

Engineering Systems Division

MIT's Engineering Systems Division (ESD) represents a bold educational and research initiative aimed at establishing engineering systems as a field of study and advancing theory, policy, and practice in this domain. Within MIT, ESD is an interdisciplinary academic unit spanning most departments within the School of Engineering as well as the School of Humanities, Arts, and Social Sciences; the Sloan School of Management; the School of Science, and lately the School of Architecture and Planning.

ESD research focuses on complex systems of national and international importance involving technology, organizations, and society. In so doing, ESD brings together students and engineering, management, and social sciences faculty interested in researching large-scale, complex engineering systems. The division focuses on four complex, technology-based domains: health care delivery, energy and the environment, extended enterprises, and critical infrastructure systems. While technology is a fundamental part of these systems, so too are issues of managerial and societal interactions. ESD faculty and students have forged novel industry-government-academic relationships in their work with hundreds of enterprises.

Nearly 50 faculty members, all holding dual or joint appointments within ESD and one of the aforementioned units, are devoted to teaching and research in the emerging field of engineering systems. Approximately 370 students are enrolled in ESD's five master's programs, plus another 60 students in our [PhD program](#). All are working to understand, model, and predict the behavior of technologically enabled complex systems in order to help the engineering profession address contemporary critical issues and better serve humankind. Academic year 2008 was marked by significant accomplishments.

Faculty

Professor Yossi Sheffi was named ESD director on September 24, 2007, by Professor Subra Subresh, dean of MIT's School of Engineering. Professor Sheffi – whose appointment became effective on November 15, 2007 – received his BSc from Israel's Technion in 1975, his SM from MIT in 1977, and his PhD from MIT in 1978. He holds faculty appointments in the Engineering Systems Division and the Department of Civil and Environmental Engineering. An expert in systems optimization, risk analysis, and supply-chain management, Professor Sheffi serves as director of the MIT Center for Transportation and Logistics (CTL), a position he continues to hold as ESD director (Dr. Chris Caplice took over day-to-day responsibilities at CTL). Under his leadership, the Center has experienced substantial growth, launching many educational, research, and industry/government outreach programs.

Professor Sheffi is the author of numerous research articles and two books, including the best seller *The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage*, published by MIT Press in 2005. It received rave reviews from *The New York Times*, *The Wall Street Journal*, and *The Economist*, as well as dozens of trade publications. The *Financial Times* chose it as one of the best business books of 2005 and it was *ForeWord* magazine's "2005 Book of the Year" in the business and economics category.

Since 1998, Professor Sheffi has served as the director of MIT's Master of Engineering in Logistics degree program (MLOG), which he founded. It has grown from attracting 17 applications at its inception to hundreds of applications today, and has inspired the creation of dozens of similar programs worldwide. In 2003, Professor Sheffi founded and has since led the MIT-Zaragoza International Logistics Program, an international collaboration among academia, industry, and government. This program has led to substantial economic growth in Aragón, and in 2006, Professor Sheffi received Aragón's presidential award for "the most substantial contribution to the regional economy."

Outside the Institute, Professor Sheffi has consulted with numerous governments and leading manufacturing, retail, and transportation enterprises around the world. He is also an active entrepreneur, having founded five successful companies, and is a sought-after speaker for corporate and professional events.

Professor Sheffi has been recognized with numerous awards and honors in academic and industry forums and was on the covers of *Purchasing* and *Transportation and Distribution* magazines. In 1997, he won the Distinguished Service Award, the highest honor given by the Council of Supply Chain Management Professionals. He is also a life fellow of Cambridge University's Clare Hall College.

In his announcement, Dean Suresh thanked Institute Professor Joel Moses, who graciously served as the interim director of ESD since January 2006.

At the end of AY2008, Olivier L. de Weck, associate professor of aeronautics and astronautics and engineering systems, was named ESD associate director, effective July 1, 2008. Professor Sheffi said Professor de Weck will "help define the intellectual footprint of ESD" in coming years. Professor de Weck's research interests, teaching emphasis, and professional experience are mainly in systems engineering for changeability and commonality, and space systems design for exploration and logistics. He works with large-scale systems that exhibit high levels of technological, human, and organizational complexity, and his contributions include time-expanded decision networks that provide a methodology for designing long-lived, evolvable complex systems.

Professor de Weck holds a Diplom-Ingenieur in industrial engineering from ETH Zurich (1993) and an SM (1999) and a PhD (2001) in aerospace systems engineering from MIT. Before joining MIT he was a liaison engineer and later engineering program manager on the Swiss F/A-18 aircraft program at McDonnell Douglas (1993–1997). He is an associate fellow of the American Institute of Aeronautics and Astronautics (AIAA), winner of the 2006 Frank E. Perkins award for excellence in graduate advising, and recipient of the 2007 AIAA Multidisciplinary Design Optimization Technical Committee's outstanding service award. He held the Robert Noyce career development professorship from 2002 to 2005, has more than 100 journal and conference publications in the area of systems engineering and space systems design, and has received research funding from General Motors (GM), National Aeronautics and Space Administration (NASA), BP, Jet Propulsion Laboratory, ArvinMeritor, Defense Advanced Research Projects Agency (DARPA)/Air Force Research Laboratories, and the Alfred P. Sloan Foundation.

Professor de Weck received a tenure appointment in spring 2008, as did Professor Daniel E. Frey. Both professors' work was recognized as being fundamental to the growing field of engineering systems.

Professor Frey is Robert N. Noyce career development professor and associate professor of mechanical engineering and engineering systems. He holds a PhD in mechanical engineering from MIT (1997), an MS in mechanical engineering from the University of Colorado (1994), and a BS in aeronautical engineering from Rensselaer Polytechnic Institute (1987). Before joining MIT, he served as a naval officer, during which time he qualified as a carrier-based jet pilot and was an intelligence analyst for counter-narcotics operations. Professor Frey's research concerns robust design of engineering systems. Robust design is a set of engineering practices whose aim is to ensure that engineering systems function despite variations due to manufacture, wear, deterioration, and environmental conditions.

Professor Frey's numerous awards and honors include best paper awards from the American Society of Mechanical Engineering (ASME) and the International Council on Systems Engineering (INCOSE), the Junior Bose Award for Excellence in Teaching in 2006, a best paper award from INCOSE in 2005, an National Science Foundation (NSF) CAREER award in 2004, the MIT Department of Aeronautics and Astronautics Teaching Award in 2000, the Everett Moore Baker Memorial Award for Outstanding Undergraduate Teaching at MIT in 1999, and an R&D 100 Award in 1997. He received the Joint Service Commendation Medal for his service in the armed forces in 1991, and served as the first adviser to PBS's Peabody Award-winning program, *Design Squad*.

During AY2008, Professor Frey was named to oversee admissions for ESD's PhD program. Nancy Leveson, professor of aeronautics and astronautics and engineering systems, was named to oversee ESD's PhD program, replacing Richard de Neufville, professor of civil and environmental engineering and engineering systems, who is now on sabbatical.

We are pleased to announce that Mort David Webster has joined the ESD faculty as an assistant professor. Professor Webster, who had been a visiting professor in MIT's Department of Earth, Atmospheric, and Planetary Sciences and the MIT Joint Program on the Science and Policy of Global Change, is interested in exploring the interface between formal quantitative models and the policy process. His research focuses on how to analyze the uncertainty in assessment models of global climate change to produce insights that are useful to the policy community—including addressing the role of learning in the future on today's decisions, the effect of uncertainty on multistakeholder negotiations, and better means of communicating results to nonexperts. He becomes the first junior member of the faculty with an ESD-only appointment.

Professor Webster earned his PhD from ESD in 2000 with a dissertation about decision-making and climate policy. He holds an MS from MIT's Technology and Policy Program (1996) and a BSE in computer science and engineering (1988) from the University of Pennsylvania. He was an assistant professor of public policy at the University of North Carolina at Chapel Hill from 2001–2006 and a research associate with MIT's Joint

Program on the Science and Policy of Global Change from 2000–2001. He is an associate editor of *Energy Economics*.

Mary (Missy) Cummings also joined the ESD faculty in 2008 as associate professor of aeronautics and astronautics with a joint appointment in engineering systems. She is also director of the Humans and Automation Laboratory. Her research interests include human supervisory control, human–unmanned vehicle interaction, bounded collaborative human–computer decision making, direct-perception decision support, simulation and evaluation of human interaction in automated systems, and the ethical and social impact of technology. Her previous teaching experience includes instructing for the US Navy at Pennsylvania State University and as an assistant professor for the Virginia Tech Engineering Fundamentals Division. Cummings received her BS in mathematics from the United States Naval Academy in 1988, her MS in space systems engineering from the Naval Postgraduate School in 1994, and her PhD in systems engineering from the University of Virginia in 2003. A naval officer and military pilot from 1988–1999, she was one of the Navy’s first female fighter pilots.

Currently there are 49 ESD faculty members: 36 in engineering, 10 in management, one in science, and two in humanities, arts, and social sciences. Twenty-four hold dual appointments, 23 hold joint appointments, and two hold full-time appointments. ESD is also home for two professors of the practice. In addition, there are eight members of the teaching staff.

As a division, ESD establishes an intellectual home for key programs and centers, engages faculty across departments and disciplines, and fosters discourse about engineering innovation, all oriented around the issues of engineering systems. In addition to the ESD SM, master’s-level programs include Leaders for Manufacturing (LFM), the Master of Engineering in Logistics (MLOG), System Design and Management (SDM), and Technology and Policy (TPP). A PhD is offered in Engineering Systems.

Now in their fifth year, the Engineering Systems PhD and Engineering Systems SM programs admitted the fifth full classes of 13 ESD PhD and three ESD SM students. An additional 23 ESD SMs entered LFM in June 2008 (Class of 2010). Graduating this academic year were 11 ESD PhDs, three ESD SMs, and 21 LFM ESD SMs.

ESD has three affiliated research centers: the Center for Engineering Systems Fundamentals (CESF); the Center for Technology, Policy, and Industrial Development (CTPID); and the Center for Transportation and Logistics (CTL). These centers are described later in this report.

Ongoing Initiatives

Graduate Education

During the past academic year, ESD made important strides on its PhD, the intellectual core of the division. An ad hoc committee composed of Professors Balakrishnan, Carroll, Larson, Magee, Sheffi, and Sussman (chair) developed a new program structure for the doctorate, which was approved by the ESD faculty in January 2008. The program

is based on a core of “fundamental engineering systems thinking” subjects; this is the knowledge that we expect all engineering systems doctoral students to have regardless of their methodological or applications interests. This core is complimented by depth in three areas, including methodology, domain/context, and advanced engineering systems thinking. This new program structure goes into effect for the doctoral students entering the program in September 2008.

Undergraduate Education

In spring 2006, ESD launched a new undergraduate subject, FAMES, or Frameworks and Models in Engineering Systems (ESD.04). Taught in conjunction with 1.041J Engineering System Design, in the Department of Civil and Environmental Engineering (CEE). This mirrors Professor Joseph Sussman’s appointment as a dual faculty member in ESD and CEE. The subject was offered again in spring 2007, but not in spring 2008 (due to Professor Sussman’s sabbatical). Considerable development work on the course has been undertaken, however, and it will be again offered in spring 2009.

This class is a complex system design project-oriented subject. In the past, it has used the case of transportation of spent nuclear fuel to Yucca Mountain, Nevada, a complex technical problem within a challenging societal context. This coming year, the class will likely be directed toward “The Metropolitan Region as a Complex System.” The class uses the construct of complex, large-scale, interconnected, open, sociotechnical (CLIOS) systems and the CLIOS Process to study such systems.

MIT Portugal Program

The MIT Portugal Program, launched in October 2006, is a strategic investment in people, knowledge, and ideas by the Portuguese government to strengthen the country’s knowledge base and international competitiveness. The program involves MIT, together with government, academia, and industry in Portugal, in the development of education and research programs in engineering systems.

The MIT Portugal Program is hosted by ESD and is led at the Institute by ESD’s founding director, Professor Daniel Roos, who serves as director of the MIT Portugal Program. The program’s engineering systems focus gives emphasis to large-scale systems that not only have critical technological components, but also have significant enterprise and sociotechnical-level interactions that call for engineers in leadership positions to have the kind of training in engineering systems that goes beyond traditionally defined engineering disciplines. The program also includes collaborations with various other MIT departments, divisions, and schools.

The Institute’s role is to pursue its engineering systems-related research and teaching in the program’s focus areas and to collaborate on activities implemented in Portugal. The four focus areas are engineering design and advanced manufacturing (EDAM), transportation systems, sustainable energy systems, and bio-engineering systems. ESD faculty serving in leadership roles include Professors Joel P. Clark and Christopher L. Magee, co-leads, EDAM; Professor David Hunter Marks, lead, sustainable energy systems; and Professor Dava Newman, lead, bio-engineering systems. In addition, a

separate integrative program in engineering systems has been developed with several research projects led by MIT faculty in collaboration with Portuguese partners.

In 2007–2008, the MIT Portugal Program successfully launched four new PhD programs associated with the four focus areas and three advanced study courses in three of the areas: transportation systems, engineering design and advanced manufacturing, and sustainable energy systems. MIT ESD faculty and faculty from other departments have played a major teaching role in these degree courses.

Research projects supported by the program are also in development; these involve many faculty members from MIT working in concert with Portuguese researchers and MIT Portugal PhD students.

The program has also begun a Distinguished Lecture Series in Portugal to highlight cutting-edge work in science and technology, bringing top innovators to Portugal to share their work relevant to education, research, industry, and society.

MIT ESD–MITRE Collaboration

The long-term objective of the ESD–MITRE collaboration is to perform joint research related to many aspects of the engineering of complex systems. The partnership has continued this year with two continuing research projects. The first of these projects, Enterprise Dynamics and Modeling, included plans for a workshop in summer 2008. The second project, Social Contexts of Enterprise Systems Engineering, has developed several case studies that will be released to the public in the next year.

Faculty Notes

The Instituto Superior Técnico (IST) of Lisbon, Portugal, has named four members of the ESD faculty as full professors in various departments at the school. The MIT professors are Professor Daniel Roos (engineering), Professor Dava Newman (bio-engineering), Professor David Marks (energy), and Professor Richard de Neufville (transportation). The appointments will strengthen the relationships between MIT and Portugal, and facilitate the development of courses and the conduct of research programs. As a result of these nominations, the MIT faculty will be able to participate in the Academic Council of IST, participate in hiring and promotion juries, and supervise doctoral and masters students and their theses. The professor designations at IST do not require specific time to be spent at the school, but rather participation in seminars, courses, research, and other MIT Portugal Program activities.

Hamsa Balakrishnan, assistant professor of aeronautics and astronautics and engineering systems, was appointed first holder of the T. Wilson career development professorship in aeronautics and astronautics and engineering systems. She also received an NSF CAREER award for her proposal titled “Practical Algorithms for Next Generation Air Transportation Systems.”

Cynthia Barnhart, professor of civil and environmental engineering and engineering systems, became associate dean for academic affairs in the School of Engineering as of September 1, 2007. In addition, she was named president of the Institute for Operations

Research and the Management Sciences in February 2008 and was the corecipient of the 2007 Roger-Charbonneau Prize for *Handbook in Transportation*, coedited with Gilbert Laporte (HEC Montreal).

Christopher (Chris) Caplice, executive director of the MLOG program, was appointed executive director of Center for Transportation and Logistics when former CTL director Professor Yossi Sheffi assumed the directorship of ESD in fall 2007.

Edward F. Crawley, Ford professor of engineering and professor in aeronautics and astronautics and engineering systems, was appointed director of the Bernard M. Gordon–MIT Leadership Program, launched by a \$20 million gift by the Gordon Foundation to create new approaches to prepare students for engineering leadership.

Joseph F. Coughlin, senior lecturer in engineering systems and director of the AgeLab, was named by *The Wall Street Journal* as one of “12 People Who Are Changing Your Retirement” and a Hero in Homecare Innovation by the Visiting Nurse Association.

Richard de Neufville, professor of civil and environmental engineering and engineering systems, received a Fulbright grant to participate in science policy seminars in Germany.

Olivier L. de Weck, associate professor of aeronautics and astronautics and engineering systems, was awarded tenure at MIT, won the 2007 Best Paper award from the journal *Systems Engineering* for a paper titled “Assessing Risks and Opportunities of Technology Infusion in System Design” and received an honorable mention (second place) for the Logistics Spectrum Prize Paper Award from the Society of Logistics Engineers. He was named associate director of the MIT Engineering Systems Division starting July 1, 2008.

Professor Thomas W. Eagar was named the Fred L. Plummer educational lecturer of the American Welding Society for 2008. In fall 2007, Professor Eagar received a special award from the US Navy students in Course 2N “in appreciation of his support of the MIT naval construction and engineering graduate program.”

Stan N. Finkelstein, senior research associate at ESD and the Harvard–MIT Division of Health Sciences and Technology, coauthored *Reasonable Rx: Solving the Drug Price Crisis* (published in January 2008 by FT Press).

In addition to being awarded tenure, Daniel D. Frey, Robert N. Noyce career development professor and associate professor of mechanical engineering and engineering systems, received the ASME Design Theory and Methodology Best Paper Award for his paper “Evaluation of the Pugh Controlled Convergence Method.” In addition, *Design Squad*, a PBS series produced by WGBH/Boston in close consultation with Professor Frey, won the George Foster Peabody Award.

Stephen Graves, professor of engineering systems, mechanical engineering, and management, has been named a Production and Operations Management Society fellow. Each year, two operations management researchers (at most) are recognized for their exceptional contributions to the operations management profession and the society through their research and teaching.

Daniel Hastings, professor of engineering systems and aeronautics and astronautics, was coauthor of “Two Empirical Test of Design Principles for Survivable System Architecture,” which won a best paper award at the 2008 INCOSE Symposium, held June 16–20 in Utrecht, the Netherlands.

Richard Larson, Mitsui professor of engineering systems and civil and environmental engineering and director of ESD’s Center for Engineering Systems Fundamentals, was invited to sit on a committee on research priorities in emergency preparedness and response for Public Health Systems, sponsored by the Institute of Medicine, which is part of the National Academy of Sciences. This is a result of newly passed Public Law 109-417, “Pandemic and All Hazards Preparedness Act,” an act that will allocate significant new research and implementation funding toward this problem domain.

Nancy Leveson, professor of aeronautics and astronautics and of engineering systems, was selected as one of this year’s Federal 100—the executives from government, industry, and academia who had the greatest impact on the government information systems community in 2007.

Seth Lloyd, professor of mechanical engineering and engineering systems, was named a fellow of the American Physical Society for seminal contributions to the theory of quantum computation and quantum communications and their physical implementations.

David Mindell, Frances and David Dibner professor of the history of engineering and manufacturing and professor of engineering systems, published *Digital Apollo: Human and Machine in Spaceflight* (MIT Press) in May 2008. The book examines the ways in which human pilots and automated systems worked together to achieve Apollo’s lunar landing, and, more broadly, the debate over humans and automation in space. A Discovery Channel documentary based in large part on *Digital Apollo* aired in July 2008 as part of Discovery’s “Moon Machines” series.

Sanjoy Mitter, professor of electrical engineering and engineering systems, won the 2007 Richard E. Bellman Control Heritage Award for contributions to the unification of communication and control, nonlinear filtering, and its relationship to stochastic control; optimization; optimal control; and infinite-dimensional systems theory.

Dava Newman, professor of aeronautics and astronautics and engineering systems, and director of the Technology and Policy Program, was named by *Time Magazine* as one of the Best Inventors of 2007 for her BioSuit™ system. The BioSuit™ is included in the Metropolitan Museum of Art’s “Super Heroes” exhibit (May–September 2008).

Donna H. Rhodes, ESD senior lecturer and principal research scientist, was coauthor of “Architecting Systems for Value Robustness: Research Motivations and Progress,” which won the Institute of Electrical and Electronics Engineers (IEEE) Systems Conference best paper award in April 2008. Dr. Rhodes also received a best paper award at the INCOSE International Symposium 2008 in Utrecht, the Netherlands, with her coauthors, also affiliates of SEARi, the Systems Engineering Advancement Research Initiative.

Yossi Sheffi, professor of civil and environmental engineering and engineering systems, assumed the directorship of ESD on November 15, 2007. On May 6, 2008, he testified before the full House Committee on Homeland Security in a session on “Broadening the Homeland Security Strategy.” His remarks dealt with changing the mission of the Department of Homeland Security to include resilience and supply chain considerations.

In fall 2007, McGraw-Hill released the third edition of *Designing and Managing the Supply Chain* by David Simchi-Levi, professor of civil and environmental engineering and engineering systems and LFM-SDM codirector. Professor Simchi-Levi’s book is used by business schools around the world as their main textbook on supply chain management.

Joseph M. Sussman, JR East professor and professor of engineering systems and civil and environmental engineering, was elected a fellow of the American Association for the Advancement of Science. He was also given the 2008 Career Achievement Award by the engineering school alumni of the City College of New York, and was named as the first chair of the Intelligent Transportation System Program Advisory Committee by the US Department of Transportation.

James M. Utterback contributed to the Wallenberg Symposium on Medicine, Technology and Economics at The Royal Academy of Engineering Sciences in Stockholm on October 26, 2007; he spoke on “Synthesis and Experiment in New Firm Creation: The Confluence of Biotechnology and Nanotechnology.” In addition, he was reelected to the Board of Governors of the Argonne National Laboratory at the University of Chicago for a second term of three years (2008–2010) and elected a life fellow of Clare Hall at the University of Cambridge (UK).

Mort David Webster, assistant professor of engineering systems, joined the ESD faculty on July 1, 2008; in June 2008 he was named principal investigator of a \$750,000 grant from the NSF’s Human and Social Dynamics Program for a three-year research project on “Collaborative Research: An Improved Model of Endogenous Technical Change Considering Uncertain R&D Returns and Uncertain Climate Response.”

Annalisa Weigel, Jerome C. Hunsacker career development professor of aeronautics and astronautics and engineering systems, received the Henry B. Kane ’24 Award from the MIT Alumni Association in fall 2007.

John R. Williams, associate professor of information engineering and civil and environmental engineering, coedited *RFID Technology and Applications*, a book on both passive and active RFID technology published in June 2008 by Cambridge University Press. His coeditors were Professors Stephen B. Miles and Sanjay E. Sarma, both of the MIT Auto-ID Labs, of which Professor Williams is director.

Institute Professor Sheila Widnall, professor of aeronautics and astronautics and engineering systems, was awarded honorary degrees from Claremont Graduate University, Oxford University, and Northwestern University.

Alumni Honors

Rick Dauch, LFM '92, was named president and CEO of Acument Global Technologies in June 2008.

Juan-Pablo Montero, an expert in environmental economics and a 1994 alumnus of TPP, was named Chile's economist of the year in December 2007. Montero is an associate professor of economics at Pontificia Universidad Católica de Chile and a research associate of MIT's Center for Energy and Environmental Policy Research.

Pat Shanahan, LFM '91, was named program chief of Boeing's 787 Dreamliner program in fall 2007.

Dr. Rudolf Smaling, a graduate of ESD's SDM and PhD Programs, received the best paper award from the journal *Systems Engineering* for "Assessing Risks and Opportunities of Technology Infusion in System Design," which was coauthored with Professor Olivier de Weck.

Student Honors

PhD Program

Entering PhD student Regina Clewlow received a BP-MIT Energy Fellowship.

Dr. Michael Hanowsky (PhD 2008) was awarded a Fulbright Fellowship. Working in Mexico, he will investigate the effects of various carbon taxation schemes on the transportation industry in the context of a developing economy.

Entering PhD student David Keith was awarded an Australian Fulbright Fellowship.

PhD candidate Lara Pierpoint received a Hugh Hampton Young Memorial Fund Fellowship.

Entering PhD student Nidhi Santen received a John S. Hennessy Fellowship for work in environmental studies.

ESD PhD candidate Matthew Silver was part of a team that finished as a runner-up in the MIT 100K Elevator Pitch Contest held October 13, 2007, at the Stata Center. Silver's team, which consisted of employees from his start-up firm, IntAct Labs, won a \$1,000 prize.

Entering PhD student Kunal Thaker received a Sandia National Laboratories/MIT Excellence in Engineering Fellowship.

Robb Wirthlin, PhD candidate, 2000 SDM graduate, contributor to ESD's Lean Advancement Initiative (LAI), and a major in the US Air Force, was nominated by the Air Force to participate in NASA's astronaut mission-specialist training program. If selected by NASA in May 2009, Robb will be trained to contribute to future moon missions, as well as to the design, development, and testing of the Ares launch and Orion crew exploration vehicles.

Master of Engineering in Logistics Program

Recipients of the MIT-CTL International Logistics Fellowship, which is awarded to incoming MLOG students interested in conducting research in the global aspects of logistics, transportation, or supply chain management, were Nelly Andrieu, Rintiya Arkaresvimun, Erik Caldwell, Yanfeng Huang, Guruprakash Rangavittal, Khalid Usman, and Graham Whitemore.

MLOG student Erik Caldwell received the Council of Supply Chain Management Professionals (CSCMP) New England Roundtable Scholarship, awarded to students interested in supply chain who excel academically and in extracurricular activities.

Leaders for Manufacturing Program

This year's recipient of the Charles "Harrison" Smith III Award was LFM student Ryan Lester, who was cited for his contributions to LFM's academic program as well as its social environment.

The Web/IT track in the MIT 100K Competition was awarded to CyberAnalytix, whose team members included Stephen Boyer and Nagarjuna Venna of the SDM program and Audrey Chang from LFM.

Center for Engineering Systems Fundamentals

This year, three students conducting research in CESF were selected to attend the National Academy of Sciences Student Forum on Science and Technology Policy: Mike Metzger, Karima Nigmatulina, and Kats Sasanuma.

Lectures and Conferences

International Council on Systems Engineering

The 2008 international INCOSE symposium was held June 14–19 in Utrecht, the Netherlands. Pat Hale, director of the SDM Fellows Program and current INCOSE president, addressed the audience in the plenary session. ESD professor Daniel Roos conducted a symposium track on the Coalition of Engineering Systems Universities with ESD senior lecturer and principal research scientist Dr. Donna Rhodes as one of the session speakers. Members of ESD's SEArI were the recipients of both of the symposium's best paper awards. The first paper was authored by ESD research scientist Dr. Adam Ross and by Dr. Rhodes. The second paper was authored by ESD doctoral candidate Matthew Richards, Dr. Ross, Dr. Rhodes, and ESD professor Daniel Hastings.

Institute of Electrical and Electronics Engineers Systems Conference

The 2008 IEEE Systems Conference was held April 7–10, 2008 in Montreal, Canada. Dr. Donna Rhodes was a speaker on the executive plenary panel. The best paper award for this conference was awarded to SEArI research scientist Dr. Adam Ross and Dr. Rhodes.

Conference on Systems Engineering Research

The Conference on Systems Engineering Research was held April 4–5, 2008, in Los Angeles. Keynote presentations were given by Pat Hale and Dr. Donna Rhodes. With

CTPID/LAI researcher Dr. Ricardo Valerdi, Dr. Rhodes coled a workshop aimed at doctoral students who are working on systems engineering research topics.

2008 Risk Management Conference

The LFM and SDM programs cohosted this year's Risk Management Conference, held March 11–12, 2008, bringing speakers from academia and industry to MIT to discuss "Strategies for Balancing Risks and Opportunities in Global Product Delivery." Joan B. Cullinane, president of Velcro USA Inc., and Nicholas Donofrio, executive vice president of innovation and technology at IBM, were the event's keynote speakers. Speakers from MIT included ESD professors Nancy Leveson and Olivier L. de Weck, Professor David Simchi-Levi, and Professor David Schmittlein, dean of the MIT Sloan School of Management. Professor Wallace Hopp of the University of Michigan also participated.

In addition to the keynote speakers, presenters from industry included Dr. Jeffrey D. Tew from General Motors's Research and Development Center; John O'Connor, Cisco's director of supply chain risk management; and Stephen Hoover, vice president and center manager of the Xerox Research Center. Alfred Ford, deputy director of submarine safety and quality assurance at Naval Sea Systems Command, presented as well. The event also provided an opportunity for SDM and LFM students to present their research in a well-received poster session.

Brunel Lecture on Complex Systems

On October 23, 2007, Paul F. Levy, president and chief executive officer of Beth Israel Deaconess Medical Center, delivered the seventh annual Brunel Lecture on Complex Systems. Levy, who holds a master's degree in urban planning from MIT and was an adjunct professor of environmental policy at the Institute as well as former executive dean of Harvard Medical School, spoke about "Process Improvement in the Rarified Environment of Academic Medicine." The talk is available on MIT World at <http://mitworld.mit.edu/video/504/>.

Charles L. Miller Lecture

On April 7, 2008, José Mariano Gago, Portugal's minister of science, technology, and higher education, delivered the seventh annual Charles L. Miller Lecture before a standing-room-only audience. His topic was "The Future of Science and Technology in Europe." According to Minister Gago, "the EU intends to become the most advanced knowledge-based economy in the world while achieving at the same time social cohesion and sustainable, environmental development." The lecture can be viewed on MIT World at <http://mitworld.mit.edu/video/571/>.

IBM-MIT Innovation Lecture Series

On December 14, 2007, IBM and ESD cosponsored the IBM–MIT Innovation Lecture Series "Engineering Systems Solutions to Real World Challenges in Healthcare." The event featured senior executives from Vassar Brothers Medical Center.

Meeting the Entropy Challenge

Seth Lloyd, professor of mechanical engineering and engineering systems, moderated (along with Robert Silbey, Class of 1942 professor of chemistry) several panel discussions at “Meeting the Entropy Challenge: An International Thermodynamics Symposium,” held at MIT October 4–5, 2007. The discussions included “Foundations of the Second Law,” “Frontiers of the Second Law,” “Teaching the Second Law,” and “The Second Law and Energy.” Videos are available on MIT World. (See <http://mitworld.mit.edu/video/520/>, <http://mitworld.mit.edu/video/529/>, and <http://mitworld.mit.edu/video/546/>.)

Major Meetings

ESD Meetings

ESD held two offsite meetings in AY2008. The winter meeting was held on January 11, 2008, at Le Meridien Hotel in Cambridge. The agenda included an ESD overview by newly appointed ESD director Yossi Sheffi, a presentation of the PhD Review Committee Report and recommendations by Professor Joseph Sussman, and a presentation by Chris Caplice on the master’s programs and opportunities for collaboration. The faculty convened breakout groups to discuss the four research domains that will constitute ESD’s focus in the near future. In addition, a dinner was held to recognize Professor Joel Moses’s two-year tenure as acting director of ESD. The occasion marked the debut performance of the ESD fight song by MIT’s own a cappella group, Resonance.

ESD’s spring meeting was held on June 4, 2008, at the Hyatt Regency Hotel in Cambridge. The discussion, steered by Yossi Sheffi and Olivier de Weck, centered on the future publication of a brochure detailing ESD’s strategic plan, and included a presentation of design options for the document by Stoltze Design. In addition, Professor Daniel Roos discussed early plans for the 2009 ESD Symposium, which will mark the 10th anniversary of the Division, highlighting advances in research and the development of a community of engineering systems faculty and students beyond MIT.

ESD Alumni Advisory Council

The ESD Alumni Advisory Council convened on April 7, 2008, at MIT. On the agenda were two research presentations: one by associate professor Daniel Frey on adaptive experimentation and robust design and the other by professor of the practice Deborah Nightingale on an enterprise systems approach to healthcare. Professor Joseph Sussman presented the ESD PhD Review Committee Report. Professor Yossi Sheffi presented an ESD overview and led a discussion of ESD priorities with Dedric Carter, the new assistant dean for development and strategic initiatives for the School of Engineering. The group also attended Minister José Mariano Gago’s Miller Lecture as well as the Miller Lecture reception and dinner.

The members of ESD’s Advisory Council include Jason Amaral, Thomas Clark Davis, Moises Goldman, Joseph Harrington, Benjamin R. Jurewicz, Henry Lichstein, Joseph Albert Martore, John Edward Shephard Jr., James Donald Shields, Dr. Donald E. Shobrys (chair), Matthew Siegel, and Leif Christian Ulstrup.

ESD at IAP

ESD offered close to 20 courses during MIT's Independent Activities Period (IAP) 2008. Among the topics were "Considering Risk and Uncertainty in Designing Climate Policy," "Independent Activities Design-a-palooza," "MIT's Global Airline Industry Program: Research on the National Air Transportation System," "Living an Extraordinary Life," and "Global Trade Management." Most ESD programs participated, and the LAI Lean Academy™ offered two courses on aeronautics and astronautics.

Employee Recognition

ESD's academic administrator, Elizabeth Milnes, received the Joseph A. Martore Excellence in Education Award in November 2007 for her outstanding contributions to the ESD PhD Program and the ESD graduate student community.

In April 2008, Christine Bates, program coordinator, finance/admissions for the SDM program, was honored with the School of Engineering's Infinite Mile Award for Sustained Excellence. In May 2008, Tara Eisner, a member of the LAI administrative staff, was presented a Certificate of Appreciation.

Yossi Sheffi

Director, Engineering Systems Division

Professor of Civil and Environmental Engineering and Engineering Systems

Director, MIT Center for Transportation and Logistics

More information on the Engineering Systems Division can be found at <http://esd.mit.edu/>.

Leaders for Manufacturing

An active partnership among MIT School of Engineering, the MIT Sloan School of Management, and more than 20 corporations, the MIT Leaders for Manufacturing (LFM) Program produces world-class leaders for manufacturing and operations. This innovative 24-month dual-degree graduate program, created in 1988, includes an integrated engineering and management curriculum and a six-and-a-half-month internship at a partner company that serves as a single integrative research project leading to a thesis. Students earn an MBA or master of science in management, as well as a master of science in one of eight participating engineering programs. LFM focuses on theory and global practice from concept development through product delivery, including challenges faced on factory floors and in global supply chains. Corporate partners provide generous fellowships for all students.

LFM was launched with significant industry funding and is in its 20th year of operation. This year, as LFM celebrates this milestone, the program is examining its vision to ensure that our focus continues to be relevant to industry, faculty, and students.

On the administrative level, LFM and SDM are managed by a common staff, enabling conservation of resources. Both LFM and SDM are cosponsored by MIT's School of Engineering and MIT School of Management and reside within MIT's Engineering Systems Division.

Academic Program

The LFM Fellows Program class of 2008 had 47 graduates. Each graduate completed an internship at a partner company during the summer and fall of 2007. Internships are focused projects of concern to the partners, accomplished by interns with company support and MIT faculty guidance. Representative projects this past year included strategic sourcing, lean in product development, lean assessment and implementation in manufacturing, call center/customer service, and supply chain and inventory modeling. Many of the projects represent a significant benefit for the partner companies and advance areas of research. For the classes of 2009 and 2010, internships process improvements—including an improved matching process and better defined project milestones—are being implemented to further increase the benefit for all stakeholders.

Another 47 students (class of 2009) completed their first year of on-campus studies and started their six-month internships. Forty-eight new students (class of 2010) were admitted and began an intensive summer session in June 2008. The class of 2010 has an average of five years of work experience. Applications to LFM remain consistent with the five-year average.

Don Rosenfield continues to serve as the director of the LFM Fellows Program. Codirectors for the LFM and SDM programs are Warren Seering from the School of Engineering and Tom Allen from the MIT Sloan School of Management. On July 1, 2007, Warren Seering replaced David Simchi-Levi, who was on sabbatical and resumed his role as codirector from the School of Engineering for both LFM and SDM on July 1, 2008. Ron Slahetka departed as industry codirector in June 2008. A search for a new industry codirector is under way. Ted Equi joined LFM in January 2008 as its research, internship, and alumni manager. Patty Eames became LFM's program coordinator in May 2008 and Lois Slavin became LFM and SDM's full-time communications director in June 2008.

LFM's academic program consists of a mix of management and engineering courses. Major and required courses are ESD.32J Product Design and Development, taught by Steven Eppinger and Warren Seering; ESD.267J/15.762J Supply Chain Planning and ESD.268J/15.763J Manufacturing System and Supply Chain Design, both taught by Stephen Graves and David Simchi-Levi; ESD.750J/15.066J System Optimization and Analysis for Manufacturing, taught by Jeremie Gallien; ESD.751J/15.064J Engineering Probability and Statistics, taught by Arnie Barnett and Roy Welsch; 15.761 Operations Management, taught by Sebastian Fixson; ESD.60 Lean/Six Sigma Processes, taught by Steven Spear and Eric Rebentisch; 15.515 Financial Accounting, taught by Joseph Weber; 15.280 Communication for Managers, taught by Leigh Hafrey, Neal Hartman, and other MIT Sloan communications faculty; 15.311 Organizational Processes, taught by Katherine Kellogg, Roberto Fernandez, and Mark Mortensen; 15.010 Economic Analysis for Business Decisions, taught by Eric Van den Steen, Richard Holden, and Michael Grubb; 15.769 Operations Strategy, taught by Charles Fine; 15.316 Building and Leading Effective Teams, taught by John Carroll; 15.317 Organizational Leadership and Change, taught by Tom Kochan and Jan Klein; and 15.792J Proseminar in Manufacturing, taught by Don Rosenfield.

LFM students may enroll in eight engineering disciplines. These include:

- aeronautics and astronautics
- biological engineering
- chemical engineering
- civil and environmental engineering
- electrical engineering and computer science
- engineering systems
- materials science and engineering
- mechanical engineering

The LFM 2010 class by engineering discipline is as follows:

- aeronautics and astronautics: 1
- chemical engineering: 4
- electrical engineering and computer science: 5
- engineering systems: 24
- materials science and engineering: 1
- mechanical engineering: 13

Marketing Efforts

LFM has continued to strengthen its marketing in the past year. New initiatives include a cutting-edge search engine optimization strategy, an Alumni Challenge to attract more inquirers, and an engaging video featuring reflections by LFM students and faculty.

China LFM

Major studies on competitiveness in China indicate a critical imperative—the need for manufacturing enterprises to recruit, develop, and retain mid- and top-level leaders over the short and long term. The China Leaders for Manufacturing Program (CLFM) was developed to address this issue.

CLFM is an educational and research partnership among global firms and Shanghai Jiao Tong University's (SJTU) Antai College of Economics and Management, School of Mechanical Engineering, School of Electronics and Electric Engineering, and School of Chemistry and Chemical Technology. Its mission is to educate the next generation of manufacturing and operations leaders in China.

Modeled after MIT's Leaders for Manufacturing Program and created with MIT's authorization and educational support, China LFM is the country's first ever dual-degree graduate program focused on educating China's next generation of manufacturing and operations leaders. A partnership of SJTU and industry, CLFM offers a two-and-a-half-year dual master's degree program combining the disciplines of engineering and management. Students will also work an additional six months at a partner company site during the required internship experience. Each graduate will receive an MS in engineering

from SJTU's School of Mechanical Engineering or School of Electronic, Information, and Electrical Engineering and an MBA from SJTU's Antai College of Economics and Management. Chemical engineering is being added to the engineering offerings.

China LFM now has 16 companies signed up for CLFM, and reached its goal of 15 by May 2008. CLFM industry partners include Alcoa, Apple, Caterpillar, China Longgong, Corning, Schlumberger, The Timken Company, and Tyco International. Eight companies—Amazon, Cisco Systems, Dell, Flextronics, Honeywell, Intel, Novartis, United Technologies Corporation—partner with both CLFM and the MIT LFM Program.

The first CLFM class matriculated in September 2007, with the second cohort matriculating in September 2008. Representing MIT at the opening ceremony for the first class were Institute Professor Tom Magnanti (representing the School of Engineering), deputy dean of MIT Sloan School of Management Steve Eppinger, LFM codirectors Tom Allen and Warren Seering, and director of the LFM Fellows Program Don Rosenfield. LFM's International Plant Trek went to China and Japan in March. Students from both programs visited companies together in Shanghai and held cohort-building and joint-learning events, fulfilling one of the primary goals of LFM's involvement with CLFM. Seventeen SJTU faculty members have been trained at MIT using the Sloan School's teach-the-teacher model. SJTU teachers come to MIT for a semester to take the course they subsequently teach at SJTU. Three more faculty members are scheduled for training in the fall of 2008.

LFM Alumni

The LFM 2007 Alumni Conference took place in Seattle, Washington. Its theme was "Managing Variability." More than 120 alumni gathered to see presentations by Travelocity, Washington Biodiesel, Amazon.com, Dell, Recreational Equipment Inc., Boeing Commercial Airplanes, Toyota, Booz Allen Hamilton, and Industrial Revolutions, as well as presentations on commodity price variability and market evolution, managing and motivating a diverse workforce, and designing a network of women leading sustainability to confront uncertainty.

Aaron Raphel, LFM '05, became the official voice of the alumni at the LFM operating committee.

As part of LFM's and SDM's commitment to lifelong learning, an initiative begun in FY2002 was continued to encourage LFM and SDM alumni to stay connected with MIT by sharing relevant information. LFM and SDM continued to schedule monthly webcasts presented by MIT faculty and various LFM and SDM alumni. The content of each webcast, also called a "webinar," provides valuable information on the latest trends, cutting-edge developments, and innovative strategies, all of which pertain to manufacturing and/or systems design. The presentations are given in real time via the Internet and telephone; this allows participants to follow along visually and audibly as well as to ask questions. Alumni continue to express a high degree of interest in these virtual knowledge-sharing events, and webinars have evolved into a key tool for alumni engagement.

The alumni have also been instrumental in setting up an infrastructure to support LFM. Through an organized fundraising effort, the alumni have established three different funds to support the program: the William C. Hanson and Don W. Davis Leadership Fund, the Alumni Annual Fund, and the Endowed Discretionary Fund.

This year the funds distributed \$4,730 to support students on the International Plant Trek and \$18,800 for first-year scholarships. The class of 2008 continued the tradition of raising money for the program. This year 72% of the class gave a total of \$67,500 for the support of the funds listed as well as support of special projects.

Proseminar Speakers

On campus, LFM students attend weekly seminars with faculty and industry experts to enrich their formal education by learning about current manufacturing leadership and business issues that are local, national, or international in scope. Speakers in fall 2007 and spring 2008 included Jeff Wilke (LFM '93), senior vice president, North America retail, Amazon.com; Honeywell International Incorporated's Joe DeSarla (LFM '96), vice president, ACS Integrated Supply Chain; Hans Laudon (LFM '00), vice president Honeywell Integrated Supply Chain, Aftermarket Services, Avionics & Electronics; Mitch Malone (LFM '04), director, SIOP Planning and Inventory; Kim Murdoch, director, Planning and Asset Management; Tom Greenwood, director, Strategic Initiatives, SpiritAero; John Casey, president, Electric Boat, General Dynamics; Art Soucy, vice president, Global Supply Chain, Pratt & Whitney; Peter S. diCicco, executive director of the Coalition of Kaiser Permanente Unions, AFL-CIO; Deborah Wong, director, Operations Strategy, Amgen; Vah Erdekian, vice president, Manufacturing, Cisco; Nick Forlenza (LFM '05), senior director of Enclosure Operations; Aaron Raphael, manager, iPhone Enclosure Operations, Apple; Annette Clayton, Vice President Division, Americas Manufacturing Operations, Dell; Mike McNamara, CEO, Flextronics; Bob Larson, president, China Mills Product, Aluminum Company of America (Alcoa); Jeremy Wallach (LFM '04), consultant, CRA International; Bill Perkins, director, systems engineering, General Dynamics Ordnance and Tactical Systems; Rafael de Jesus (LFM '00), regional manager, ABB; Jean-Francois Baril, senior vice president, Sourcing and Procurement, Nokia; Mike Rutz (LFM '95), senior director, Networks and Enterprise New Product and Tim Cawley, senior vice president, Mobile Devices Supply Chain, Motorola; Mark Jenks (LFM '91), director, 7E7 Wing and Empennage Team and Tim Copes (LFM '92), president, Boeing Shared Services Group; Elizabeth Williamson, director of 300mm Manufacturing Operations/director of Alliance Contracts and Platform Business Office, IBM; Jan Klein, senior lecturer, MIT Sloan; and Don Rosenfield.

Plant Tours

The LFM plant tours expand students' understanding of manufacturing complexity by introducing them to LFM partner companies' diverse operations, plant floor workers, executives, and LFM alumni. In the summer term and during the academic year, students see an average of 15 companies during local visits and a two-week national plant tour. This past year, local plant tours were held at Amgen, Genzyme, Novartis, Honeywell, and Intel. Students also participated in the annual two-week plant trek that included visits to Dell, Cisco Systems, and Flextronics International in Austin, TX; Harley-Davidson in Milwaukee, WI; American Axle & Manufacturing, GM, and

the North American Auto Show in Detroit, MI; The Boeing Company in Seattle, WA; Amazon.com in Fernley, NV; and Honeywell in St. Charles, IL.

The LFM International Plant Tour went to China and Japan and visited ProLogic, Ri-teng Computer Accessory, GM, Honeywell, Flextronics, and Toyota.

Career Development

LFM students, sponsored and nonsponsored, continue to be highly sought after once they have completed the program. Partner companies as well as other organizations take a special interest in LFM students, as proven by their commitment to speak to the class on various issues during the Proseminar session. To date, 64% of the class of 2008 has accepted positions within manufacturing and operations companies and 45% have accepted positions within partner companies.

Internships and Research

The LFM '09 class has the largest number of off-cycle internships (eight) in the history of LFM. Some partner companies use off-cycle internships to match with their business cycle and get more immediate impact from the research projects. The matching of students to partner internships and faculty advisers is a complex process that the program has managed from inception. The LFM internship matching process continues to be refined. A two-way matching process that explicitly captures company preferences was implemented. The method requires significantly less lead time and it led to higher satisfaction from the different constituents. The learning during the LFM '09 on-cycle internship has generated additional enhancements for the LFM '10 class that were presented and approved at the June 2008 operating committee meeting. We are continuing to link internships for the LFM 2009 class to company-faculty-student research groups. These groups allow for cross-internship learning and the development of common themes.

Student Awards

Brian Feller received the LFM Best Thesis Award, given for the third year by the program. He received a laptop computer generously donated by Intel. Ryan Lester received the Harrison Smith Award, a leadership award given annually to honor a first-year LFM who exemplifies LFM '98 Harrison Smith's most remembered qualities while at LFM: living life to the fullest, bringing the class together, and making happy and lasting memories of the LFM experience for the entire cohort. Smith died tragically in a car accident shortly after his graduation in 1999 while en route to a position at Dell.

Governance

LFM is run by a governing board consisting of the partner companies' senior officers, program codirectors, and MIT deans. It is cochaired by Dick Johnston of Raytheon and Larry Loftis of Boeing. The operating committee handles ongoing management of the program and includes company representatives, faculty, and directors. The focus of the operating committee, chaired by Ron Slahetka, is a series of standing committees that include companies, faculty, and students.

New Partners

An active student, staff, and company committee has been very successful at bringing new partners to LFM. New partner companies that have joined in the past several years include General Dynamics, American Axle and Manufacturing, Cisco Systems, Flextronics International, and Zara (Inditex), the Spanish clothing manufacturer and retailer. Genzyme became a managing partner.

Tom Allen, codirector, Howard W. Johnson professor of management, and professor of engineering systems

Warren Seering, codirector and professor of mechanical engineering and engineering systems

Ron Slahetka, industry codirector

Don Rosenfield, director, LFM Fellows Program

More information about the Leaders for Manufacturing Program can be found at <http://lfm.mit.edu/>.

System Design and Management

MIT's System Design and Management (SDM) Program was created in 1996 in response to industry's need to develop the next generation of leaders in product design and systems engineering. SDM combines cutting-edge courses from the MIT Sloan School of Management and MIT's School of Engineering, enriching the experience with innovative distance learning, flexible matriculation options, and an interdisciplinary perspective. SDM prepares graduates to think outside the box, lead across organizational boundaries, and inspire others to collaborate and innovate in both technical and nontechnical arenas.

The centerpiece of SDM's portfolio is its rigorous 13- to 24-month graduate program. Built on a foundation of core courses in system architecture, systems engineering, and system and project management—and integrated with classes in engineering and specially designed courses in management—this program leads to a master of science degree granted jointly by the School of Engineering and the MIT Sloan School of Management.

Targeted to professional engineers with three or more years of experience, SDM has a 15-course curriculum in systems, engineering, and management, including a project-based thesis. It offers three curriculum options: a 13-month in-residence format; a 24-month distance education for company-sponsored students, requiring one academic semester in residence at MIT; and a 24-month commuter program for local students. SDM's mission is to educate future technical leaders in the architecture, engineering, and design of complex products and systems, preparing them for careers as the technically grounded senior managers of their enterprises.

Distance Education Delivery

SDM continues to evaluate its distance education delivery with the goal of increasing the quality of the remote learning experience while reducing costs, both for MIT and for sponsoring companies. This includes streaming all classes on the web so that students

who cannot attend a session can view the video of it almost immediately, without having to wait for a videotape to be mailed to them.

Pat Hale continues as director for his fourth year. In January 2008, Pat assumed the role of president of INCOSE, after serving as president-elect for two years. This role has provided the program a high level of visibility in an organization of industry and educational institutions highly aligned with the SDM academic mission.

Codirectors for the program are Warren Seering from the School of Engineering and Tom Allen from the MIT Sloan School of Management. David Simchi-Levi from the School of Engineering has been on sabbatical and will return to his codirector role on July 1, 2008. John Grace is SDM's industry codirector.

Student Statistics

In January 2008, SDM admitted its 12th class, enrolling 63 students, seven of whom are dual degree students from the Navy's 2N Naval Engineer degree program. As was done in FY2007, SDM held information evenings in August, September, October, and June for local MIT alumni and others interested in SDM, as a way to recruit prospective students for SDM '08. These successful events brought more than 100 prospective students to campus or suburban locations, where they heard presentations about the program from several faculty, students, and alumni.

System Design and Management Student Statistics

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|--------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Admitted | 35 | 58 | 47 | 50 | 37 | 27 | 36 | 37 | 62 | 58 | 61 | 56* |
| On-campus | 8 | 16 | 6 | 14 | 8 | 7 | 18 | 27 | 44 | 44 | 47 | 40 |
| Self-supported | 3 | 1 | 2 | 5 | 2 | 1 | 6 | 25 | 42 | 34 | 40 | 36 |
| Research assistant | 3 | 12 | 2 | 4 | 3 | 1 | 10 | 0 | 0 | 2 | 1 | 4 |
| Distance education | 27 | 42 | 41 | 36 | 29 | 18 | 17 | 10 | 18 | 14 | 14 | 16 |
| Company-sponsored | 29 | 45 | 43 | 41 | 32 | 25 | 20 | 12 | 20 | 24 | 21 | 20 |

* In addition, 7 naval officers from 2N were admitted for a second degree program

Sponsoring Theses of Self-Funded System Design and Management Fellows

In the past few years, companies have also engaged the program using self-funded fellows for research internships that then develop into SDM theses. Support typically involves identifying a thesis topic and naming a company mentor to work with a student and MIT faculty member on a topic of pressing concern. Thesis sponsorship allows a company to expand its presence within SDM at a modest cost, work with an SDM fellow and MIT expert on a relevant project, and favorably position the company for a broader relationship with SDM and MIT.

MIT-Industry Partners System Engineering Program

This past year was the seventh for the MIT-Industry Partners Systems Engineering Program. Partners included United Technologies Corporation (UTC), Boeing, John Deere, Wachovia, and Tata Interactive. To build a systems engineering core competency,

this unique program targets three key populations: experts enrolled in the SDM program, experts enrolled in the Systems Engineering Certificate Program, and the organizational leaders of those experts. The program has been very successful, with 136 students completing the certificate program and more than 100 organizational leaders completing the six days of content in the organizational leaders workshop. With its active participation in all levels of the program, UTC now has more than 240 employees who have benefited from the SDM program. The next cohort of certificate students for FY2008 is expected to reach 40, with students from UTC, John Deere, Cummins, Draper Lab, Instrumentation Lab, and the US military.

Career Development for SDM Self-Sponsored Students

Led by career development director Helen Trimble, SDM has provided career services to its self-funded students for the past four years. These services include individual career consultation and coaching in presentation skills; resume writing; networking and negotiating; interviewing; company, career, and opportunity research; and government regulations for foreign nationals. SDM graduates have achieved 100 percent employment during this same period in industries and organizations as diverse as nonprofits, aerospace, financial services, and in technology consulting and leadership roles in product development, business strategy, and operations.

Tom Allen, Codirector, Howard W. Johnson professor of management, and professor of engineering systems

Warren Seering, Codirector, professor of mechanical engineering and engineering systems

Jack Grace, industry Codirector

Pat Hale, Director, SDM Fellows Program

More information about the System Design and Management Program can be found at <http://sdm.mit.edu/>.

Technology and Policy Program

The Technology and Policy Program (TPP) is an interdisciplinary graduate-level program that focuses on issues at the interface of technology, policy, and the sociotechnical aspects of complex systems. TPP is dedicated to educating engineers and scientists who wish to lead in the development and implementation of responsible technology strategies and policies for the benefit of humankind. Embedded in this mission statement are several guiding principles:

- Dual professional excellence with technical rigor in engineering or science and understanding of policy analysis culminating in a research master's thesis
- Knowledge and flexibility to manage conflicting interests and values at all stages of the policy process
- Effective leadership and communication skills in the technology policy process

TPP is founded on the premise that the solutions to most challenging technical problems confronting society are not purely technical in nature. Engineering and science approaches alone are insufficient because these problems reside within both social

and technical contexts—consideration to which must be given in order to formulate successful solutions. Solving these sorts of problems requires leaders who have technical skills as well as a sophisticated understanding of the political, economic, and legal concerns governing the ways in which solutions are devised, chosen, financed, implemented, and administered. TPP strives to give students a thorough understanding of the interface between technology and policy and to create leaders who are engineers and scientists rather than engineering and scientific leaders.

Within the intellectual and educational ambit of the School of Engineering's Engineering Systems Division (ESD), the TPP graduate educational program focuses on developing skills in policy development, leadership, and analysis. In addition, the program requires a significant research thesis as a fundamental component of engineering systems studies. TPP provides a high-impact, high-quality education to its students, and its goals are to make TPP the most prestigious and sought-after technology policy program in the world and to produce the technological decision makers of the future.

TPP offers a two-year master's of science program and supports the ESD PhD doctoral program by encouraging dissertation research in the areas of technology, management, and policy (TMP). While TPP receives most of its applications from outside of MIT, several internal admits (i.e., students already enrolled in other MIT graduate programs) join TPP each year; roughly one-third of TPP students concurrently pursue a second master's or a doctoral degree. Each entering class numbers around 40 students (48 in fall 2008), comprised of approximately 45 percent women, 40 percent international students, and 11 percent underrepresented minorities. This year, 33 students graduated with master's degrees in technology and policy, and four master's students were accepted to continue their studies at the doctoral level. Currently, 30 ESD doctoral students are pursuing technology, management, and policy research, reflecting a steady-state admission rate of about five students per year. Eleven of the ESD doctoral graduates this year concentrated in TMP research.

Fellowship funding was provided to several incoming students in order to attract the top TPP candidates to MIT. This year these funds came from the Rabinowitz and de Neufville funds, as well as a tuition-only Keil Fellowship. The Office of the Dean for Graduate Education also provided matching fellowship funding to TPP students this year, specifically for underrepresented minority (URM) students. These fellowships continue to allow us to recruit and retain excellent students. With these funds, TPP has achieved a yield of 100% of our admitted URM students over the past four years. Fellowship funds have been generously provided by TPP alumni and donors for several student or programming initiatives, including funding for recruitment and outreach, support for TPP women student events, and support for some of the costs associated with the TPP visiting speaker series and alumni relations. This past year, TPP students benefited from discussions with Professor Noam Chomsky, Dr. Praveen Amar, and an IAP workshop with Rich Hayes (Union of Concerned Scientists) on media skills for engineers and scientists.

The Technology and Policy Student Society (TPSS) is one of the most active student groups on campus. TPSS holds elections on a yearly basis for officers representing

the broad spectrum typical of TPP students. The society not only organizes talks, workshops, and social events, but also plays an important role in the annual TPP Open House. Generous donors have made it possible for the Technology and Policy Program to recognize TPP students for leadership. Students organized several leadership roundtable discussions featuring current TPP students. Students also continued their popular series of culture nights with presentations by students from Pakistan, Japan, and Greece. Current TPP students also lead many organizations and clubs across the Institute, most notably the MIT Energy Club, which is comprised of some 800 students.

The Technology and Policy Program greatly values practical experience and actively encourages students to take summer internships between their first and second years of study. In January 2008, 20 students (half the first-year class) traveled to Washington to learn more about career options from TPP alumni and attend meetings with prospective internship employers, including the World Bank, US government agencies such as NASA and the White House Office of Management and Budget, and private consulting companies and think tanks such as Intelligent Community Forum. Several of our students found internships in Washington this summer, while others are working elsewhere in the United States or abroad, including at the Far East Organization in Singapore, and for nonprofit groups in Peru, Ghana, and Pakistan. Students whose internships were unfunded were able to earn valuable experience by taking advantage of living-cost funding provided by TPP alumni and donors—including Larry Linden, Francis Chin, Donald Cooke, and the Far East Organization—in order to make their internship experiences possible.

Each year, TPP students also nominate faculty members and researchers for their TPP Appreciation Award. This year's recipients were Professor Randolph Kirchain and Professor John Heywood.

This year's Best Thesis in Technology and Policy was awarded jointly to Lisa Jakobovits and Romain Lacombe, supervised respectively by Professor Mort Webster and Dr. Denny Ellerman. Jakobovits's thesis title is "A Comparison of Cost-Containment Instruments for US Carbon-Reduction Policies." Lacombe's is "Economic Impact of the European Union Emission Trading Scheme: Evidence from the Refining Sector."

TPP maintains ties to its almost 1,000 alumni and works to foster a strong alumni community through the biannual publication of the alumni directory and regional gatherings in Washington, DC, and Boston. For example, last January's gathering in Washington was attended by more than 45 people, including 30 local alumni. In summer 2008, we held our second annual summer reception to introduce our current and incoming students, who are in DC for internships, to our alumni who work there. TPP alumni receptions are also held regularly in Boston, New York, and Tokyo. TPP alumni also receive e-newsletters several times a year including articles written by current and former TPP students as well as faculty and staff. Following TPP's 30th anniversary in 2006, TPP has worked to document its history, which, when complete, will be posted on the TPP website, <http://web.mit.edu/tpp/>.

TPP initiated a much closer working relationship with our MIT Washington office this year. Dr. William Bonvillian has been a pleasure to work with, and he and Professor Dava Newman meet at every opportunity to assure a science, technology, and policy agenda and opportunities for MIT students both at the undergraduate and graduate level, especially the summer policy internship program. The events TPP endorsed and helped facilitate this past year included our summer technology and policy internship program in Washington, DC; faculty panel discussions at MIT; and the IAP, spring, and summer offerings of science, technology, and policy boot camp, which Dr. Bonvillian offers. This year Dr. Bonvillian participated in a luncheon discussion in Professor Newman's TPP leadership class, which also featured discussions with Dr. Robert Seamans, Dr. George Whitesides, and an alumni panel of Sharon Gillett, Christopher Hansen, and Professor Mort Webster.

This past year ESD.10 Introduction to Technology and Policy was taught by TPP director of education Frank Field. Dr. Field has refined elements of the course to reflect the increasing sophistication of the incoming class and has built on the foundation laid by Professor Annalisa Weigel, whose support from the Lord Foundation enabled many innovations in the class. The rate of adoption of 14.003 Microeconomic Theory and Public Policy as an alternative to 15.011 Economic Analysis for Business Decisions for the economics requirement has been extremely heartening, and TPP is working to balance the load between these two primary economics options. TPP also supported a new energy course in Urban Studies and Planning (11.369J Energy Policy for a Sustainable Future) taught by Jonathan Raab, and offered the telecommunications policy course in its half-term incarnation. An additional energy course, Enabling Energy Efficiency, is also in development for next year.

TPP is a founding member of the Technology, Management, and Policy Graduate Consortium, which includes programs in North American, European, and Asian universities, and allows TPP masters students and TMP-track ESD doctoral students to share their research and network with students in similar programs. At the Consortium's seventh annual conference, jointly hosted by Utrecht University and the Technical University of Delft in Utrecht, the Netherlands, from June 22–24, 2008, seven MIT students presented their research, with TPP student Norma Campos winning the best master's student presentation award.

Although financial support from the Cambridge–MIT Institute has ended, the Technology and Policy Program maintains a special relationship with the Technology Policy Master of Philosophy program at Cambridge University, a Consortium member. Professor Newman has served as the external examiner of the Cambridge University TP program for the past four years.

TPP has continued its participation in the collaborative and interdisciplinary Program on Emerging Technologies (PoET), along with ESD, the Program in Science, Technology, and Society (STS), the Center for International Studies (CIS), and Political Science. Currently funded by a five-year, \$2.97 million grant from the NSF's Integrative Graduate Education and Research Traineeship (IGERT) program, PoET aims to improve responses to emerging technologies by increasing understanding of the economic,

security, environmental, and cultural implications of technological advances and the uncertainties surrounding them. This year's work saw the continuation of the research in emerging computing technologies. In addition, the program has been working with Professor Drew Endy in the Department of Biological Engineering on topics emerging in the area of synthetic biology, with several research collaborations developing. A pre-proposal for continuation of NSF funding, focusing upon design test beds for exploring the evaluation of new technologies through the lens of emergent properties, has been submitted. PhD students from ESD, CIS, and STS are funded by PoET IGERT traineeships. Visit <http://poet.mit.edu/> for more information.

Both TPP and PoET sponsored offerings during IAP. PoET sponsored a workshop *Protocols and Standards: Cross-Cutting Themes for Future Research*, with participation by PoET students, faculty, and researchers along with students and faculty from bioengineering, the Computer Science and Artificial Intelligence Laboratory (CSAIL), and other interested individuals (January 30, 2008). TPP sponsored a series that included "Considering Risk and Uncertainty in Designing Climate Policy" by Mort Webster, then a visiting assisting professor in earth, atmospheric, and planetary sciences (January 8, 2008), "Space Logistics: Enabler of the New Frontier—Current Research Challenges," by Olivier de Weck (January 15, 2008), and "MIT's Global Airline Industry Program: Research on the National Air Transportation System" by Cynthia Barnhart (January 22, 2008).

With the completion of our fifth year in the academic space on the third floor of E40, the Muckley Building, TPP continues to find extraordinary value in having a home for its educational and research efforts. Having a physical focal point for TPP activities and student events (formal and otherwise) gives the otherwise far-flung TPP students (whose research activities take place across the entire MIT campus) a common base from which to develop their skills, scholarship, and community.

Dava Newman

Director

Professor of Aeronautics and Astronautics and Engineering Systems

More information about the Technology and Policy Program can be found at <http://tppserver.mit.edu/>.

Center for Engineering Systems Fundamentals

This year was a productive one for the still-new Center for Engineering Systems Fundamentals (CESF). There are now six graduate students working directly on CESF-related research projects, some of which are leading to journal publications. In addition, more MIT faculty members are becoming involved in CESF research, especially as a result of the groundbreaking Energy Box work being supported by the MIT Portugal Program and the pandemic flu research supported by the Sloan Foundation. Much of this is linked to IBM-affiliated initiatives to establish a new applied discipline, Services Science.

MIT Learning International Networks Consortium (LINC) held one of the largest international conferences ever offered by MIT on foreign soil, in Jordan and Dubai.

LINC is currently in discussions with foundations about follow-on research and implementation work to leverage the results of the conference. Including LINC, MIT-Portugal, and the Sloan Foundation, the total of new funds committed to CESF this year is approximately \$1 million.

A New MIT Subject on Fundamentals: Continuing Developments

AY2007–2008 saw the second offering of the new required ESD doctoral subject, ESD.86, Models, Data, and Inference for Socio-Technical Systems. ESD.86 is designed to use data and systems knowledge to build models of complex sociotechnical systems for improved system design and decision making, and to enhance model-building skills. This year, 19 students took the subject for credit and about another five were listeners. Professors Daniel Frey and Richard Larson view the past year's offering as the beta version, and the coming year's as the final, steady-state version. Continuing development is being supported in part by the MIT Portugal Program. We are pleased to announce that the educational materials of this subject are ported to MIT's OpenCourseWare (OCW) system and are now available on OCW web pages.

Center for Engineering Systems Fundamentals Research Initiatives

We have had an active year pursuing CESF research initiatives, with involvement from numerous MIT faculty members (both from within and outside ESD). In selecting promising research opportunities, we were guided by the ESD mission to focus on the intersection of traditional engineering, management (broadly defined), and social sciences. We benefited this year from the following support:

- Cordell Hull grant (\$100,000): Strategies to Overcome Network Congestion in Infrastructure Systems
- Research in Engineering Fundamentals (\$100,000): MIT ESD Portugal Project
- Electricity Management (\$100,000): MIT ESD Portugal Project
- The Sloan Foundation of New York (\$350,000): Pandemic Influenza: Social Distancing & Hygienic Policies to Reduce its Prevalence

We also received substantial financial support from many organizations in support of the international conference, MIT LINC 2007.

We currently have four submitted proposals under review:

- Linking Assessment and Measurement to Performance for PHEP (Public Health Emergency Preparedness) Through Engineering Systems Analysis. Stan Finkelstein, principal investigator; Richard Larson, coprincipal investigator. Submitted with the Harvard School of Public Health to the Center for Disease Control. Five years. \$1 million (MIT CESF portion).
- Decision-Oriented Analysis of Hurricane Response. Richard Larson, principal investigator; John Carroll, coprincipal investigator. Submitted to the National Science Foundation. Two years. \$400,000.

- BLOSSOMS, Blended Learning Open-Source Science Or Math Studies. Richard Larson, principal investigator; Dan Frey, coprincipal investigator. Submitted to the Hewlett Foundation. Two years. \$300,000.
- BLOSSOMS, Blended Learning Open-Source Science Or Math Studies. Richard Larson, principal investigator; Dan Frey, coprincipal investigator. Submitted to the Sloan Foundation. Two years. \$45,000.

Much of our research is focused on the services sector of the economy. This focus is combined with our emphasis on the Venn diagram intersection between engineering, management, and the social sciences. This year, Professor Larson led a group of more than 20 ESD-affiliated faculty members in the exploration of new research and educational initiatives in service science, management, and engineering. Some of his ideas about this topic are presented in his invited paper, “Service Science: At the Intersection of Management, Social, and Engineering Sciences,” published in *IBM Systems Journal* 47:1, pp. 41–52.

Presidential Elections

With ESD research affiliate and longtime friend of MIT Dr. Alex Belenky, Professor Larson has been studying queuing at election precincts during US presidential elections. This past year, that effort has expanded to consider the mathematics, logic, and tradition of presidential elections worldwide, culminating in a major book on presidential elections edited by Dr. Belenky, and published by Elsevier before the US elections in November 2008 (“Systems Studies of Voting Systems and Elections”). Dr. Belenky has published numerous op-ed pieces on presidential elections during this past academic year; they are summarized on the news page of the CESF website: <http://cesf.mit.edu/news.html>.

Social Distancing in an Influenza Pandemic

CESF has arranged a team of students, faculty members, and senior research staff to examine preparedness and response to a potential influenza pandemic, along the lines of the 1918–1919 Spanish flu, for which Boston was the urban epicenter. Participating students have ranged from a freshman UROP to Operations Research Center doctoral students. We have established ties to the Harvard School of Public Health and are coordinating our work with MIT’s plans for response to pandemic influenza with MIT’s Bill Van Schalkwyk. New publications this year included the following:

- “Pandemic Influenza: Preparations and Plans,” Richard C. Larson, Stan Finkelstein, Karima Nigmatulina. Draft Report, distributed to participants of the Workshop on Pandemic Influenza, MIT, April 22–23, 2008.
- “Planning for a Flu Pandemic: Policies to Empower Individuals and Families,” Shiva Prakash, Stan Finkelstein, Richard Larson. Draft Report distributed to participants of the Workshop on Pandemic Influenza, MIT, April 22–23, 2008.
- “Living with Influenza: Impacts of Government-Imposed and Voluntarily Selected Interventions,” Karima R. Nigmatulina and Richard C. Larson. To appear in the *European Journal of Operational Research*.

Our research into pandemic influenza has been supported by a grant from the Sloan Foundation (Dr. Stan Finkelstein, coprincipal investigator) and by an IBM Faculty

Research Award. In part as a result of this research on pandemic influenza, Dr. Larson has been invited to join the Health Sciences Policy Board of the Institute of Medicine (IOM).

The project benefited from the active participation of internationally known flu historian John M. Barry, who spoke at an MIT public forum on October 15, 2007. Video of the event is available on MIT World, at <http://mitworld.mit.edu/video/499/>.

Karima Nigmatulina, principal PhD research student working on the pandemic flu project, received first-place honors at a poster session sponsored by the National Academies of Science. The poster session was part of a two-day public event titled “Student Forum on Science, Technology and Policy.” Intended for students, postdoctoral fellows, and recent graduates interested in studying and pursuing careers in these areas, the event was held in Washington, DC on January 4–5, 2008. It featured both invited presentations and interactive discussions that convened a cross-section of government, academia, and industry to address practice and opportunities in the science and technology professions. The poster created by Nigmatulina, a third-year PhD student, focused on government and community interventions for stopping pandemic flu. Although many researchers, primarily epidemiologists, have examined this complex challenge, her work goes beyond medical interventions and other traditional methods because it employs an interdisciplinary engineering systems approach.

Hurricane Decision-Making: Example of Disaster Preparedness and Response

Fourth-year PhD student Michael Metzger has been working with Professor Larson, creating a quantitative planning model to frame and formulate rational policies for preparedness and response to hurricanes. This is a specific example of a broader interest and expertise at MIT: preparedness and response models for disasters of all types. Metzger has identified aspects of all three parts of the Venn diagram—engineering in the form of operations research, management (in the form *not* demonstrated in the response to Hurricane Katrina), and social science—as important in this work. This work has already been reported at four national research conferences. The CESF hurricane team expanded this year to include Maurice Davis Murphy, a master’s student in ESD’s TPP program and at the Operations Research Center.

Michael Metzger won second place at the aforementioned National Academies forum for his poster titled “Avoiding the Eye of the Storm,” which outlines the use of decision modeling to mitigate risks and damage in hurricane emergencies. Using an engineering systems approach, Metzger’s presentation outlined the complex fixed and variable factors in planning for hurricane emergencies. Fixed factors include pre-positioning supplies and preplanning for mobilization and deployment of personnel to assist residents in stricken areas. Variables include the storm’s location, time, and intensity. To address these issues, Metzger used a stochastic dynamic program incorporating economic, social, and logistical impacts of alternative sequential decisions.

Michael Metzger also received second-place honors for his research on strategies for hurricane preparedness and response at the second annual Department of Homeland Security (DHS) University Network Summit. The event, held March 19–20, 2008 in Washington, DC, showcased key research and education priorities of DHS Centers of

Excellence, the Science and Technology Directorate, and the Department of Homeland Security at large. Undersecretary of Homeland Security Jay M. Cohen presented Metzger with his award at a gala luncheon. In addition, Metzger was invited to serve on the DHS scholars “best and brightest” panel. He was the only student to both win an award and speak on the panel.

The Energy Box

Supported by the MIT Portugal Program, the Energy Box is being designed and created as an open-source software system to manage silently in the background—from an available desktop computer—the electricity use of a home or small business. The ideas build from concepts first proposed by MIT professor Fred Schweppe in the late 1980s and brought algorithmically to early prototype stage by MIT doctoral student Panos Constantapoulos in his doctoral thesis (cosupervised by Professors Schweppe and Richard Larson).

The Energy Box research currently includes collaborations with researchers from both Faculdade de Engenharia da Universidade do Porto, Portugal and IST. Key ESD doctoral student researchers in this effort include Daniel Livengood, Kathy Donnelly, and Woei Ling Leow. Papers related to the project include:

- “To Intelligent Energy Infrastructure: Achieving Energy Efficiency through Behavioral Economics and Energy Box Technology Implementation.” White paper working draft. Daniel Livengood, Kathy Donnelly. January 2008.
- “The Energy Box: Architecture, Design, and Interface.” Draft for review. Woei Ling Leow. May 2008.
- “Strategies to Overcome Network Congestion in Infrastructure Systems.” J. Black and R. C. Larson. *Journal of Industrial and Systems Engineering* 1:2, pp. 2–19. 2007.
- “The Energy Box’s Algorithm Bank: Space Conditioning Stochastic Dynamic Program,” Daniel Livengood, Richard Larson. June 30, 2008.

MIT LINC International Conference: Dead Sea, Jordan, and Dubai

MIT LINC—the Learning International Networks Consortium (<http://linc.mit.edu/>)—is a volunteer effort housed in CESF. It is comprised of a quasiprofessional society of leaders worldwide who believe in the transformative nature of technology as it pertains to education: specifically, “With today’s computer and telecommunications technologies, every young person can have a quality education regardless of his or her place of birth.”

The LINC 2007 Conference—the first conducted away from the MIT campus—was co-located in Jordan (on the Dead Sea) and in the United Arab Emirates (Dubai) on November 1, 2007. Her Majesty Queen Rania of Jordan, patron of LINC-Jordan, participated in the opening ceremonies in Jordan on October 28. More than 500 participants from over 40 different countries attended. On October 31, the conference moved to Dubai for an executive session, attended by the patron of Dubai LINC, His Highness Sheikh Maktoum bin Mohammad bin Rashid Al Maktoum, chairman of the Dubai Technology and Media Free Zone Authority. H.H. Sheikh Nahyan Bin Mubarak Al Nahyan, minister of higher education and scientific research, delivered the opening

address in Dubai. The presence and participation of these leaders from Jordan and the United Arab Emirates demonstrate the region's strong commitment to educational innovation supported by technology. (See <http://linc.mit.edu/conference/>.)

In attendance in Jordan were more than 150 Jordanian professors and approximately 100 Jordanian high school math and science teachers; the teachers' participation was sponsored by MIT. Case studies from Jordan, Mexico, Pakistan, Kenya, Egypt, Botswana, Algeria, the United Arab Emirates, and the United States were presented, best practices were shared, and new collaborations were established. The 18 keynote speakers represented a top-tier gathering of e-learning experts.

In addition to Professor Larson, LINC's 15-member MIT faculty advisory board includes ESD's Professor Daniel Roos, who has been very supportive of LINC's goals and directions. The faculty advisory board spans all five schools at MIT.

Outreach

There were many public CESF presentations this past academic year, including:

- "Invited Lectures on Queues." R. C. Larson, Lincoln Labs, Lexington, MA. July 2007.
- "The De-Widgetization of OR: The Importance of Human Behavior in What We Do." R. C. Larson, Second Annual Behavioral Operations Conference, Carlson School of Management, University of Minnesota, Minneapolis. July 23, 2007.
- "Police OR: From Golden Oldies to Emerging Newbies." R. C. Larson, Annual Symposium of the National Institute of Justice, Washington, DC, US Department of Justice. July 25, 2007.
- "Potential Technology-Enabled Outreach at the SSE: Lessons from LINC." R. C. Larson, presentation before LUMS advisory board, Stanford University, CA. September 22, 2007.
- "Designing and Managing Critical Infrastructures at the Intersection of Engineering/OR, Management & Social Sciences." R. C. Larson, Harvey Mudd College Mathematics Conference on Public Sector Operations Research, Harvey Mudd College, Claremont, CA. Invited Keynote Lecture. September 29, 2007.
- "Services Sciences and Engineering: Importance to Humanitarian Supply Chains." R. C. Larson, NSF Workshop on Humanitarian Supply Chains and Engineering, University of Washington, Seattle. October 8, 2007.
- "Distance Learning as a Tool for Poverty Reduction: A Focus on Two Countries, China and Mexico." R. C. Larson and M. E. Murray, lecture presented to participants in MIT LINC 2007, Dead Sea, Jordan. Oct. 29, 2007.
- "Where From Here? Some Thoughts from MIT." R. C. Larson, lecture presented at Dubai LINC Executive Session Program, MIT LINC 2007, Knowledge Village, Dubai. November 1, 2007.
- "Service Science: At the Intersection of Management, Social and Engineering Sciences." R. C. Larson, MIT Sloan School of Management. November 19, 2007.

- “OR for the OR and Much More! Engineering a Learning Healthcare System. A Look at the Future IOM Engineering Workshop.” R. C. Larson, IOM/NAS, Washington, DC, April 2008.
- “Distance Learning as a Tool for Poverty Reduction: A Focus on China and Mexico, and BLOSSOMS, Blended Learning Open Source Science or Math Studies.” M. E. Murray and R. C. Larson, MIT Global Poverty Initiative Millennium Campus Conference. April 19, 2008.
- “Living with Pandemic Influenza, via Non-Pharmaceutical Interventions (NPIs).” R. C. Larson, Dartmouth College, Hanover, New Hampshire. May 15, 2008.

Professor Larson was invited to participate in the fifth meeting of the Council of Presidents of the Federation of Middle Eastern and US National Academies of Sciences at the Dead Sea in Jordan (January 13–15, 2007). As a result of this meeting, Professor Larson will lead an effort to create a web portal for ongoing research of interest and relevant to countries and territories in the Dead Sea region.

Finally, Richard Larson, with two other senior MIT faculty members, has been serving on the advisory team of Lahore University of Management Science (LUMS). LUMS, a major private university in Pakistan that is now opening a new School of Science and Engineering, is patterned after MIT and the India IITs. The new school at LUMS opened on September 1, 2008.

Richard Larson

Director

Professor of Civil and Environmental Engineering and Engineering Systems

More information about the Center for Engineering Systems Fundamentals can be found at <http://cesf.mit.edu/>.

Center for Technology, Policy, and Industrial Development

The Center for Technology, Policy, and Industrial Development (CTPID) focuses on contemporary problems at the nexus of social, natural, and technological systems, and the dilemmas that emerge from interactions among these systems. CTPID examines the opportunities and challenges these dilemmas offer our enterprises, as well as the constraints they impose on the scope and extent of their activities.

Founded in 1985, CTPID brings together more than 45 faculty, researchers, students, and staff from the fields of engineering, management, and social sciences to approach the complex issues that shape modern economies. Participants in the research programs that CTPID develops come from industry and government as well as from academia. Among the sectors of current focus at the Center are aerospace, automotive, information quality, materials systems, and environmental law. Lately the health care sector has been of growing interest to CTPID researchers.

CTPID is a major research center associated with the School of Engineering's Engineering Systems Division, which aims to unite interdisciplinary faculty and

students to study large-scale, complex engineering systems. CTPID contributes to the division by forming collaborative research projects with industrial and government stakeholders outside of the Institute, while ESD provides academic opportunities for CTPID faculty, students, and staff.

CTPID is funded by 25 industry sponsors and 15 government agencies, for a total research expenditure volume of about \$5 million and a total administered research volume of \$8 million. FY2008 projects included the Ford–MIT Alliance (administered by CTPID), the International Motor Vehicle Program (IMVP), LAI, the Materials Systems Laboratory (MSL), the MIT Information Quality program (MITIQ), and the Technology and Law program (T&L).

The acting director of CTPID is Professor Joel Moses, Institute Professor and professor of computer science and engineering systems. Lissa Natkin is the CTPID administrative officer. CTPID's administrative offices are located in E40-227.

Highlights of the Year

In December 2006, the Ford-MIT Alliance, the Institute's longest-running research partnership with industry, was pleased to announce renewed funding: \$3 million per year for a third five-year term. The new funding period took effect on January 1, 2008 and will run through 2012. Continued funding is an acknowledgment by Ford of the alliance's significant contributions to the strategic work of the company's Scientific Research Laboratory. The renewal also acknowledges CTPID's contributions to a diverse group of research initiatives involving product development, active safety, and powertrain technologies.

During in the past year, the Ford-MIT Alliance has continued its work on cutting-edge environmental and energy technologies and policy issues. These include carbon mitigation and a nanotechnology project designed to increase the storage capacity of ultra capacitors, replace batteries, and compete with fuel cells. The Alliance is a founding partner in the MIT Energy Initiative (MITEI), and is contributing to MITEI's effort to define future energy systems.

Another of CTPID's research entities, LAI, continues to make significant contributions to supporting lean enterprise transformation across the aerospace industry. LAI's newest member, BAE Systems, is headquartered in England.

In April 2008 LAI welcomed Thomas Farmer, president of Pratt & Whitney Military Engines, as its executive board industry cochair. Mr. Farmer joins MIT Institute Professor Sheila Widnall (MIT cochair) and Blaise Durante, secretary for the Air Force, Office of the Assistant Secretary for Acquisition (government cochair), in this critical leadership role.

In another exciting leadership development, in June 2008, Richard B. Lewis, most recently chief operations officer of Rolls Royce Corporation, became LAI's executive director.

Since January 2007, LAI has been offering Knowledge Exchange Events (KEEs), including tutorials, workshops, executive seminars, and roundtables designed for

researchers and practitioners to share cutting-edge research and best practices directly with consortium and other participants. There are several vibrant and growing communities of practice that have sprung from relationships developed during and knowledge shared at LAI KEE events.

The US Army has signaled its intent to provide \$1 million in funding for a series of LAI Enterprise Management engagements during the next 12 months, contingent upon presidential approval of the Defense Supplemental Appropriation Bill.

In November 2007, the MITIQ program hosted the 12th International Conference on Information Quality, the premier conference in information quality. More than 150 participants from academic and industry communities worldwide took part in this forum.

In a new initiative, MITIQ helped the University of Arkansas at Little Rock to successfully establish the first-of-its-kind PhD degree program in information quality. The first class, consisting of two graduate students, enrolled in fall 2007.

During the past year CTPID faculty, staff, and students have been increasingly engaged in discussions and preliminary research in the area of health care delivery. CTPID's long experience with lean manufacturing is considered very relevant to this issue. Discussions have been held thus far with several hospitals in the Boston area as well as hospitals in England and Portugal.

Awards and Recognition

Several awards were made this year to IMVP scholars and affiliates. Professor Francois Fourcade (École Polytechnique) received a Best Paper Prize (Technology and Innovation Management Division) at the 2007 Academy of Management Conference. Professor Matthias Holweg (University of Cambridge) received an Emerald Management Reviews Citation of Excellence for his paper "Supply Chain Collaboration: Making Sense of the Strategy Continuum" (*European Management Journal*), and also received an Emerald Literati Network Highly Commended Award for his paper "An Investigation into Supplier Responsiveness: Empirical Evidence from the Automotive Industry" (*International Journal of Logistics Management*).

Ricardo Valerdi, a research scientist with the Lean Aerospace Initiative, was elected to the board of directors of INCOSE, where he is serving as treasurer (two-year term).

Several SEArI papers won awards: Adam Ross and Donna Rhodes, IEEE Systems Conference 2008, Best Paper; Adam Ross and Donna Rhodes, INCOSE Symposium 2008, Best Paper; Matthew Richards, Adam Ross, Daniel Hastings, and Donna Rhodes, INCOSE Symposium 2008, Best Paper; and, Matthew Richards, Lauren Viscito, Adam Ross, and Daniel Hastings, Responsive Space 6 Conference 2008, Best Student Paper.

Ford-MIT Alliance

The Ford-MIT Alliance, an Institute-wide initiative, was established in 1997. In December 2006 it was renewed for its third five-year term at \$3 million annually, beginning January 1, 2008, and running through 2012. In 2007, Ford joined MITEI as

its first sustaining member with a five-year commitment of \$1 million annually and participation in its executive committee by Ford vice president Sue Cischke. This action reflects the strong emphasis the Alliance puts on energy and environmental research within its portfolio on campus.

The portfolio is managed by an operating committee, including codirectors Professor John Heywood (MIT) and Simon Pitts (Ford), and Elaine Savage, MIT's Alliance executive director. The operating committee reports to an executive committee that includes MIT's leadership champion, Chancellor Phillip L. Clay, and works in close partnership with Ford's key executives, including the chief technical officer and vice president of research for Ford. The Alliance hosts the executive committee on campus three times annually.

The Alliance is the Institute's longest running commitment from industry and represents a significant acknowledgment by the Ford Motor Company of MIT's relevance in providing a research engine based in academia. Since 1997, the Alliance has funded over 100 projects, with budgets ranging from \$150,000 to \$1.3 million throughout the School of Engineering, the Sloan School, CSAIL, MITEI, and various interdisciplinary labs and centers across the Institute.

Ford-MIT Alliance Research Activities

Ford-MIT Alliance research focuses on key areas such as energy and the environment, active safety, powertrain, and controls. Emerging opportunities are evaluated and new projects funded as innovative and timely research topics are identified. Through a strong network and presence on campus, next-generation technologies are rapidly investigated for application of the Institute's capabilities to Ford's research areas. The Alliance houses approximately 20 active projects at any time with an emphasis on collaboration with principal investigators from Ford and exchange of personnel including students.

The Ford-MIT Alliance supported MIT's CSAIL-based autonomous vehicle team for the DARPA Urban Grand Challenge Race in November 2007 with the donation of a Land Rover and technical and financial assistance. Prior to the race the Alliance donated funds to rent the test track in California for vehicle and new software trials. Several students were sent to Ford to jointly engineer changes in the vehicle and the hardware, thus enhancing existing capabilities. This enabled the team to place fourth in this contest, a significant success, as MIT had not entered a team in earlier competitions. In addition, this research continues through a series of joint collaborations and personnel exchanges. The outcomes of such research will lead to greater innovations in safety for future passenger vehicles and collision avoidance as well supporting DARPA's vision of autonomous vehicles.

The Active Safety research projects support pedestrian detection, enhanced vehicle stability, complex alerting systems, driver wellness, and behavioral research, all of which enhance driving safety.

Aligned with these and other research interests was the relocation of the offices of the Alliance to CSAIL in 2008. Ford became the first member in CSAIL's Industry Affiliates Program in 2007.

Environmental projects within the portfolio include Ford's long-term founding support of the Alliance for Global Sustainability with ongoing research on policy, including carbon mitigation and scenarios for the future such as Before a Transition to Hydrogen, as well as its substantial support of MITEI.

Ford-MIT Alliance Future Directions

The Alliance will continue to emphasize energy-related research through the MIT Energy Initiative and pursue advanced interactions with CSAIL and other researchers, underscoring the role the Institute has in shaping the strategy of a corporate research agenda and crosscultural partnership.

International Motor Vehicle Program

IMVP is the oldest and largest international research consortium aimed at understanding the challenges facing the global automotive industry. Founded at MIT in 1979 and headquartered at MIT, IMVP has evolved to become a network of professors and researchers engaging with managers and executives in the global automotive industry. IMVP researchers are based at universities around the world, including MIT, the University of Pennsylvania, the University of Pittsburgh, Carnegie Mellon University, Oxford University, the University of Cambridge, the École Polytechnique, Catholic University of Korea, and the University of Tokyo, among others.

The IMVP research framework includes six broad areas of study, the first three of which, listed below, involve broad-based global benchmarking surveys:

- Innovation in the Automobile Industry (Advanced Engineering)
- Next Generation Product Development (Vehicle Engineering)
- Lean Production Revisited (Vehicle Assembly)
- Value Chain Dynamics: The Evolving Supply Base
- Next Generation Distribution
- Sustainability: Environmental and Social Impacts of the Automobile

IMVP Leadership

IMVP saw a change in leadership structure from the previous fiscal year. Professor John Paul MacDuffie, Wharton School/University of Pennsylvania, continued to serve in his role as IMVP codirector; he now shares that responsibility with Professor Charles Fine, MIT Sloan School of Management (replacing Professor Michael Cusumano). Professor Daniel Roos continued to serve as chairman of the IMVP advisory board. The previously open position of full-time IMVP executive director was filled by Glenn Mercer, former head of McKinsey's automotive industry practice, in the modified part-time role of IMVP senior director for global strategy and sponsor development.

IMVP Funding

IMVP is fully funded by industry sponsors. After a number of years of growing sponsorship revenues, 2008 saw a continuation of 2007's decline in revenue, due to the expiration of General Motors' and Honda's sponsorship contracts and the cancellation of Tenneco's final year of sponsorship. Toyota Motor Corporation has rejoined as an IMVP sponsor for a three-year period and new sponsor Manheim has signed on for three years of membership (at the lower fee level paid by suppliers), but the agreement with current sponsor Nissan is due to expire this year, with no agreement to renew yet. Despite an especially difficult business environment for securing research funding from the global automotive industry (which itself, especially in North America, is under extreme financial duress), IMVP continues to pursue sponsorship renewals with Nissan, General Motors, and Hyundai, and seeks to return to IMVP membership lapsed sponsors Ford and Chrysler. In the interim, we are maintaining research contacts with these firms, even if financial assistance is not immediately forthcoming.

Although we have faced many months of delays in gaining these sponsorship renewals, we are still in dialogue with these automakers, the trajectory of the talks is generally positive, and we are cautiously optimistic about our ultimate success in 2009 if not in 2008. That being said, our current financial situation is not strong and we have moved quickly to cut expenses, both by freezing research grants and by canceling our annual researchers' meeting in 2008.

IMVP Continues Relationship with World Economic Forum

IMVP continues a partnership with the World Economic Forum's Automotive Program. Based in Geneva, Switzerland, the World Economic Forum (WEF) is an independent international organization committed to improving the state of the world by engaging leaders in partnerships to shape global, regional, and industry agendas. At the annual meeting in Davos, Switzerland, each January, the CEOs of automotive original equipment manufacturers and first-tier suppliers gather to discuss the state of the industry. IMVP codirector John Paul MacDuffie attends this meeting each year as an industry adviser and works with WEF staff to develop the agenda and program for Davos. He draws on IMVP research to provide intellectual content and empirical findings to support the Forum's program of events and initiatives for its partners and member companies in the global automotive industry.

IMVP Research Impact

IMVP-funded research projects cross all elements of the automotive value chain, including:

- Alliance Portfolio Strategy in China's Auto Market
- Architectural Analysis on the Auto Parts Supply Networks
- Archetypical Engineering Solutions as Alternative Options to Modularity in Integrating External Sources of Innovation During NPD Processes
- Change in Product Architecture and OEM-Supplier Relationships
- Complementary Investment Strategies and Capability Building in Brazil

- Development of Embeddedness in Buyer-Supplier Relationships
- Development of Innovative Capabilities in the Chinese Auto Industry
- From the Lean Paradigm toward Sustainable Growth Paradigm
- Innovation in Product Architecture and Low-Cost Strategy in the Chinese and Indian Automobile Industry
- International Benchmarking of the Automobile Industry: Productivity, Quality, Capabilities, and Supply Chains
- Linking Boundary Spanner Capability with Firm Relational Capital: A Multi-Industry Study of Managing Buyer-Supplier Relations
- Measuring the Performance of Collaborative Supplier Relations
- Networks, Institutions, and Upgrading in the Argentine Autoparts Supplier Sector
- Performance Outcomes of Supplier Involvement in New Product Development in the Automotive Industry
- Pragmatic Collaboration and the Interorganizational Automotive Design Chain
- Product Architecture and Development (Role of Alliances and Interorganizational Coordination)
- Product Development of the Chinese Top Automaker
- Spillover Effects Among Compatriot Automotive Brands
- The Impact of Process Improvement on Organizational Innovation
- The Impact of Services on Firm Profitability
- Understanding the Tradeoffs in New Car Launch

On May 1–2, 2008, a number of IMVP researchers participated in the Sloan Industry Studies annual conference in Cambridge, Massachusetts, including John Paul MacDuffie (Wharton School), Charles Fine (MIT), Susan Helper (Case Western Reserve University), Arnaldo Camuffo (University of Padova), Frits Pil (University of Pittsburgh), Mari Sako (Oxford University), Eric Thun (Oxford University), and Francisco Veloso (Carnegie Mellon University).

IMVP researchers were quoted in a variety of publications, including the *New York Times* (USA), the *New York Times Magazine* (USA), *Barron's* (USA), the *Cleveland Plain Dealer* (USA), the *Christian Science Monitor* (USA), the *National Post* (Canada), the *Financial Times* (UK), *The Times* (UK), *The Sunday Times* (UK), *The Globe and Mail* (UK), *The Independent* (UK), *The New Statesman* (UK), and *Nikkei Weekly* (Japan). They also were mentioned in numerous Knowledge@Wharton (<http://knowledge.wharton.upenn.edu/>) articles, and in various additional international or non-English-language publications.

Several IMVP researchers received notable academic awards during the fiscal year, including:

- Professor Francois Fourcade (École Polytechnique) received a Best Paper Prize (Technology and Innovation Management division) at the 2007 Academy of Management conference.
- Professor Matthias Holweg (University of Cambridge) received an Emerald Management Reviews Citation of Excellence for his paper “Supply Chain Collaboration: Making Sense of the Strategy Continuum” (*European Management Journal*), and also received an Emerald Literati Network Highly Commended Award for his paper “An Investigation into Supplier Responsiveness: Empirical Evidence from the Automotive Industry” (*International Journal of Logistics Management*).

Whatever IMVP looks like in the future, it will almost certainly be more web-enabled, one way or the other, than in the past. Accordingly, we have recently overhauled the IMVP website in several ways. First, we have overhauled the document contents: some 700+ documents dating as far back as 1990 were all individually reviewed, sorted, assigned keywords, given microabstracts, and reloaded into a fast-sorting search database. We hope that after this effort, sponsors and others will find the database easier to work with, thus encouraging more frequent visits to the site. Second, we have cleaned up and streamlined away many old or obsolete pages, moved the entire site to a new server, and rewritten it with modern web-authoring tools, enabling faster and easier updates and revisions. Third, we have added some features, including an Ask The Expert form (to encourage sponsors to interact directly with us), the ability to easily upload photos and videos, and a blogging tool.

IMVP Academic Impact

IMVP researchers continued to be highly productive in their publication of scholarly papers in respected academic journals. A representative selection of recent publications includes:

Matthias Holweg and Frits K. Pil. “Theoretical Perspectives on the Coordination of Supply Chains.” *Journal of Operations Management*. 26:3, p. 389.

Jonathan Brookfield, Ren-Jye Liu and John Paul MacDuffie. “Taiwan’s Bicycle Industry A-Team Battles Chinese Competition with Innovation and Cooperation.” *Strategy & Leadership* 36:1, p. 14.

Gerald A. McDermott. “Politics and the Evolution of Inter-firm Networks: A Post-Communist Lesson.” *Organization Studies* 28:6, p. 885.

Philippe Silberzahn and Christophe Midler. “Creating Products in the Absence of Markets: A Robust Design Approach.” *Journal of Manufacturing Technology Management* 19:3, p. 407.

Sandra Rothenberg. “Sustainability Through Servicizing.” *MIT Sloan Management Review* 48:2, p. 83.

Victor P. Seidel. “Concept Shifting and the Radical Product Development Process.” *Journal of Product Innovation Management* 24:6, p. 522.

Johannes Van Biesebroeck. “Complementarities in Automobile Production.” *Journal of Applied Econometrics* 22:7, p. 1315.

Claudio Wolter and Francisco Veloso. "The Effects on Vertical Structure: Perspectives on Transaction Costs and Competences." *Academy of Management Review* 33:2, p. 586.

Markus C. Becker and Francesco Zirpoli. "Applying Organizational Routines in Analyzing the Behavior of Organizations." *Journal of Economic Behavior & Organization* 66:1, p. 128.

More information about IMVP can be found at <http://www.imvpnet.org/>.

The Lean Advancement Initiative

Now in its fifth phase of operations (September 1, 2005–August 31, 2010), LAI continues to evolve its focus on lean enterprise-level transformation and produce a unique body of research, methodologies, products, tools, and curricula. As a membership-based consortium representing industry, government, and academia, LAI works as a neutral broker to identify and share best practices, common goals, and strategic tools built on collaborative member experience. LAI's operating model combines knowledge creation, deployment, and relationship management to deliver value to its stakeholders. LAI engages its members and delivers new findings and information through a series of knowledge exchange events, conferences, workshops, and tutorials.

The LAI Educational Network (EdNet) is an outreach activity that translates LAI research findings and practitioner knowledge into university-level curricula. EdNet is comprised of some 40 universities in the United States, England, and Mexico that have signed a no-cost collaborative agreement with MIT. Members leverage their collective resources to develop, test, deliver, and continuously improve curriculum materials and share best practices.

LAI Strategic Imperatives

Phase V goals include:

- provide value to all consortium stakeholders
- sustain the LAI consortium as a learning community among industry, government, and academia to address enterprise excellence and take collective action for continuous improvement
- facilitate enterprise transformations within and between industry and government
- expand and diffuse enterprise transformation knowledge

LAI Leadership

LAI is governed by a group of cochairs from government, industry, and academia. They include Blaise Durant (Office of the Assistant Secretary of the Air Force), Institute Professor Sheila Widnall (MIT), and Thomas Farmer, President, Pratt & Whitney Military Engines (industry).

LAI's codirectors are Professor Deborah Nightingale, MIT Department of Aeronautics and Astronautics and Engineering Systems Division, and Professor John Carroll, MIT Sloan School of Management and ESD.

LAI Research

The LAI Phase V research program is designed to accelerate lean enterprise transformation, design future lean enterprises, and evolve adaptive lean enterprises. LAI research seeks to provide knowledge, insight, and tools to enable true enterprise transformation. LAI's Phase V program is structured around four collaborative research teams that are headed by both an MIT faculty and research lead and include associated faculty advisers and graduate student researchers. These teams are focused on:

- enterprise transformation/enterprise architecting
- eEnterprise systems engineering
- lean enterprise product development
- enterprise change management

LAI's research teams work to address these grand questions:

- How can I understand how my organization/enterprise currently operates within its larger context?
- How can I define and evaluate the future possibilities for a more efficient and effective enterprise?
- What are the most effective strategies and tactics to achieve these future possibilities for my enterprise?
- How can I best manage the enterprise change process?

LAI's Four Research Areas

1. Motivation for Enterprise Transformation/Enterprise Architecting

To transform an enterprise we need to know not only where we are, but more importantly, where we want to be (future state). In enterprise value analysis, how do we define the possible future state of the enterprise and evaluate which path to take? Once we define the future vision, how do we design the enterprise, and how do we incorporate the multiple dimensions at the enterprise level?

2. Motivation for Enterprise Systems Engineering

Our industry today is characterized by extended enterprises developing complex systems/systems of systems. Long lifecycles, constrained resources, and program complexity increases the importance of predicting engineering effectiveness. Global enterprises have distributed engineering workforces working collaboratively on programs. The nature of these programs demands high levels of systems competency, but there is often a shortage of these skills, and sociocultural factors appear to be increasingly important to successful program outcomes.

3. Motivation for Enterprise Lean Product Development

How far and how directly can lean principles developed for production operation be applied to product development? Focusing on enterprise, how can lean principles be applied to help enterprises develop and manage resources and capabilities to efficiently create streams of successful products?

4. Motivation for Enterprise Change Capabilities

This requires a complete and comprehensive set of precepts for managing organizational to enterprise change and a road map for leadership that will help to initiate, accelerate, and sustain lean enterprise transformation. The use of case study observations of change efforts provides insights into what makes for effective lean enterprise cultures and structures. LAI also provides references and illustrations for tools and methods that support enterprise transformation. Transformation that derives from within lean enterprises approaches differs from traditional notions of managing planned organizational change.

2007–2008 LAI Highlights

LAI and EdNet both welcomed new members.

New LAI members include BAE Systems, United Launch Alliance, United Space Alliance, and the US Army. New EdNet members are Tecnológico de Monterrey, Universidad Anahuac de Puebla, Universidad Popular Autónoma del Estado de Puebla, the University of Virginia Darden School of Business, and the University of Texas Pan-American.

LAI and the US Army agreed to enter into a new strategic partnership for \$1 million.

Lean enterprise leadership from every US service branch participated in a strategic overview of the government's vision and future direction at LAI's 2008 conference.

LAI offered a dozen highly successful knowledge exchange events for 150 participants at sites around the country and will continue to update and expand these offerings.

LAI's Lean Academy® Course has been accepted by OpenCourseWare and will be the first widely available open introductory curriculum for lean six sigma principles, practices, and tools. The Lean Academy® Course was offered during IAP at MIT for the first time for credit and 25 undergraduate and graduate students enrolled.

EdNet partnered with the Lean Educators Academic Network to cohost a second annual Lean Educator Conference and ran very successful educational events at Edwards Air Force Base and MIT.

In addition to the publications listed below, LAI and EdNet researchers and staff presented 26 papers and presentations at nine conferences.

LAI Products

The LAI tool suite is regularly expanded, updated, and revised; a comprehensive list is available at <http://lean.mit.edu/>.

LAI Moving Forward

As LAI moves further into Phase V, it is focused on strengthening and expanding the consortium to effect and support international enterprise transformation efforts. LAI will continue this work by conducting research, sharing knowledge, and supporting members in their continuous improvement efforts. LAI will continue to deploy new findings, information, and tools through new Knowledge Exchange Events, site visits, curriculum building, short courses, and case studies with consortium members.

EdNet's first product, the LAI Lean Academy® Course, has been offered to more than 1,000 students by 30 qualified instructors and has been adopted by about 10 schools. Building on this product's maturity, the EdNet community will focus on developing more targeted curricula in Lean Product Development, Lean Health Care, and Enterprise Value Stream Mapping.

LAI Publications

Journal Articles

Davidz, Heidi, and Deborah Nightingale. "Enabling Systems Thinking To Accelerate the Development of Senior Systems Engineers." *Systems Engineering Journal* 11:1, 2008.

Lane, Jo Ann, and Ricardo Valerdi. "Synthesizing System-of-Systems Concepts for Use in Cost Modeling." *Systems Engineering Journal* 10:4, December 2007.

Rhodes, Donna H., and Ricardo Valerdi. "Enabling Research Synergies Through a Doctoral Research Network for Systems Engineering." *INCOSE Journal of Systems Engineering* 10:4, December 2007.

Valerdi, Ricardo, and Ray Madachy. "Impact & Contributions of MBASE on Software Engineering Graduate Courses." *Journal of Systems & Software* 80:8, pp. 1185–1190, August 2007.

Valerdi, Ricardo, Adam Ross, and Donna H. Rhodes, "A Framework for Evolving System of Systems Engineering." *Journal of Defense Software Engineering* 20:10, pp. 28–31, October 2007.

Book Chapters

Roth, George. "Learning History: An Action Research Practice in Support of Actionable Learning," in P. Reason and H. Bradbury (eds.), *Handbook of Action Research, Vol. II*. Newbury, CA: Sage, 2008.

Roth, George. "The Order and Chaos of the Learning Organization," in T. Cummings T. (ed.), *Handbook of Organization Development*. Newbury, CA: Sage, 2008.

Theses

Aykroyd, Timothy N. "Value Assessment of New Product Innovations." SM Thesis, System Design and Management Program, Massachusetts Institute of Technology, January 2008.

Davis, Mark J. "Synchronization of System-of-Systems Interfaces in Military Satellite Communications." S.M. Thesis, System Design and Management, Engineering Systems Design, Massachusetts Institute of Technology, January 2008.

Fong, Allan. "Developing a Boundary Object Model To Analyze Communication Interfaces: Applications for System Integrators." M.S. Thesis, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, August 2007.

Haddad, Marc. "Knowledge Integration for Problem Solving in the Development of Complex Aerospace Systems." PhD Thesis, Technology, Management and Policy, Engineering Systems Division, Massachusetts Institute of Technology, June 2008.

Patneau, Steven M. "Transforming Commercial Aerospace Supply Chain Management Practices by Utilizing Toyota Production System Principles, Practices, and Methodologies." S.M. Thesis, System Design and Management (SDM), Engineering Systems Division, Massachusetts Institute of Technology, January 2008.

Sgouridis, Sgouris. "Symbiotic Strategies in Enterprise Ecology: Modeling Commercial Aviation as an Enterprise of Enterprises." PhD Thesis, Engineering Systems Division, Massachusetts Institute of Technology, September 2007.

Working Papers

Pessoa, Marcus V.P. "Weaving the Waste Net: A Model to the Product Development System Low Performance Drivers and Its Causes." LAI White Paper 08-01, January 23, 2008.

Sgouridis, Sgouris, Joseph Sussman, Henry Weil, and Kirkor Bozdogan. "Taming the Business Cycles in Commercial Aviation: Trade-Space Analysis of Strategic Alternatives Using Simulation Modeling." Working Paper, 2008.

More detailed information is available at <http://lean.mit.edu/>.

Materials Systems Laboratory

The MIT Materials Systems Laboratory (MSL) is internationally recognized for its innovative work analyzing the competitive position of materials and the strategic implications of materials choice. For nearly two decades, MSL has addressed issues arising from materials choice in a range of applications in the automotive, electronic, and aerospace industries. The Lab's recent emphasis has been on automotive applications.

MSL has five researchers (two professors and three full-time research staff) and 15 graduate students. MSL graduate students come from a number of departments and programs at MIT, including the Engineering Systems Division, the Technology & Policy Program, the Department of Materials Science and Engineering, and the Department of Mechanical Engineering. Five students are currently working on their PhDs. Several of MSL's master's degree candidates are planning to continue on toward their PhD or have plans to pursue multiple master's degrees.

The Lab's work builds on a unique combination of materials-processing knowledge, engineering design practice, manufacturing process analysis, and environmental information to construct analytical tools for decision support and competitive analysis. To develop these tools, MSL has refined its extensions to classic engineering process modeling for the past two decades. Modeling elements have been married to elements of product design, material properties, and manufacturing assumptions, to yield tools that can estimate the costs of product manufacture under a wide range of conditions. These tools analyze primary materials production, primary materials processing, component and subassembly manufacture, and end-of-life vehicle processing. In each case, these tools estimate the costs of production as a function of processing technology, material flows, operating conditions, and energy and capital requirements.

MSL also has developed techniques for understanding how markets respond to the different combinations of engineering and economic performance available by using different materials. Further, MSL researchers analyze the environmental consequences of materials and process choice, incorporating the emerging life-cycle analysis paradigm. These tools make it possible, when used with economic and engineering assessments, to develop robust, credible, and defensible product strategies that take life-cycle information into account.

MSL's Role in the MIT Portugal Program

MSL has played a key role in developing the Engineering Design and Advanced Manufacturing (EDAM) degree programs to be offered by the MIT Portugal Program. This involvement has drawn on MSL's considerable experience in conducting joint research activities with universities in Portugal, and our role in the development of an advanced automotive design and engineering center in the north of Portugal. Joel Clark (professor in the Department of Materials Science and Engineering and the Engineering Systems Division) is codirector of the EDAM education and research activities. Jeremy Gregory (research scientist in the Laboratory for Energy and the Environment) has coordinated the curriculum development and other activities related to both the advanced master's and PhD degree programs. With the aggressive plans for the deployment of both a master's and a PhD program, many members of the MSL staff are actively working on curriculum development with Portuguese partners and are making excellent use of the badly needed space allocated for the program by MIT.

Numerous research activities have been conducted as part of the MIT Portugal Program. Richard Roth (research associate at CTPID) has directed a multiuniversity program (in conjunction with Instituto Superior Technico of Lisbon, Faculdade de Engenharia da Universidade do Porto, and the University of Minho) to develop innovative design solutions using advanced materials for automotive body applications. This work has included interaction with Volkswagen/AutoEuropa in Portugal as well as the recently opened automotive design center, Centro para a Excelência e Inovação na Indústria Automóvel. Other joint research projects have recently been initiated as part of the MIT Portugal Program, including projects involving the investigation of improved methods for injection molding, tool design and use strategies, and improved recycling systems.

Collaborative Research Laboratory with General Motors

MSL's research sponsors include major automakers and materials suppliers. A five-year agreement with General Motors established the Collaborative Research Laboratory in Materials and Manufacturing Systems Analysis. This lab gives MSL a basis for conducting more in-depth research into the strategic implications of materials and processing developments for the automobile industry, focusing in particular on issues of the strategic position of new automotive technologies both from economic and environmental standpoints. As part of this collaborative research arrangement with General Motors, MSL currently has research projects in the areas of flexible automobile manufacturing, lightweight materials and automotive design, and the economics of the vehicle launch process.

Sustainable Materials Systems

Several MSL research efforts explore the notion of sustainability in the context of materials systems. These projects include an examination of the economics of recycling, the role of sustainability metrics in engineering design, the implications of resource scarcity for firms, and the exploitation of compositional statistics in scrap re-melting to increase the use of scrap materials.

Recycling Economics

MSL is also conducting more in-depth research in the area of recycling. Historically, MSL has examined automotive industry recycling practices, as well as material selection and substitution in the electronics industry, particularly in packaging. MSL has an ongoing project in the area of markets and electronics recycling. Researchers Randolph Kirchain, (assistant professor in the Department of Materials Science and Engineering and the Engineering Systems Division), Frank Field (senior research associate at CTPID) and Jeremy Gregory have been working to understand current recycling practices and to develop an economic model for improving product design and recycling technology. They have been working closely with a number of industrial partners, including Hewlett Packard, Gillette, and Duracell.

Sustainability Metrics in Design

MSL is conducting a research program in conjunction with two Sloan Foundation Industrial Centers: the International Motor Vehicle Program and the Center for a Sustainable Aluminum Industry. This year's efforts have focused on an exploration of the kinds of design signals that can be extracted from the current crop of life-cycle analysis tools, to help product developers make material choices—or, more precisely, characterize the degree to which different tools yield different signals. This work is complemented by a series of industry interviews with automobile and materials decision makers to explore the forms of sustainability metrics that are employed today in product development, and the weight given to these signals in comparison with more conventional product evaluation metrics.

Resource Scarcity and the Firm

As an outgrowth of past work for the Supply Chain 2020 program, MSL has been working to explore the specific implications of resource scarcity on the operation and planning functions of the firm. Traditional examinations of resource scarcity have tended to consider the notions of market efficiency and intertemporal equity within the context of the entire economy, and the conclusions have tended to suggest that markets can take care of these issues in the long term. However, from the perspective of the firm, there are open questions as to the best strategies to employ in the face of potential resource scarcity and the kinds of information that are most effective in the development of these strategies.

Uncertainty and Scrap Utilization

A final topic in this area of sustainable materials systems is a continuation of an effort to explore the application of modifications of conventional methods for devising furnace charges in metal foundries. These modifications focus on the incorporation of statistical information about feedstock composition into the mathematical programming employed. Early results suggest that there are real opportunities to improve the rate of consumption of scrap streams, offering a win-win opportunity for conventional foundry practice: improved environmental *and* economic performance. While the work to date has been entirely theoretical, MSL is currently working with Alcoa to develop a testbed application of these tools in one of their foundry facilities, with an eye toward a more substantial development program starting next year.

Microphotonics/Optoelectronics

MSL has also been continuing its work in the area of microphotonics. Professor Randy Kirchain and Richard Roth have been working on a number of research activities aimed at gaining a better understanding of the materials and processes used to manufacture a variety of critical components for the microphotonics industry. Through close interaction with the Center for Integrated Photonics Systems and sponsoring companies such as British Telecom and a number of microphotonics components suppliers, they have developed models to address questions of network architecture and the influence of new component technology on network deployment strategies. In particular, this has led to a better understanding of future optical network deployment strategies both from an investment and operating cost perspective. MSL has also worked closely with the Communications Futures Program and the Communication Technology Roadmap within the Microphotonics Center to understand the economics and market drivers behind a variety of microphotonics applications.

Richard Roth is the director of MSL. Joel Clark is the program's principal investigator.

More information about MSL can be found at <http://web.mit.edu/ctpid/www/msl.html>.

MIT Information Quality Program

The MIT Information Quality Program (MITIQ) develops new knowledge in the information quality field. Launched in 2002, MITIQ conducts research on all aspects of information quality, such as how to manage information as a product, how to develop an information product map, and how organizations adopt information quality over

time. MITIQ is an outgrowth of MIT's Total Data Quality Management Program, which was founded in 1990 by then-Sloan School of Management associate professor Richard Wang and J. N. Maguire information technology professor Stuart Madnick.

MITIQ Accomplishments

Last year, Richard Wang, MITIQ director, submitted research proposals for more than \$700,000 in funding to assist law enforcement agencies in their efforts to improve information quality in areas such as criminal history records and information sharing. The proposals led to an initial contract of \$95,000 to Northeastern University to develop an information quality self-assessment tool for law enforcement agencies. Although this small seed contract did not come through the MITIQ program, it has laid a foundation for future funding from the Department of Justice, in addition to voluntary help from Professor Yang Lee, the principal investigator of the \$95,000 contract to Northeastern University, for MITIQ consortium work. Additionally, because of the initial contract, Dr. Wang was invited back to a working group sponsored by the Bureau of Justice Assistance (Office of Justice Programs, US Department of Justice)—the Global Justice Information Sharing Initiative, Privacy and Information Quality Working Group.

In a new initiative, MITIQ helped the University of Arkansas at Little Rock (UALR) to successfully establish the first-of-its-kind PhD degree program in information quality. UALR is rapidly becoming the focal point for information quality education, both in the United States and internationally. In June 2008, Dean Mary Good announced the reappointment of Dr. Wang as visiting university professor of information quality.

At MIT in November 2007, MITIQ hosted the 12th International Conference on Information Quality (ICIQ-2007). ICIQ-2007, the premier conference in the information quality field, presented a forum for researchers and practitioners to exchange IQ knowledge and ideas. More than 150 participants from both academic and industry worldwide took part.

Continuing the MIT 2007 IQ Industry Symposium, which is designed to bring together practitioners, vendors, and academics to address IQ issues, MITIQ is sponsoring the second IQ Industry Symposium, to be held July 16–17, 2008 (<http://mitiq.mit.edu/IQIS/>). The symposium will include topics such as industry tutorials, invited presentations, and industry practices; all will complement the annual International Conference on Information Quality at MIT (<http://mitiq.mit.edu/ICIQ/>).

MITIQ Funding

The MITIQ consortium continues to receive sponsorship from Lockheed Martin and UTi Worldwide totaling \$150,000 per year. It is expected that Acxiom Corporation, when the company returns to being profitable, will renew their sponsorship. Other leading organizations and participants in the ICIQ Conference and IQ Industry Symposium may also join the consortium, as they realize benefits gained from the MITIQ Consortium.

MITIQ Publications

Madnick, Stuart, Wee Horng Ang, Yang Lee, Dinsha Mistree, Michael Siegel, Diane M. Strong, and Richard Wang. "The House of Security: Stakeholder Perceptions of Security Assessment and Importance," in *The FSTC Innovator, Volume I—Journal for Financial Services Technology Leaders*.

Shankaranarayanan, G., and Richard Wang. "IPMAP: Current State and Perspectives," in *Proceedings of the 12th International Conference on Information Quality*, November 2007.

Zhu, Hongwei, and Richard Wang. "An Information Quality Framework for Verifiable Intelligence Products," in *Data Engineering: Mining, Information, and Intelligence*, Y. Chan, J. R. Talburt, and T. Talley, eds. (forthcoming, Springer).

Additional information about MITIQ can be found at <http://mitiq.mit.edu/>.

Technology and Law Program

The Technology and Law Program (T&L) offers research opportunities and graduate-level courses focusing on the interface of law and technology. Research activities include the design and evaluation of policies that encourage technological change for the prevention of chemical pollution through regulation, liability, and economic incentives; promoting environmental justice by involving communities in governmental decisions that affect their health, safety, and environment; and addressing the effects of globalization on sustainability.

T&L offers a two-semester sequence in environmental law and policy that is colisted in Engineering and Urban Studies. 15.655 Law, Technology, and Public Policy, a core subject in the Technology and Policy Program, and 15.657 Sustainability, Trade, and Environment are listed jointly with the School of Engineering and MIT Sloan. Originally part of the Cambridge–MIT Institute, the latter course continues to be offered at Cambridge University; it is also taught at the Harvard–Cyprus Institute of the Environment in Nicosia. A course in European and International Environmental Law is also taught at the Harvard–Cyprus Institute. As a result of the program, the MIT perspective on environmental law and sustainability has achieved international recognition.

Technology and Law Publications

Ashford, N. A. and C. C. Caldart. *Environmental Law, Policy, and Economics: Reclaiming the Environmental Agenda*. MIT Press, 2008, 1088 pages. See <http://mitpress.mit.edu/9780262012386/>.

Contributions to Books

Ashford, Nicholas. "Environmental Regulation, Globalization, and Innovation," in Kevin P. Gallagher (ed.), *Handbook on Trade and the Environment*. Northampton: Edward Elgar, 2009.

Ashford, Nicholas A. and Charles C. Caldart. "Environmental and Occupational Health Protection Laws," in the *Encyclopedia of Public Health*. Elsevier, 2008. Available at <http://hdl.handle.net/1721.1/41847/>.

Technology and Law Personnel

Technology and Policy professor Nicholas Ashford is director of the Technology and Law Program. Charles Caldart participates as a lecturer in T&L course offerings.

More information about the Technology and Law Program can be found at <http://web.mit.edu/ctpid/www/tl/>.

Joel Moses

Acting Director

Institute Professor, Professor of Computer Science and Engineering Systems

More information about the Center for Technology, Policy, and Industrial Development can be found at <http://web.mit.edu/ctpid/www/>.

MIT Center for Transportation and Logistics

For more than 30 years, the MIT Center for Transportation and Logistics (CTL) has been a world leader in supply chain management, logistics, and transportation education and research. The Center's world-renowned research programs directly involve more than 75 faculty and research staff from a wide range of academic disciplines, as well as researchers in various affiliate organizations around the world. In education, MIT is consistently ranked first among business programs in logistics and supply chain management.

Our website, at <http://ctl.mit.edu/>, offers a wealth of information about the Center and its programs, including descriptions of current research projects, event listings, explanations of our corporate outreach program, a listing of MIT theses in transportation since 1980 and in logistics and supply chain management since 1999, and details on our educational offerings, including master's, PhD, and executive education programs.

Education

In fall 2007, 36 new students arrived on campus to enter the Center's Master of Engineering in Logistics (MLOG) program as the class of 2008. MLOG is an intensive nine-month degree track that prepares graduates for supply chain management careers in various industries including manufacturing, distribution, retail, transportation, and logistics services.

The MLOG class of 2008 was geographically dispersed, with 50% coming from outside the United States, representing nine different countries. By graduation, 90% of the class had at least one job offer (with an average of two offers per student).

Master of Engineering in Logistics Alumni Interaction

CTL held its third annual MLOG Re-Connect event in March 2008. This three-day event, which is open to MLOG alumni, current MLOG students, and incoming MLOG students, features research presentations and professional development talks from selected faculty members. Its objectives are threefold. First, the event encourages

networking. Second, it provides executive training to alumni. Finally, it gives incoming students an advance look at thesis research projects. Approximately one-third of the alumni base attended this year.

Master of Engineering in Logistics at IAP

During IAP 2008, MLOG sponsored the Supply Chain Innovation and Leadership Series, which consisted of the following:

- “Supply Chain at a start-up: The challenges of success!,” Judith Taylor, NxStage (January 10, 2008)
- “Supply Chain at a start-up: The challenges of success!,” Simon Osbourne, VP, Logistics, 7-11 Stores (January 14, 2008)
- “Global Trade Management,” Graham Napier, President & CEO, TradeBeam (January 15, 2008)
- “Procurement & Supply Chain Management,” Tony Miliken, Chief Procurement Officer and Senior VP, Supply Chain, MeadWestVaco (January 16, 2008)
- “Case Study in Team Leadership,” Alex Niemeyer, Partner, McKinsey (January 17, 2008)
- “Supply Chain Challenges in the Bottling Industry,” Paul Hamilton, VP, Supply Chain Logistics & Technology, Pepsi Bottling Group (January 22, 2008)
- “Global Trade Management: Strategy and Execution,” Larry Smith, VP, Global Supply Chain, Becton-Dickinson (January 24, 2008)

Supply Chain Education Partners Program

This year, 16 companies participated in the Partners Program, which promotes supply chain knowledge sharing among leading executives and students in the MLOG program. A team of students is assigned a jointly scoped-out project that has both practical and research aspects. This year’s projects included:

- 100% Container Scanning: Security Policy Implications on Global Supply Chains—General Motors
- Network Design and Safety Stock Placement for a Multi-Echelon Supply Chain—P&G/CVS
- An Assessment of the Value of Retail Ready Packaging—P&G
- Evolutionary Supply Chain Risk Management: Transforming Culture for Sustainable Competitive Advantage—P&G
- Leveraging Risk Management in the Sales and Operations Planning Process—Cisco
- Customer Focused Collaborative Demand Planning—Cisco
- The Impact of Lead Time on Truckload Transportation Rates—C.H. Robinson

- An Engineering Approach to Improving Hospital Supply Chains—Cardinal Health
- Determination of Drivers of Stock-Out Performance of Retail Stores using Data Mining Techniques—Unilever
- Framework for Selection of Distribution Strategies—Monsanto
- The Impact of “Never Run Out” Policies—Armada Supply Chain Solutions
- The Impact and Dynamics of Centralization in Supply Chain Decision Making—Intel Corporation
- Customer Service-Driven Supply Chain Segmentation—Siam Cement Group

Inventory Optimization in a Retail Multi-Echelon Environment—CVS

- A Multi-Echelon Supply Chain Model for Strategic Inventory Assessment through the Deployment of Kanbans—CAT Logistics
- Analysis of Cost Versus Reliability In A Multi-Echelon Supply Chain—Shell Chemical
- Product & Customer Profiling for Direct Store Delivery—Schwan Foods
- Vendor Managed Inventory Forecast Optimization and Integration—General Mills
- Supply Chain Investment Decisions Under Demand Uncertainty—Chiquita Brands

Research

During the past academic year, many new research projects were added to the ones carried over from previous years on the CTL website. In total, 110 projects in various categories were listed on the site. Major projects and initiatives are described below.

MIT Global SCALE Network

In March 2008, CTL announced the creation of the [MIT Global SCALE Network](#), an international alliance of leading research and education centers dedicated to the development of supply chain and logistics excellence through innovation.

The Global SCALE (Supply Chain And Logistics Excellence) Network spans North America, Latin America, and Europe, and plans to expand into Asia and Africa. The network currently includes CTL in Cambridge, MA, the [Zaragoza Logistics Center \(ZLC\)](#) in Zaragoza, Spain, and the [Center for Latin-American Logistics Innovation \(CLI\)](#) in Bogotá, Colombia (see following section).

The network will allow faculty, researchers, students, and affiliated companies from all three centers to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications and help companies to compete in an increasingly complex business environment. The member organizations are developing joint research projects that will begin in 2008.

SCALE will also enhance supply chain and logistics education at each center. Graduate students at CTL, ZLC, and CLI will not only benefit from the shared knowledge created through this collaboration but will also participate in the network's global research projects and take part in an educational exchange, traveling to other network centers and learning alongside other network students.

The Global SCALE Network will build on the already successful, five-year partnership between CTL and the ZLC. The other network member, CLI, was launched earlier in the same month through a \$19 million agreement between CTL and Colombia-based logistics company LOGyCA (see below).

Center for Latin-American Logistics Innovation/LOGyCA

In February 2008, CTL and LOGyCA, a Colombia-based logistics company, signed an agreement worth \$19 million creating the Center for Latin-American Logistics Innovation, a research and education center for supply chain and logistics in Latin America. CLI joined CTL and ZLC in Spain as the third member of MIT's growing international network of centers dedicated to supply chain education and research, which now spans the United States, Europe, and Latin America.

CLI will help Latin American businesses and individuals compete in local, regional, and global markets by delivering leading-edge research, technology, and educational programs in logistics, transportation, and supply chain management. The Center will also become a major force in academia within Latin America and across the globe.

LOGyCA, which boasts the most robust supply chain technology infrastructure in the region, houses the CLI in its Bogotá headquarters. CLI researchers and students will have access to the infrastructure and knowledge base that helped Colombia establish the largest collaborative technology platform in Latin America. CLI will also connect with its counterparts in the United States through CTL and in Europe through the ZLC in Spain.

The partnership between CTL and LOGyCA is based on a 10-year agreement, which officially began on March 1, 2008. The \$19 million deal includes a \$4 million gift from LOGyCA to CTL.

The MIT-Zaragoza International Logistics Program

CTL has a multiyear partnership with the government of Aragón, Spain, to help create the leading European education and research program for logistics and supply chain management in its capital city of Zaragoza. MIT works with the Zaragoza Logistics Center (ZLC), a research institute associated with the University of Zaragoza, on research, graduate education, executive training, and outreach events for the international community.

The ZLC began 2008 with six full-time faculty members. Jarrod Goentzel, executive director of the MIT-Zaragoza program, completed his temporary assignment in Zaragoza and returned to MIT to continue in his role of directing the partnership; in the process, Dr. Goentzel transitioned from full-time to adjunct faculty status at ZLC. As of June 2008 the following professors are members of the full-time ZLC faculty: Dr. Mustafa

Çagri Gürbüz, Dr. Santiago Kraiselburd (also executive director of Zaragoza Logistics Center), Dr. Mozart Menezes, Dr. Maria Jesus Saenz, and Dr. Prashant Yadav. Susana Val was promoted to assistant research professor in the transportation area at ZLC. Ruben Sainz joined as assistant research professor in June 2008 to work on projects related to the Spanish National Center of Excellence in logistics. The following continued in their role as full-time research staff during FY08: Dr. Asvin Goel, Dr. Desirée Knoppen, and Dr. Alessio Trentin.

In FY08 the ZLC added two adjunct faculty members, Dr. Daniel Corsten, professor of operations and technology management at Instituto de Empresa Business School, and Rogelio Oliva, associate professor of information and operations management at the Mays Business School at Texas A&M University.

Construction of the new ZLC building in the center of the PLAZA logistics park near Zaragoza was further delayed due to the focus on building infrastructure for the World Expo which opened in June 2008. Meanwhile, the ZLC continues to use premium office space located between PLAZA and the University of Zaragoza for its temporary facility. The link with PLAZA enhanced the ZLOG program (see below) as students engaged on projects directly with PLAZA and with other companies in the area that have relationships with PLAZA.

In 2008 the fourth class graduated from the MIT-Zaragoza international masters degree program (ZLOG). ZLOG is an intensive nine-month program modeled on MIT's MLOG program. The class of 2008 consisted of 25 students selected from 155 applicants. The class is highly international, with students from 15 countries and five continents. Of the 25 students, eight were women. Again the median GMAT of 700 places the class on the same quality level as top business schools in Europe. One-third of the class entered with an MBA, looking to add the ZLOG degree as a specialization to enter the field of supply chain management. The class of 2008 averaged over six years of work experience, higher than previous ZLOG classes. At graduation, over 90% of students in the class had at least one job offer at graduation and over 75% had accepted an offer. Three students continued on to PhD studies in the MIT-Zaragoza program.

Looking ahead to the ZLOG class of 2009, over 200 applications were received, the highest number ever for ZLOG. The resulting class of 2009 consists of 36 students from 14 countries and five continents. The average age is 30, and students bring around six years of work experience on average; women comprise half of the class. The MIT-Zaragoza doctoral program grew significantly, with three additional students who will visit MIT in FY09 to enhance their education.

Again this year, the core graduate coursework was enhanced. For example, the Corporate Systems & Supply Chain Context course was renamed to MZ.530 Financial Systems and Supply Chain Management, to reflect a narrower focus on finance. A number of new electives were offered this year as well. In 2008 the MIT-Zaragoza program hosted its first PhD summer academy. For two months, a panel of highly experienced professors and researchers will introduce various advanced topics.

Seven ZLOG students completed the recently created dual master's degree program with Instituto de Empresa (IE) Business School in Madrid, obtaining both the ZLOG and the IE International MBA. In March 2008, the leading Latin American business school INCAE partnered with the MIT-Zaragoza program at ZLC to launch a dual-degree program that will allow students to earn both the INCAE International MBA and ZLOG degrees in two years. The ZLC also began offering a new executive education program with its partner institution INCAE.

Research

ZLC continued its leadership of the Spanish National Center of Excellence on Integrated Logistics (CNCLI) and its work on the Singular Strategic Project for research in logistics. The CNCLI played the coordination role for the national technology platform for integrated logistics, which engages industry and research institutes to define research and development priorities and action plans on strategically important issues for Spain's future growth and competitiveness. One key activity was hosting a major research event in September (see below for details).

MIT-Zaragoza continued its strategic research partnership with Deutsche Post/DHL to discover and develop innovative solutions for international supply chains. The research was conducted with financial support from the EU and from InnovAragón, an initiative of the government of Aragón in northern Spain. A major research initiative is the Supply Chain 2020 project (see SC2020 section below). The program's European Advisory Council, consisting of executives from leading companies, met October 2007 in Munich, Germany, to help shape the work and generate new ideas. For more information, see <http://www.supplychain2020.net/>.

Funded research projects were also conducted this year with the following companies and organizations: RENFE (the national railway authority of Spain), AENA (the national airport authority of Spain), Acciona Energy (the world's largest wind park developer), General Motors, DHL, USAID, John Snow Inc., DFID, the Rockefeller Foundation, and the Gates Foundation. In addition, a major research proposal submitted in partnership with SAP was funded by the EU Framework Program.

Outreach

There were two major outreach events during FY08. The 2007 Zaragoza Conference on Logistics and SCM, on September 12–13, 2007, was organized by ZLC and promoted by the Spanish National Center of Excellence in Logistics. This conference hosted a number of academics from around the world to present over 70 papers in 15 sessions. The ZLC also participated in the CTL-hosted Crossroads event in March 2008 (see Outreach Events).

MIT-Zaragoza featured several smaller industry-oriented events during the year, including workshops, seminars, and a webcast on specialized topics such as the use of radio frequency identification technology in supply chains and humanitarian supply chains.

The MIT-Zaragoza Distinguished Speaker Series significantly scaled up its activity to offer 16 sessions from leading academics between September 2007 and June 2008. These included:

- Kalyan Talluri, Universitat Pompeu Fabra, Barcelona, Spain (September 14, 2007): On Upper Bounds for Network Revenue Management
- Emre Berk, Bilkent University, Ankara, Turkey (October 10, 2007): Stochastic Joint Replenishment Problem: Single Location and Multi-Echelon Models for Nonperishables
- Joe Blackburn, Vanderbilt University, Nashville, TN, USA (October 23, 2007): Valuing Time in the Supply Chain: Using a Product's Marginal Cost of Time to Drive Supply Chain Design
- Cagri Haksoz, Cass Business School, City University of London, UK (October 26, 2007): Supply Contract Fragility Risk
- Oli Madsen, Technical University of Denmark (November 20, 2007): Time Window-Constrained Vehicle Routing Problems—Survey and Recent Developments
- Yehuda Bassok, Marshall School of Business at University of Southern California, USA (December 11, 2007): Inventory Assortment and Substitution Problems
- Jan Fransoo, Technische Universiteit Eindhoven, Netherlands (December 19, 2007): Research Overview at the Department of Operations, Planning, Accounting, and Control at Technische Universiteit Eindhoven
- Agata Jaworska, Freelance Designer, Amsterdam, Netherlands (February 15, 2008): Made in Transit—Shifting the Paradigm of Packaging from Preserving Freshness to Enabling Growth
- Victor Martínez de Albéniz, IESE Business School, Barcelona, Spain (March 12, 2008): Competing for Shelf Space
- Ted Farris, University of North Texas, USA (April 11, 2008): Solutions to Strategic Supply Chain Mapping
- Rene Castro, INCAE Business School, Costa Rica (April 15, 2008): The Use of Economic Instruments for Local and Global Sustainable Development
- Juan José Salazar González, Universidad de la Laguna, Spain (April 18, 2008): Models and Algorithms for Answering Some Questions on the One-Commodity Pickup-and-Delivery TSP with Stochastic Demands
- Mitchell Tseng, Hong Kong University of Science and Technology (May 19, 2008): Creating Value in Global Manufacturing for a Flatter World
- Nicole DeHoratius, University of Portland & University of Chicago (May 20, 2008): Do Upstream Stockouts Matter? A Natural Experiment at Fashion Manufacturer Costis Moros
- Cristina Giménez, ESADE Business School, Barcelona, Spain (May 20, 2008): Supply Chain Integration and Performance: The Impact of Business Conditions
- Maureen Lewis, World Bank (June 30, 2008): Governance Tools for Strategic Purchasing in the Health Sector

Supply Chain 2020

The SC2020 project is a multiyear pioneering research effort to identify and analyze the factors that are critical to the success of future supply chains. The project will map out the innovations underpinning successful supply chains up to the year 2020. By looking further into the future than most business research initiatives do, the project hopes to deliver practical breakthroughs on the design and management of future supply chains. The project also aims to help companies understand the forces that are changing supply chains, so they can be better prepared for the future. This work can create value in society through improvements in transportation, logistics, and supply chain management practices.

Initiated by the MIT–Zaragoza International Logistics Program, the global research project involves dozens of faculty, research staff, and students at MIT and other institutions around the world. Two advisory councils comprised of 44 supply chain executives from more than 40 leading companies—the Industry Advisory Council and the European Advisory Council—routinely meet to play a crucial role in helping to shape the work and generate new ideas. To date, seven advisory council meetings have been conducted.

Currently in its third phase, the SC2020 project involves close collaboration with participating companies to test and explore more ideas on supply chain strategy development. During the FY08, the project team created processes and methodologies for implementing the concepts and ideas developed as part of the research. Two ESD doctoral students are engaged in furthering this work and are at various stages of their research. A leading manufacturer of polyvinyl butyral films has been engaged to test the approach. Three workshops have been held as part of this effort. The research should be completed in fall 2008. The overarching objective is to provide actionable results to solidify the research findings and formalize the SC2020 strategy development approach.

In addition, the project team scoped out another effort aligned with the SC2020 theme to explore the challenge of process design under uncertainty using supply chain design as a case study. The project has its roots in SC2020 findings and is designed to leverage ideas from the product design domain to better inform process design practices.

MIT Efficient Healthcare Delivery Research Group

The MIT Efficient Healthcare Delivery Research Group (MEHD) is a consortium seeking to improve health care delivery by fostering innovation in health care supply chain management. The MEHD consortium was officially launched on July 1, 2007. Members of the consortium include the health care organizations CVS, Pfizer, Cardinal Health, and the Association for Healthcare Resource and Materials Management.

The initial phase of research took a broad view of the healthcare system in order to understand the dynamics of the industry and in particular to isolate the key source of the disruptive change that pervades the industry. Two industry roundtables have taken place to discuss the research directions and findings with industry sponsors and prospects. Both of these meetings were well attended with representatives from different sectors of the healthcare industry including pharmaceutical manufacturers, distributors,

hospitals, retailers, medical device makers, equipment makers, and health insurers. The research during FY09 will focus on challenges and issues identified so far to develop insights and propose solutions.

The project is funding one doctoral and one master's student and is engaged with other healthcare-related efforts within MIT, such as the Center for Biomedical Innovation.

Supply Network Risk Management

The Supply Network Risk Management project (SNRM) was launched during FY08 to explore the challenge of supply network risk in a holistic manner and leverage the expertise of CTL in this domain. The project is planned to proceed along three different directions over the course of the research: Internal Perspective: Designing and Managing Company Supply Network, Extended Perspective: Global Risk Practices, and Market Perspective: Business Performance and Financial Implications of Risk.

The first phase of research focusing on the internal perspective is anchored by a research project with a large CPG company. This particular phase of the project is divided into two distinct milestones. The first milestone was successfully reached in June 2008, culminating in a report analyzing over a dozen interviews with company executives as well as an in-depth review of the literature related to risk management. The next stage in this phase is under way and scheduled to be completed by December 2008. Two graduate students from the TPP and MLOG program were involved in carrying out the research during FY08.

Demand Management

In 2006, Demand Management (DM) research began at CTL with a variety of initiatives. The major question being addressed is, "What strategies, principles, and methods can be leveraged to optimally match supply and demand over time?" To address this question, a comprehensive database of DM practices and survey results across a multitude of industries is being established. The focus is on the exchange of information, practice profiling, interviews with experts, and industry surveys.

Recent DM-related events organized by CTL include a Demand Management Retreat for 10 CTL noncompeting sponsor companies, which took place December 11, 2007; a two-day workshop in Thailand for the Siam Cement Company held January 18–19, 2008; and a Supply Chain 2020 track at the 2007 CSCMP Conference in October of that year.

Hydrogen Supply Chain

In May 2007, the Zaragoza Logistics Center received a €290,000 research grant for systems modeling and analysis of the hydrogen supply chain with the objective of developing options and helping guide large-scale infrastructure development. The three-year project will be developed in direct collaboration with Acciona Energy, the third-largest operator of wind energy, and other key partners Gas Natural and Repsol YPF. The expected result is a comprehensive decision support model—utilizing principles from commercial supply chain, systems engineering, and operations research—that can be used to assess various scenarios for a hydrogen supply chain and weigh complex

alternatives. The model would enable a strategic evaluation of various technologies for production, storage, and distribution of hydrogen and assess infrastructure development as a phased rollout. The MIT-Zaragoza program could help link this project with ongoing work in the MIT Energy Initiative.

MIT-Volpe Transportation Human Factors Research Program

The new MIT-Volpe Transportation Human Factors research program was created in FY07 to initiate active research collaborations in several areas. In the first year of the program three new projects began: Human Factors Pertaining To Uncertainty and Dynamic Contradictions in Air Traffic Flow Management, Professor Amadeo Odoni; Locomotive Cognitive Alert Technology Development and Evaluation, Dr. Charles Oman; and Pilot Computer Model Development and Aircraft Computer Model Integration, Dr. Charles Oman.

New England University Transportation Center

In August 2006, the US Department of Transportation's (USDOT) Research and Innovative Technology Administration named MIT as the lead university of the New England University Transportation Center. CTL is the Institute's host department for the New England Center, which is one of 10 university centers set up in each of the standard federal regions by USDOT to provide a national resource for research and education in both freight and passenger transportation.

This leadership appointment comes with a \$6.25 million grant for the New England Center, to be awarded over three years. The award was made for proposed research on "Strategic Management of Disruptive Change on Transportation Systems." This area of inquiry builds on research currently being done by the CTL AgeLab on aging and transportation; specifically, on the impact of disruptive demographics. Dr. Joseph F. Coughlin, founder of CTL's AgeLab, is also the director of the New England University Transportation Center.

The partner universities of the New England University Transportation Center led by MIT include Harvard University and the state universities of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

MIT Supply Chain Frontiers Publication

CTL Supply Chain Frontiers is an electronic newsletter created by CTL to disseminate information to approximately 3,000 industry and media contacts. Published eight times a year, *Frontiers* includes feature articles on Center research projects and other subjects of interest to supply chain professionals. It also includes news on Center events, educational activities, papers and presentations given by CTL representatives, and staff appointments.

In March 2008 it was decided to make *Frontiers* the house publication of the newly formed MIT Global SCALE Network (see previous section on this network). Starting with the March/April 2008 issue, *Frontiers* is now published in English and Spanish and is distributed to SCALE network contacts as well as to the CTL mailing list.

CTL Supply Chain Strategy

The Center has partnered with the Institute of Management and Administration, Inc. to produce *CTL Supply Chain Strategy*, a monthly newsletter available in electronic and hard copy formats. Published 12 times a year, the newsletter's mission is to bridge the gap between supply chain and corporate strategy with articles that help companies to manage supply chains strategically. It is read by senior executives and was launched on March 1, 2005, in partnership with Harvard Business School Publishing. HBSP subsequently withdrew from the venture.

CTL Outreach

CTL's outreach program works primarily with corporations in order to generate revenue in support of our research and outreach activities, to establish relationships with a wide range of organizations who can serve as research collaborators and ready sources of real-world input, and to foster rapid adoption of supply chain management innovations developed by CTL.

The foundation of our corporate outreach is the Supply Chain Exchange, a nonresearch corporate membership program designed to foster interaction and networking—the “exchange” inherent in the name—among CTL researchers, our corporate members, and industry at large. We believe the exchange to be the largest and most active membership program in the supply chain management field. Since mid-FY2004, new exchange members have paid an annual fee of \$25,000. Membership in the exchange is a prerequisite to deeper interactions with CTL, including directed research projects, sponsorship of MLOG thesis projects, and membership in higher tiers of the outreach model (Research Partner and Strategic Partner).

The current exchange members are:

- APL
- Boston Scientific Corporation
- BT Group
- C.H. Robinson Worldwide, Inc.
- Cardinal Health, Inc.
- Caterpillar Logistics Services, Inc.
- Cephalon
- Chiquita Fresh North America
- Cordis, a Johnson & Johnson Company
- Covidien
- CSX Transportation
- CVS Corporation
- DHL
- EMC Corporation
- Fairchild Semiconductor
- General Mills, Inc.
- General Motors
- Goodyear
- i2 Technologies, Inc.
- Intel Corporation
- Limited Brands, Inc.
- LXP
- Masterfoods USA, a division of M&M Mars, Inc.
- The Michelin Group
- Monsanto Company
- MTA New York City Transit

- NYK Line (North America), Inc.
- The Pepsi Bottling Group, Inc.
- Pfizer Inc.
- The Procter & Gamble Company
- Reebok International Ltd.
- The Schwan Food Company
- Sealed Air Corporation
- Shaw's Supermarkets, Inc.
- Shell
- The Siam Cement Public Company Limited
- Solutia Inc.
- Staples
- Tata Steel
- Texas Instruments Incorporated
- Tyco International
- Unilever
- UPS
- USTRANSCOM
- W. R. Grace & Co.

Corporate Relations

The ongoing, two-part strategy that drives our outreach program is to increase the number of CTL's partner organizations via membership in the exchange program and to deepen our engagement with individual partners by growing their participation in our educational and research activities.

During FY08, exchange program memberships of five companies terminated their membership in the exchange: Cephalon, Covidien, i2 Technologies, Inc., Philips Lighting, and W. R. Grace & Co. On the plus side, four new partner companies were added to the program: GE Energy, IPC (Independent Purchasing Cooperative), Nokia, and Schlumberger Limited.

Thus, the number of exchange partners diminished by one, from 46 to 45, although this obscures the highly successful effort put into re-enrolling 41 companies from the previous year. In fact, the memberships of 12 companies lapsed during the year, and seven of those were reversed through our retention efforts. Some of the retained members had actually notified us of their intent to terminate. On balance, we believe we ended the year with a portfolio of more engaged partners.

For the coming year we would like to increase the absolute number of partners while deepening our partner engagement overall. We are aware of the demands that a larger, more active partner base represents and we plan to augment our resources accordingly.

Outreach Events

In FY08, CTL organized symposia, roundtables, workshops, conference sessions, and a Research Fest to achieve our varied outreach objectives.

Reconnect

MLOG/ZLOG Reconnect 2008 took place on March 26, 2008; it provided a premier networking opportunity for MLOG alumni and current students. For more details see the Education section.

Crossroads

This year's CTL Crossroads Conference, which took place on March 27, 2008, focused on *The Next Ten Years* in supply chain management. The day-long event offered presentations, panels, and interactive sessions that examined the next 10 years of supply chain through five different lenses:

- Education and Professional Development
- Energy and Environment
- Globalization & Emerging Markets
- Information Technology
- Scenario Planning: New Ways to Envision the Future

For each topic, industry and academic experts from JohnsonDiversey Inc., Intel, LOGyCA, MIT-CTL, and Nokia shared their visions of what can be expected in the next 10 years in supply chain management and logistics. This was the fourth annual Crossroads Conference, which always focuses on bridging the gap between supply chain and business strategy.

Research Fest

On May 21–22, 2008, CTL invited members of the Center's Supply Chain Exchange to get an insider's look at the innovative research being done by students in CTL's MLOG program. During this day-and-a-half-long review, MLOG students presented their thesis projects, many of which have been sponsored by CTL partners. This year, Research Fest included presentations on topics that included:

- energy and carbon efficiency
- healthcare supply chains
- multi-echelon inventory
- distribution strategies
- demand planning and shaping

MIT Efficient Healthcare Delivery Group

On May 21, 2008, the MIT Efficient Healthcare Delivery (MEHD) Group held its semiannual meeting on the MIT campus in Cambridge. MEHD group members from organizations across the health care industry met with CTL researchers to share insights from current projects and discuss the future direction of the Center's healthcare-related research. The meeting included an off-site trip to Philips Healthcare, where MEHD group members were exposed to the company's new strategy to offer "innovative solutions across the entire care cycle from hospital to home." The mission of the MEHD Group is to envision the future of the healthcare system and create new knowledge,

new technologies, and new business practices that will help improve healthcare delivery everywhere. We assume that transformative innovation in the healthcare supply chain is essential, and that in order to survive and succeed, industry participants must be attuned to new developments and in command of new ways of doing business.

Executive Education

CTL held two major supply chain management executive education courses during the year, on January 8–10, 2008, and June 10–13, 2008. Titled “Supply Chains Driving Strategic Advantage,” the courses provide executives with the crossfunctional and global perspective they need to leverage their supply chains for lasting strategic advantage. Taught by CTL’s world-class team of prominent MIT faculty and researchers, the four-day courses use the Center’s global research on industry-leading supply chain practices and future challenges. Using a mix of management exercises, case studies, and interactive sessions, the courses tackled key supply chain issues, including management of uncertainty, carbon efficient supply chains, strategic scenario planning, strategy alignment, and supply chain resilience.

In June, CTL added a supply chain simulation to the course. The interactive online simulation took participants through key supply chain practices such as creating a balanced supply chain across suppliers with different lead times, building flexibility into the supply chain to avoid stock-outs and excess inventory, and evaluating and using demand forecasts.

FreightLab

An important area of research for CTL is freight transportation, and on June 18, 2008, the Center’s FreightLab held an Innovation in Transportation roundtable on campus. Most leading companies recognize that they must have multiple supply chain channels to handle various products and customers. However, determining how to actually flow the products is not always as obvious, and these strategic decisions have been made even more difficult by the increasing cost (and uncertainty) of fuel prices. CTL researchers and industry executives took part in an interactive, day-long session that addressed two basic questions:

1. How is the rising price of fuel effecting the way in which freight transportation systems should be managed?
2. How should a company determine the optimal flow of their product through their network?

In addition, CTL researchers shared the interim results from an ongoing project and led discussions on other key issues including:

- When does direct store delivery make sense?
- What products should be flowed through a central distribution center and what should be moved vendor direct?
- How should a portfolio of flow paths be managed?
- When should the distribution be completely outsourced to a third party?

- What product, vendor, customer, and market conditions have an impact on this decision?

Council of Supply Chain Management Professionals 2008

CTL will again create and host a Main Session and a Hot Topics afternoon session at the supply chain industry's Council of Supply Chain Management Professionals (CSCMP) annual conference. This year the event will be held in Denver, Colorado, on October 5–8, 2008. The Main Session, attended by all conference delegates, will be presented by CTL's Dr. Mahender Singh and will be based in the latest SC2020 research on ways to excel in a highly uncertain business environment. A two-hour Hot Topics session later that day will elaborate on this theme with a panel discussion on the effects of rising costs and globalization on supply chains. The afternoon session will also involve a case study.

Retailing in India

To meet the demand for information on the supply chain implications of India's growth as a global trading power, CTL is organizing a symposium on the country's retailing industry that will take place on October 22, 2008. The event will take a global look at retail supply chains flowing in and out of India. Top speakers from academia and industry will explore the dynamics of this retail segment, compare and contrast its most pressing logistics issues, and reveal emerging solutions that are needed to address this ever-growing market.

Executive Workshops

MIT CTL offers open-enrollment executive workshops in scenario planning and strategy alignment. These highly interactive events can be brought onsite to companies using real business cases from within that organization. MIT CTL also offers general workshops at MIT. The strategy alignment workshop presents participants with a set of scenarios—each a specially constructed model of a distinct, plausible view of the future. The purpose is not to pinpoint future events but to highlight large-scale, driving forces that push the future in different directions. By working within the bounds of these scenarios, participants are able to think productively about contingencies and alternatives and learn to work with uncertainty rather than try to eliminate it from forecasts. The strategy alignment workshops walk executives through the process of developing strategically aligned supply chains through the use of real supply chain case studies from inside their own companies.

Other Events

The SCILS leadership series took place in January 2008. A CTL Supply Chain Roundtable at the Loyola Institute of Business Administration in Chennai, India, on February 11–12, 2008, offered several lectures, interactive sessions, and facilitated discussions. Key objectives for the event included a review of state-of-art practices in building supply chain resilience and in strategic supply chain design and planning, as well as an examination of current issues affecting supply chain leaders in the region. On February 10, 2008, CTL research affiliate Prashant Yadav presented at the Pharmaceutical Policy Research Seminar at Harvard Medical School. Dr. Yadav discussed supply chain interventions for improving access to malaria medicines. His presentation included insights from the study he conducted with funding from the Bill and Melinda Gates Foundation to look at the global supply chains for health products for malaria and HIV/

AIDS to provide better access to treatment in low-income countries. On December 3, 2008, CTL will hold a symposium on a topic of growing importance to companies that have to compete in volatile markets—supply network risk management.

CTL's Web Presence

The development of CTL's web presence and web communications strategy continues to evolve and expand. This fiscal year saw the expansion of CTL's Partner Gateway, a repository for exclusive partner-only content that allows CTL partners to be a step ahead of the competition with access to the latest in CTL research initiatives.

The Center's email marketing strategy has also been expanded to meet the needs of CTL's business goals, along with use of the Google Adwords service to promote corporate outreach objectives and to promote the center's graduate degree programs.

This year the Center is starting to leverage video assets that have been archived over the past few years with work on a new video library that will be launched over summer 2008. The website will also host in-depth pages on graduate program theses that will include a video presentation of the papers given at the end of each year. The Center has contracted with Adobe for their new webinar service for publishing webcasts for both internal training and external marketing and education.

The end of FY2008 brought about the beginning of a discovery process for a new main website/content management system. This will be designed and implemented over the next 12 months.

Finally, the Center is in the final stages of implementing a new Customer Relationship Management (CRM) web service called Salesforce.com. This service platform will support the Center's strong focus on corporate partner relationships. The Center plans to roll out a new events management tool in conjunction with this CRM.

Personnel Changes

This year CTL director [Yossi Sheffi](#) was appointed director of ESD at MIT, a position that will allow him to play a more strategic role in the development of MIT research and education. Professor Sheffi continues as the director of the Center, because CTL is part of the Engineering Systems Division. To lead the Center's day-to-day operations, Dr. [Chris Caplice](#) was appointed executive director of CTL. Caplice is also executive director of the Center's MLOG program. To support him in this capacity, [Jim Rice](#) was appointed deputy director of CTL; Jim is director of the Center's Integrated Supply Chain Management program. The changes will enhance the Center's range of services by increasing the collaboration among its three pillars—research, education, and corporate outreach—as well as between CTL and ESD.

In addition, there have been several new hires in 2008: Thomas Coveney (who came to us from IS&T); Bruce Mehler, Steve Proulx, and Shalom Saar; visiting military scholar Steve Farmen; international visiting students Anna Corrina Caglianno, Caroline Said, Alejandro Serrano, and Ying Wang; and Anna Cristina Barros and Nicholas Burns (both

on a temporary basis). Departures from the Center included Jonathon Long, Rebecca Schneck Allen, Jennifer Simckowitz, and Joanne Kim.

Recognition

In February 2008 the *Wall Street Journal* selected CTL's Dr. Joseph Coughlin as one of 12 "change agents" who are having the biggest impact on retirement. In March 2008, The Visiting Nurse Association named Dr. Coughlin, director of the MIT AgeLab, a 2008 Home Healthcare Hero for his research in developing new approaches to home healthcare and related services. His work with his AgeLab colleagues and other research partners across MIT, Massachusetts General Hospital, and Harvard Medical School was cited as some of the most innovative in the nation.

Erik Caldwell and Bryan Fisher, students in CTL's MLOG program, won the MLOG 2008 Outstanding Thesis Award for their research on the "Impact of Lead Time on Truckload Transportation Rates."

Yossi Sheffi

Director

Professor of Civil and Environmental Engineering and Engineering Systems

More information about the Center for Transportation and Logistics can be found at <http://ctl.mit.edu/>.