu was awarded the INFORMS Optimization Society Student Paper Prize (October 2009); also, he received an IBM Goldstine Fellowship (February 2010) and the Outstanding Teaching Assistant Award from the Sloan School of Management (May 2010).

Rajiv Menjoge received the MIT Sloan School Excellence in Teaching Award (May 2010).

Cong Shi won first prize in the INFORMS 2009 Nicholson Student Paper Competition (October 2009).

Theophane Weber was a finalist in the INFORMS 2009 Nicholson Student Paper Competition (October 2009).

ORC Alumni

Margaret Brandeau (Stanford) and Garret van Ryzin (Columbia) became INFORMS fellows (October 2009).

Edward Kaplan (Yale) received the INFORMS Philip McCord Morse Lectureship Award (October 2009).

Ralph Keeney (Duke) was awarded the INFORMS President's Award (October 2009). This award recognizes, and thereby encourages, important contributions to the welfare of society by members of our profession at the local, national, or global level.

Susan Martonosi (Harvey Mudd College) and Amr Farahat (Cornell) received first place in the INFORMS Case and Teaching Materials Competition (October 2009). The purpose of this annual competition is to encourage the creation, dissemination, and classroom use of new, unpublished cases in operations research and the management sciences.

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