Dick Larson's lectures on distance learning, technology-enabled education and urban operations research at Shanghai's Tongji Univ. rate headlines on the electronic sign.

Changing education with more active learning styles, internet

"I feel most comfortable existing at MIT across departments and schools, and the problems that my students and I work on have those attributes as well," says Prof. Richard Larson, a new member of the CEE Dept. All his degrees (SB '65, EE & SM '67, PhD '69) are from Course 6, Electrical Engineering & Computer Science, and he originally joined the faulty in 1969 as an assistant professor in EECS. However, "the majority of my activity was initially in the Operations Research (OR) Center, which operates across a half dozen departments in the School of Engineering and Sloan School of Management." For seven years he had a joint appointment with the Dept. of Urban Studies and Policy, focusing on OR applied to cities.

CAES and Singapore

From 1995 to June 2003, Larson was the director of the new Center for Advanced Educational Services (CAES). CAES was the production arm of the Singapore-MIT Alliance (SMA), which educates students simultaneously at MIT and two top engineering research universities in Singapore (National Univ. of Singapore and Nanyang Technological Univ.). Founded in 1998 to promote global engineering research, SMA has educated hundreds of students through the most technologically advanced distance learning facilities available.

Larson explains, "We figured out the technology of the live internet connectivity between here and Singapore with the internet-2 and broadband, basically using the internet as a free version of ISDN (broadband telephone) video conferencing. We designed and built the modern classrooms at MIT used for the SMA and other high technology, distance learning connections."

Given the current technology for the SMA, "what's on the TV screen in Singapore is essentially live even though it is 12 time zones away. Students in Singapore can be called on by the professor at MIT just as frequently as the students sitting at arm's length from the professor in the classroom. Whether someone is on screen, or directly in front of you, doesn't matter in terms of the immediacy of interaction, questions and answers. After the SMA professors teach a few times, they don't even intuitively notice whether they're talking to a virtual student or a live student because the technology is so advanced." The only impediment right now is a momentary delay caused by the finite speed of light, and speed of compression and decompression of signals crossing under the Pacific Ocean by internet-2 on cable.

LINC and distance learning

About 2-1/2 years ago, Larson (with MIT volunteers) put together LINC (Learning International Networks Consortium). LINC consists of foundations, universities, government agencies, and a few private for-profit organizations whose focus is helping young people in developing countries get more higher education by whatever type of distance learning—satellite, internet, TV broadcasts, videotapes—the local infrastructure will support. "In the West, around 40 to 60% or more of the people receive some kind of college or university education," cites Larson. "In developing countries, it's not unusual to see only 4% of the young people get higher education, and they're usually from a privileged elite. Most of the people have no chance of going to college."

LINC helps developing countries obtain on-the-ground resources to create distance learning and other technologies to expand higher education opportunities. The embryonic organization is involved with the technology, business and economies of distance learning, and also the pedagogy of learning styles. Without understanding the pedagogy, "you can produce the most boring, irrelevant, useless lectures imaginable. I've seen places where 10,000 students were trying to learn, and the professor sat at his computer reading the bullets on a power point slide in a monotone. There was no emotion, no interaction with a live class, no active learning, no pedagogical design whatsoever. Yet quite often that is what's done. People have to be educated to teach properly under these circumstances," says Larson.

The first LINC workshop in Feb. 2003 attracted delegates from 19 countries: Algeria, Canada, China, France, Hong Kong, India, Iran, Ireland, Israel, Japan, Kenya, Mexico, Niger, Pakistan, Spain, Syria, Venezuela, United Arab Emirates, and the US. "We'll have about 25 countries represented at our next International Symposium in March 2004. Profs. John Williams and Steve Lerman will demonstrate the various software technologies for distance learning. The Virtual University of the Monterrey Institute of Technology, Mexico, will give a case study." Larson praises the Virtual University as an "excellent example of how to bring distance learning to the developing world. Not only do they serve Mexico brilliantly in 28 satellite campuses, but their content and Spanish broadcasts are so attractive that they have client satellite campuses throughout South America."

While Larson feels that all the international representatives at LINC workshops can learn from each other, "the MIT teaching style is actually quite admired. The culture of MIT is a controlled rebelliousness among the students, which creates an attitude that they don't take the world as it is, but they want to invent it themselves.

There are many competitions and undergraduate research opportunities. Students challenge the professors in class, which isn't done in many other countries."

The LINC volunteer team is redesigning the LINC web site to allow a compelling set of discussion groups. For summer 2004, LINC is supporting the African Internet Technology Initiative (AITI), which was started by Solomon Assefa, a doctoral student in EECS. Under the mentorship of former MIT president Paul Gray, LINC has raised money for AITI through the Lord Foundation. Some of the African students at MIT return to their countries in summer as unpaid interns and teach local students and faculty in information technology to put more on-the-ground knowledge and resources in Africa. An increasing number of non-African MIT students are joining them in this summer effort. AITI has a web site, but they hope to view LINC as their future administrative home at MIT.

Another current initiative connects China's Food and Drug Administration with LINC, Dr. Bob Rubin in the Harvard-MIT Health Sciences and Technology program, and the Pfizer Corp. CAES had built Pfizer Corp a bilingual Spanish/English web site called "Good Clinical Practices," to certify physicians to become trained clinical researchers. They can then become involved in drug trials, do experimental design, watch how patients respond, write it up as a refereed journal article, and become involved in the scholarly community as well as in community practice. With help from Pfizer, LINC is adding Chinese language subscripting to its web site and creating a computer server in Beijing. The Chinese Food and Drug Administration plans to make this site a major resource to train physicians and do clinical practices.

Doctoral student Mike Metzger is working with four UROP (undergraduate research opportunities program) students to create an online community of practice, scholarship and learning around Larson's MIT Open Courseware (OCW) class, 1.203J *Logistical Transportation Planning Methods* (also nicknamed *Urban Operations Research.*) Taught jointly with Prof. Amedeo Odoni (CEE and Aero/Astro) and Prof. Arnie Barnett (Sloan School of Management), Larson says, "We've been running it for more than 25 years. It was one of the first 30 OCW courses to be posted, with much of the original web site funded by Sloan Foundation grants. Online materials include a textbook, animations and simulations, the lecture notes, problem sets, quizzes and solutions."

Last December a pop-up window on the 1.203J site invited visitors to volunteer their name, e-mail address, affiliation, and why they visited the site. Larson reports that about a thousand people responded, "and more than half of them are practitioners with projects such as designing the public transit system in Lima, Peru. We're going to use those thousand names as the seed names for an online community of scholarship and learning, centered around the OCW transportation planning course.

"Right now, OCW resembles the hub of a wheel and the spokes, with everything going in and out of MIT. If you build the rest of the wheel, then the people out there can communicate directly with each other. The fellow from Lima, Peru who's designing a public transit system might find 15 other people along the wheel designing public transit systems in other countries using the techniques of this course. We hope that they can form a little sub-community and chat with each other via the internet."

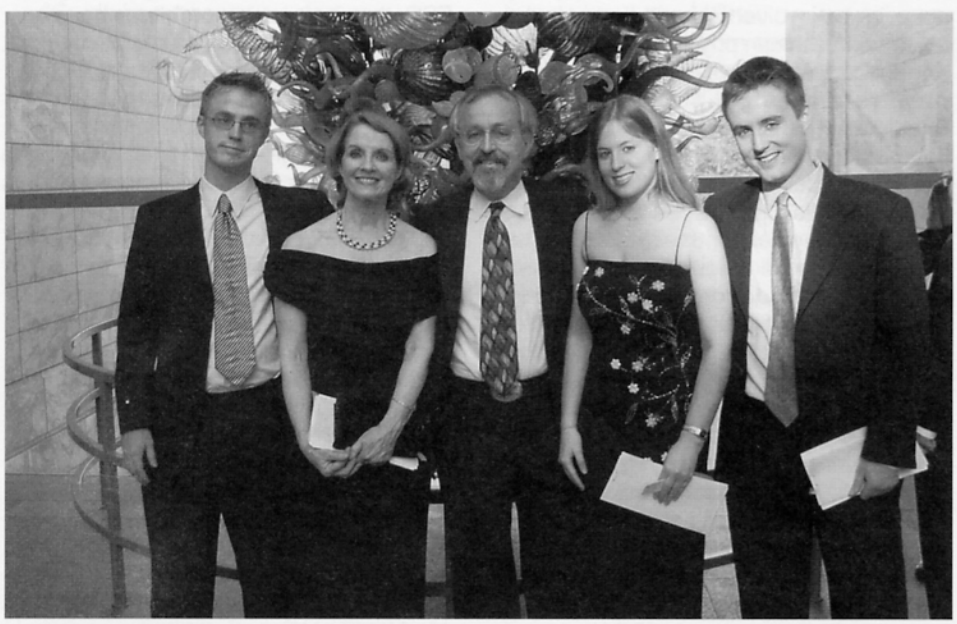
As distance learning spreads, "This technology takes a huge, exponentially growing market share and transforms various segments of education as we have known it." Larson enumerates, "China has millions of students, primarily depending on satellite communications. Mexico treats all of Latin America minus Portuguese-speaking Brazil. Pakistan has world-class infrastructure for its virtual university. Last year I gave a talk in Algeria and all their 28 satellite campuses were online, linked up by video conferencing. The Arab Open University serves four or five countries. We're involved with proposals for Israel and one or more Arab countries to create distance learning opportunities for both Israeli and Arab students."

The roots of distance learning reach back to the 1920s, when the name and address of correspondence schools were printed on the back of match books. ("Start a high-paying career as an automobile mechanic!") Major recent changes stem from the technology of the internet, which has connected the world much more closely, and the pedagogical research in the last 10 years.

In the US, most distance learning students are not 18- to 22-year-olds being sent to college by their parents whether they are ready or not, says Larson. "They're 25- to 50-year-olds with mortgages, car payments, jobs, families. Not having the luxury of coming to campus, they take one or two courses at a time after the kids go to bed, or on weekends. Because they spend their own money and take courses as their own choice, they tend to be highly motivated."

The predominantly online Univ. of Phoenix is the largest private university in the country today. In the last three years, their distance learning component has grown at about 70% per year, says Larson. "If they did not fulfill an important market need, they would not have that rate of growth. The school is accredited, as opposed to many unaccredited distance learning places that basically sell worthless diplomas to anyone who pays. Almost any service industry has both shams and quality, and you have to be careful, just as you have to carefully choose your banker or broker."

The increase in broadband connectivity and streaming media has made it possible to send good audio, and now good video, over the web. Distance learners struggling with an old-fashioned modem at home can't receive video very well, but anyone with quality broadband can pick up streaming video. Larson points out, "Korea leads the world with 70% broadband connectivity in the home, and they have a number of cyber universities."



Larsons from left to right at a family celebration in Omaha, Nebraska: Evan (Carleton '06), M. Elizabeth Murray (Smith '70), Dick (MIT '65, '67, '69), Ingrid (Stanford '08), Erik (MIT '02).

CHIA-HUNG WU

Eastman Court, with Bldg. 6 on the left, Bldg. 16 straight ahead, and the newly renovated Dreyfus Building (Bldg. 18) on the right.

End of chalk & talk?

For many years, few people questioned the traditional lecture style ("chalk-and-talk") of teaching. Larson fondly recalls how "a really compelling teacher in a chalk-and-talk lecture can knock the socks off a student. When I was an undergrad, Amar Bose was a young associate professor teaching circuit theory. After the first lecture, I realized that he had a rare genius for teaching. I would come to class with nothing but a clear head, because taking notes actually destroyed my concentration. He was a master of chalk-and-talk. [Every year the Amar Bose Teaching Award honors an outstanding teacher in the School of Engineering.] Unfortunately most of us are not as good.

"Our goal is to design environments to maximally engage the student, create the fewest impediments to learning, and make it maximally efficient for that student to learn in that environment. Lecturing may not even be involved," says Larson. In the revamped freshman physics 8.02 *Electricity and Electromagnetism*, lecturing doesn't play a role in the TEAL (Technology-Enabled Active Learning) project. Prof. John Belcher used I-Campus support to design and build an interactive, highly unusual studio classroom. The students come once a week for three hours and sit in groups of three or four. Given some electromagnetic gadgets, they have to accomplish a set goal to demonstrate their proficiency and knowledge of the assigned readings for that week.

"That kind of active, collaborative learning is a different environment from sitting passively in a lecture hall taking notes while the professor speaks. In some cases it's better, and in some cases it's worse," acknowledges Larson. "Prof. Belcher's project has been so successful that it will be extended to other subjects, including freshman physics 8.01 *Newtonian Mechanics*."

Another example of a learning environment is non-linear experiential goal-oriented learning. The second-year Spanish students insert a CD-ROM in their computers, and it transforms them to a hypothetical hotel room in Bogota, Colombia. "A reliable source says that bad guys are out to kidnap you. In planning your escape route out of Bogota, you've got to phone your friends who speak only Spanish and get information from them about what's safe to do, such as hiring a cab or renting a car. But the reliable source says that the bad guys have poisoned your friends, and their memory is deteriorating at the rate of 10% per hour," narrates Larson. "With any delay in calling them, the information they will give you will be less reliable. You've got five hours to solve the problem, having simulated conversations with them in Spanish. It's total involvement in that environment, which has nothing to do with lecturing or chalk-and-talk."

Background

After leaving the CAES in 2003, Larson "looked around for my OR colleagues. Basically they're all in CEE, starting with Prof. Patrick Jaillet, and Profs. Cynthia Barnhart, David Simchi-Levi, Joe Sussman and Yossi Sheffi. The systems part of CEE seems to be growing and flourishing.

"In addition, I'm interested in problems outside of CEE such as the psychology of waiting lines, and social and economic issues of systems, so I have a duel position with CEE and ESD (Engineering Systems Division of the School of Engineering). In ESD, the engineering problems have an additional aspect, such as socioeconomic, political, or psychological factors. Those are the realities when you're trying to implement large systems in practice."

When Larson was an undergrad in the 1960s, the percentage of female students was in the small single digits. "It's now about 46%, and projected to hit 50% soon. That's a very positive change," he says. "We're more like a contemporary university rather than an all-male engineering school. The other welcome change I've seen is a broadening of the scope of the majors. The School of Humanities and Social Sciences, the School of Architecture and Planning, the Media Lab and Media Sciences, and the Sloan School have made MIT more of a broad-based university than a narrow engineering institute.

"One thing that hasn't changed is that MIT remains a meritocracy, where students are admitted because of their accomplishments. If students have a great high school record, they have a good chance of getting in. That was the same when I was a student, and it's the same today. It's a tough place to get into, and it's a tough place to graduate from. I think the culture emphasizes survival. The key thing is to segment your life so that you work hard and play hard."

In addition to teaching 1.203J *Logistical Transportation Planning Methods*, Larson runs a doctoral seminar in ESD (ESD 934 *Mining Data, Modeling Systems, Making Impact*, co-taught with Dr. Nitin Patel) dealing with data mining and exemplary case studies in OR which have been finalists in the international Edelman Prize Competition. "This contest is the world series of best-in-class implementation of OR in companies and governmental organizations. Usually they save organizations hundreds of millions of dollars a year. It's great material for teaching students how to do it right."

INFORMS

As president-elect of INFORMS (the Institute for Operations Research and the Management Sciences) in 2004, Larson will spend 2005 as president and 2006 as past-president. His priority agenda during these three years is to encourage more people with masters and bachelors degrees to become active members. "Currently, about 3/4 of the 10,000 members have PhDs. OR and Management Science are supposed to focus on solving complex real-world problems. A group of PhDs talking among themselves and their students cannot know about, frame, or formulate complex real-world problems without interactions with practitioners who are trying to work through real problems."

Larson's key agenda is to revisit the roots of OR as an empirically based observational science. MIT physics professor Philip Morse was the founding director of the MIT OR center in 1953, and the founding president of INFORMS. During World War II, Morse searched for German submarines from airplanes and on battleships, and created mathematical models to determine how large the flotillas of ships steaming across the Atlantic should be to minimize their chance of being torpedoed. He also designed mathematical theories to maximize the chance of finding enemy submarines, and to determine the optimum location of Britain's few radars to detect incoming missiles and airplanes from Germany. After the war, OR migrated to private companies to solve their operations problems. The MIT OR center is about to celebrate its 50th birthday in April, and has evolved as the world's largest doctoral program in OR, although it also grants the SM.

While the tie between practice and theory was extremely strong at the beginning of the profession, Larson believes that OR has become too academic in the

last decade or two. "Right now we have PhD students who have never set foot in the real world and are dealing with toy problems. OR must go back to its roots to retain its vitality. I believe the INFORMS membership should be at least 50% non-PhDs. People who work in industry or for government organizations could bring their unsolved problems to the professors and doctoral students, and create a close interchange of real-world needs and academic research. Otherwise, we will be researching decades-old problems and getting very marginal improvements, and the profession will die. OR needs its tie to the real world, just like any other engineering profession," he says.

Web links:
http://ocw.mit.edu/index.html
See the OpenCourseWare listings of over 500 classes from 33 academic disciplines, plus many links and options.

http://ocw.mit.edu/OcwWeb/Civil-and-Environmental-Engineering/1-203JLogistical-and-Transportation-PlanningMethodsFall2001/CourseHome/index.htm
Follow along with this MIT class and not worry about your grade average.

http://ken.MIT.edu/linc/
The general link to LINC

Comings/goings

Awards

In January, Prof. Joseph Sussman received the Council of University Transportation Centers Award for Distinguished Contribution to University Transportation Research and Education. The award honors someone who has a long history of significant and outstanding contribution to university education and research. "Your selection is an earned tribute from your colleagues and is recognition of the outstanding work you have done for transportation education and your profession," according to the announcement letter.

Katherine Lin '05 has been named one of the new Burchard Scholars. This program brings together distinguished members of the faculty and promising sophomores and juniors who have demonstrated excellence in some aspect of the humanities, arts, and social sciences, as well as in science and engineering. As the winner of the List Foundation Fellowship for the Arts in 2003, her project on contemporary Taiwanese and Taiwanese-American composers is described in the Arts subheading of the *Readers' notes* column.

Grad student Christopher Wodzicki was one of three finalists in the country for the Skidmore, Owings & Merrill traveling fellowship.

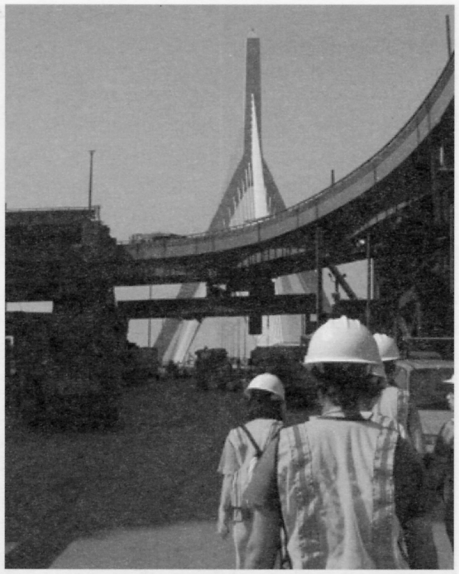
In December 2003, Guido Salvucci '92 (SM) & '94 (PhD) was awarded the Macelwane Medal at the American Geophysical Union (AGU) fall meeting honors ceremony in San Francisco. The citation by Prof. Dara Entekhabi commends him for making "research contributions in diverse topics in hydrologic science, and [having] opened up new frontiers several times in his young career. His signature is a deep and intuitive solution to unresolved problems that have been around in the discipline for decades. The solutions ...demonstrate an intuition for physical processes and a skill to extract just the right amount of analytics to make a contribution stay and speak to many.

"...Especially noteworthy are his contributions to (1) understanding the significant role of climate, soils, and terrain in organizing the pattern of hydrologic exchanges; (2) understanding the effects of rate-limitation processes in soil physics; (3) unraveling the role of time perturbations and spatial scale in water balance; and (4) inferring land surface fluxes from remote sensing measurements.

"Another area of notable contributions is remote sensing of land surface fluxes, for example, evaporation. Evaporation, the core driver of linked water, energy, and biogeochemical cycles over land, is not monitored such to allow mapping. In a series of studies Guido offered a truly remarkable solution that is based on fundamental physics of the problem and does not rely on parametric assumptions. He combines the knowledge of the transition timing derived from soil physics to show that the rate of evaporation in each regime is predictable....

"Guido has recently created new value for historical observations using remarkably clever conditional sampling. He has managed to unravel the dependence of evaporation and recharge/discharge losses on soil moisture from measurements of precipitation. The solution is fundamentally independent of the scale of observation. The breakthrough allows the estimation of the state control on fluxes without any parameterization assumptions and using available measurements."

In the CEE newsletter story, "Microwaves measure soil moisture from space satellites" (Vol. 16:4, Summer 2002), visiting professor Eni Njoku discussed some of the current and proposed satellites for this type of research. NASA announced in January 2004 that they have authorized three Earth System Science Pathfinder small satellite programs, including the Hydros mission with Prof. Dara Entekhabi as principal investigator and Njoku as the Jet Propulsion Lab principal scientist.



RAQUEL RAE ESCATEL

Once the curving beams of the Southeast Expressway are removed, the shining white peaks and cables of the Zakim-Bunker Hill bridge will dominate the skyline. Thanks to CEE lecturer Fred Salvucci, students were able to go on an official tour of the Big Dig project (wearing official safety equipment, as seen in the bottom right) in August 2003, as well as walking on the partially opened new bridge.

For 20 years the Big Dig has been a grand goal, a money sink, or a transportation dream at the end of an eternal commuters' nightmare, depending on one's viewpoint. What was proposed in 1983 as a $2.2 billion project to be finished by 1995, is now estimated to cost $14.6 billion with a tentative (but frequently receding) completion date of 2005.

According to an MIT press release (http://web.mit.edu/newsoffice/nr/2004/hydros.html), the MIT-led project will measure soil moisture from space, providing data needed to assess the impacts of global change and improve accuracy in weather forecasting. That measurement has been missing from the array of clues—rainfall, atmospheric chemistry, humidity and temperature—used by scientists to predict change in the local and global climate. Knowing the soil moisture, they can calculate evaporation (the process that links the water, energy and carbon cycles) and get a better understanding of global change.

"Soil moisture has been one of the Holy Grails. The community of earth system scientists has been trying to measure it for a long, long time, but couldn't because it's so expensive," said Dara Entekhabi, principal investigator of the Hydros project. "We have a measurement for rainfall, atmospheric chemistry, humidity and temperature, but surface soil moisture has been missing. In the same way that temperature tells the state of the surface