Samer Madanat on What’s New at ITS—the Winter 2007 Director’s Message:

**NASA Ames Aviation Research Partnership,**  
**Sustainable Fuels Working Group,**  
**Chengdu Transit and**  
**PATH at 20**

In previous issues of *NewsBITS*, I described some of the ongoing research and educational initiatives at UC Berkeley in the field of transportation. Several of these initiatives have attained critical mass in the past few months; the current issue provides an update.

**NEXTOR's NASA Ames Partnership**

On the air transportation side, a team of faculty including NEXTOR co-director Mark Hansen and Alexandre Bayen, who joined UC Berkeley last year as a member of the CEE systems program, has strengthened our relationship with the NASA Ames Center. At the core of this expansion is a large research project in the field of air traffic control, which brings together ITS researchers and researchers at NASA Ames. Some of the graduate students involved in these projects have decided to make a career out of air traffic control research, and have “gone over to the other side” this year to join the sponsor team. More on this story is provided in the accompanying article, which includes an interview with some of our researchers.

**Transportation Sustainability: a new working group on fuels**

On the ground, our initiatives in transportation sustainability research are also accelerating. The new joint Transportation Sustainability Research Center (TSRC) has focused its activities thus far on questions of alternate transportation fuels. Its seminar series last semester served as a focal point to generate interest from faculty in several campus departments. With the Berkeley Institute of the Environment, TSRC is organizing a working group on transportation fuels in the spring semester, with a membership of 12 faculty and researchers, ranging from Political Science to Agricultural and Resource Economics.

**The Chengdu Project: Sustainable Urban Transportation**

While developing and deploying alternate transportation fuels is one approach to achieving sustainability in transportation, this will not be sufficient. A complementary approach is to reduce energy consumption through significant mode shift to public transportation, which has additional benefits of reducing congestion and decreasing vehicle emissions and other environmental externalities. While it is unfortunately true that transit ridership in the U.S. cannot be expected to increase in the foreseeable future, this is not the case in the developing world.

I believe that rapidly motorizing cities in China and other developing countries are where transportation researchers and planners have the greatest opportunity for improving transportation sustainability through large increases in transit ridership. And it is also where such developments are most needed. Automobile ownership in China is growing at the alarming rate of 80 percent each year. By the end of 2006, it is expected that nine out of every 1,000 Chinese citizens will own a car, bringing the number of automobiles on Chinese streets to nearly 13 million. If this rate of increase continues, the number will rise tenfold to more than 130 million automobiles by 2010! The effects of this unsustainable growth are already manifest in severe traffic congestion problems in larger cities, such as Beijing and Shanghai. The projected associated greenhouse gas emissions have dangerous global implications. Already, 10 percent of China’s almost 4 billion metric tons of CO2 emitted each year is due to the transport sector, and China is...
poised to become the world’s leader in greenhouse gas emissions before 2020. Similar unsustainable levels of automobile ownership are projected for cities in many other large developing countries including India, Mexico and South Africa.

The good news is that, at least in China, governments (from the local to the national levels) recognize that this is a very serious problem and are anxious to intervene. And they realize that to arrest this trend, public transit will need to be more ubiquitous in Chinese cities. The national government in Beijing has established a target stating that by 2010, at least 30 percent of all trips made in any Chinese city are to be provided by public transit. As a result, city officials in China are very interested in what transportation researchers can do to help them achieve this target.

UC Berkeley transportation faculty and researchers are at the forefront of this engagement. Through the Volvo Center of Excellence in Future Urban Transport, Robert Cervero and two of his graduate students (Chris Cherry and Jenny Day) are investigating mode choice issues for dwellers of outlying housing development in Shanghai and quantifying the environmental footprint of electric bikes. Elizabeth Deakin and her students (Alley Thomas and Wendy Tao) have been studying bus rapid transit planning in Chinese cities.

Another group of ITS researchers, including Mike Cassidy, Yuwei Li and me, are part of the Urban Sustainability Initiative at UC Berkeley. With funding from the Gordon and Betty Moore Foundation, we have started a partnership with the local government in the city of Chengdu, to develop a fully integrated transit system for the city. Three graduate students are involved in this project. For more on these exciting developments, I refer you to the article in this issue.

PATH Celebrates Its 20th Anniversary

While we geared up for new initiatives, we also took the time to celebrate our past and present achievements. This year was the 20th anniversary of PATH. This milestone was marked with a two-day symposium, which reviewed the history and contributions of the center. The occasion was an appropriate time to reflect on the key elements that have facilitated the success of PATH, including a strong partnership with the California DOT, a core team of dynamic staff researchers, close interaction with private sector partners, and an extensive network of faculty and student researchers at UC Berkeley and other universities. All these parties were represented at the PATH@20 celebration, which is covered in another article in this issue.

I wish you all a happy, healthy and successful new year.

—Samer Madanat, Director, Institute of Transportation Studies, Berkeley
Chengdu Sustainability Project: a Moore Foundation Urban Sustainability Initiative to Increase Transit Use

The Institute of Transportation Studies has joined forces with the city of Chengdu, China, and Southwest Jiaotong University (SWJTU) to help Chengdu, the capital of the Sichuan province, design and implement a wholly integrated transit system, as part of the new UC Berkeley-based Urban Sustainability Initiative (USI), launched in October with a $1.1 million initial one-year grant from the Gordon and Betty Moore Foundation. The initiative is intended to foster collaborations between UC Berkeley and a wide range of institutions in Asia, Africa and Latin America to match the latest knowledge available with decision-makers for implementation in the world’s fastest-growing urban areas. The USI is administered by the Berkeley Institute of the Environment (BIE) and is comprised of several elements. ITS is leading the initiative’s transportation efforts, which account for roughly one-third of the total budget. Additional funding is expected over the following two years.

The ITS team, which is led by Professors Samer Madanat and Michael Cassidy and ITS Researcher Yuwei Li, traveled to Chengdu in the summer of 2006 and established a partnership with SWJTU, whose Professor Dianye Zhang, is also Chengdu’s Deputy Commissioner of Communication, which means that he is the lead official in charge of the city’s transportation system.

Integrated Mass Transit

Chengdu’s planned BRT system

The project will involve design and implementation of an integrated mass transit operation that will enable riders to seamlessly transfer between various components of the system. The ITS team major contribution will be to design the feeder bus system to connect with the city’s planned subway and bus rapid transit lines. Scheduling, trip planning and comprehensive signal coordination are among the elements needed for implementing the scheme. Additionally, extensive understanding of trip-making decisions will be developed through analysis and modeling using expertise...
developed by ITS researchers. They will be working closely with Southwest Jiaotong University researchers, who have developed an extensive data library of travel patterns and preferences for Chengdu residents.

**How It Relates to the Moore Foundation's Urban Sustainability Initiative (USI)**

This project fulfills one of the primary goals of the initiative, which is to produce new technical and institutional capacities for decision-makers that are transferable and can be replicated in similar situations, thereby creating a living laboratory of sustainable transportation practices.

The project has another unique aspect, Madanat pointed out, in that it is applying a holistic approach to urban transportation sustainability. “We’re looking at the broad picture of sustainable systems,” he said, rather than focusing on discrete pieces of the transportation system, such as energy or vehicle design.

**Chengdu’s road network**

**A Mandate to Increase Transit Use**

For Chengdu, the partnership represents a response to a government requirement that transit in China’s larger cities represent at least a 30 percent share of travel within 10 years. In Chengdu, that share is roughly 14 percent currently. The main modes the city’s decision-makers are hoping to replace are taxis and electric and gasoline-powered motorbikes, which contribute large amounts of pollution, both during their operation and in their after-lives and production.

**Chengdu’s planned metro system**

**Collaboration on Two Campuses**

The collaboration extends beyond a simple exchange of knowledge. As part of the project, a professor from SWJTU will be spending time in Berkeley working with researchers and students at ITS, and students from ITS will be working in Chengdu with their counterparts at SWJTU, fulfilling another mandate of the Moore Foundation’s grant: intellectual cross-fertilization and exchange.

Finally, Madanat noted, the sustainable transportation methods and systems deployed and tested and perfected in Chengdu should be transferable to other cities undergoing similar growth, not just in China, but in other countries with rapidly motorizing urban areas. He added: “Success in Chengdu will open the door for transferring our ideas to cities throughout the developing world. Through UC Berkeley’s Volvo Center of Excellence, we intend to customize our methods to a number of such cities, including Nairobi, Kenya (in collaboration with Volvo partners at Columbia University), Xian, China (with Volvo partners in China’s Center for Sustainable Transportation) and others.”
ITS and NASA: A flourishing relationship

Grad student Megan Smirti in an Ames simulator.

Last fall, some 20 graduate students in “Selected Topics in Air Transportation,” a seminar co-taught by Professors Mark Hansen, Alexandre Bayen and Lecturer Jasenka Rakas journeyed across the Bay twice to NASA Ames for a hands-on tour of the Mountain View facility. The tour included a visit to “FutureFlight Central,” a two-story air traffic control and air traffic management test facility that provides a full-scale, real-time simulation of an airport. Students sat in the simulated cockpit of a jetliner as it “landed” at a virtual SFO, and gazed through “windows” (in reality, 12 projection screens) of a virtual air traffic control center at 360-degree views of an airport.

“The technology was really cool,” said grad student Megan Smirti, who is primarily interested in policy aspects of air transportation. “The neat thing about this alliance with NASA is they’re doing the cutting edge stuff that nobody else is doing.”

A Growing Relationship

The field trips, which also included presentations by NASA researchers, are just one example of the growing relationship between UC Berkeley transportation students and NASA, the nation’s leading government organization for aeronautical research. There are others.

Three ITS PhDs, Charles-Antoine Robelin, Avijit Mukherjee, and Kenny Kuhn recently were hired by NASA Ames where they are working as researchers.

Robelin, for example, works in a branch of the agency’s aviation division that deals with air traffic flow around major airports. He is also involved in research for the Next Generation Air Transportation Systems (NGATS) project, which is aimed at automating portions of the nation’s air transportation system over the next 20 years.
George Meyer, a NASA scientist for more than 30 years and former Berkeley PhD student, works part time on research and has been visiting Berkeley on a weekly basis in 2006, as part of joint NASA-Berkeley projects.

NASA recently awarded substantial sums of research money to NEXTOR (the National Center of Excellence for Aviation Operations Research), a consortium of research scientists from five universities, housed at ITS, as well as to individual faculty members acting as principal investigators for several related research projects.

Much of the NASA funding is aimed at finding solutions to the growing air traffic congestion problem and upgrading the country's air traffic control system. A midair collision over the Grand Canyon 50 years ago prompted the first large-scale reforms in the country's then-fledgling air traffic control system. That system was overhauled again in 1981, but today's air traffic controllers are struggling to keep up with existing demand in the airspace above metropolitan areas, and will be unable to handle the anticipated increase in passengers from 740 million in 2005 to a projected billion in 2015. Marion Blakey, head of the Federal Aviation Administration, recently warned that "the system will be strained beyond its limits" unless a new system is put in place soon.

Building on the Existing Partnerships

Since NEXTOR’s founding 10 years ago, its faculty and student researchers have concentrated on various aspects of the air traffic problem, such as air traffic management and control, airline operations, aviation systems planning, safety data analysis, and aviation economics. NEXTOR, which is sponsored by the FAA, works closely with the federal agency as well as public entities such as ports, airports, and departments of transportation, and private industry, such as Honeywell, Boeing, and Federal Express.

Mark Hansen, professor of civil and environmental engineering, is co-director of NEXTOR and a coordinator of NASA Ames University Affiliated Research Center (UARC), which provides funding for a wide variety of projects at universities, including Berkeley.

In 2005, Alexandre Bayen joined the faculty as an assistant professor of civil and environmental engineering, and brought with him a close relationship with NASA Ames where he worked one day a week while pursuing a PhD in Aeronautics and Astronautics at nearby Stanford University. He also brought a background in computational control theory and an interest in the potential automation of air traffic control functionality. One of his goals is to develop mathematical algorithms for advanced collision avoidance systems for aircraft, which would have the dual effect of allowing more aircraft to use the airspace and do it more safely. He likens it to Star Wars films where streams of aircraft crisscross one another efficiently and without colliding.

"When I came to Berkeley it was very natural—and almost inevitable—to set up this connection (with NASA) again," explained Bayen. In his laboratory, his student researchers began applying the algorithms to air traffic computer simulations developed jointly with NASA Ames.

More recently, Bayen started to work on large-scale modeling projects funded by NASA Ames, focused on modeling nationwide flows of aircraft throughout the day, in order to analyze them and optimize the overall system.

It also seemed natural for Hansen and Bayen to create a class for students to better understand the types of research that involved each of them. Ultimately, it led to the seminar, which debuted in 2006, and the field trips to NASA Ames. Hansen, with his background in transportation economics, policy and planning, and close relationship with the FAA and UARC, and Bayen, with his ties to NASA, found much overlap in their research.

"Although Mark and I work on very different topics, we use the same data," explained Bayen. "We get a lot of that data from the FAA and from NASA. We get software from NASA, and we share these facilities."

"There's a huge amount of overlap," added Hansen. "Two of the NRA's (research grants from NASA) we received were proposed under the NEXTOR umbrella. Alex and I are also working on a UARC project, and a NASA project that came through the NRA. Those
are all joint projects. Funding comes through different mechanisms but the projects are very closely interlinked." Most of the projects, in fact, are related in some way to the larger Next Generation Air Transportation System initiative, a federal program charged with redesigning and transforming air transportation by 2025.

The interest in aviation at ITS has grown steadily over several decades. Former ITS Director Adib Kanafani was instrumental in establishing aviation research at the institute more than 30 years ago. Ten years ago NEXTOR was established as a multi-university research center and was housed within ITS (the other participating universities are Massachusetts Institute of Technology, University of Maryland, Virginia Polytechnic University and George Mason University). When Bayen joined the faculty, he and Assistant Professor Raja Sengupta, an expert in unmanned aerial vehicles, helped establish the Systems Program within the department of Civil and Environmental Engineering, providing expertise in aviation.

With the NASA connection, Berkeley is widening its aviation program. For students interested in aviation research, this makes Berkeley a good place to study, and a potential launching pad to jobs at NASA or private industry involved in air traffic control. As Hansen points out, the Bay Area itself has become a “hotbed of aviation research.”

NEXTOR will be hosting the annual Air Transportation Research Society’s World Conference June 21-24 in Berkeley just before the World Conference on Transportation Research, which ITS will co-host with the University of California Transportation Center.
PATH Marks 20th Anniversary with Symposium and Gala Events

Scene from the PATH luncheon during day one of the research symposium at Richmond Field Station

Workshops, Demonstrations and Dedication of the Parsons Traffic and Transit Lab Are Among the Featured Events

The PATH @ 20 celebration, marking the anniversary of the 1986 founding of Partners for Advanced Transit and Highways, held last October at PATH headquarters at the Richmond Field Station, brought together past and present researchers, faculty and partners from government, academia and industry to review PATH's past accomplishments, provide some highlights of its current work and sketch some possibilities for the future.

Some 100 people attended, from organizations including the California Department of Transportation (Caltrans), the UC campuses of Berkeley, Davis, Irvine, Los Angeles and Riverside and the University of Southern California (USC) and federal and regional transportation agencies and transportation research consulting firms. Technical sessions and breakout sessions were held over the course of a day and a half.

Additionally, demonstrations were given of various PATH research projects, including a hydrogen fuel cell vehicle researchers are using for various studies, a Segway Human Transporter, cars that communicate with the roadside via wireless radios, warning systems that use sensors to alert drivers when it is unsafe to make a left turn and automated precision bus docking using magnets embedded in the roadway.

Guests were also invited to attend the inauguration of the Parsons Traffic and Transit Laboratory, named after founding PATH Director Robert E. Parsons, where traffic lab researchers have collected detailed, real-time traffic and transit data from a number of arterials and transit systems to be used for research on traffic and driving behaviors. More about the lab dedication and demonstrations.

A gala dinner was held the night of October 26, where longtime PATH friends and supporters exchanged anecdotes and watched a commemorative film marking milestones in the organization's growth.

The event started with a plenary session, which was led by PATH Director Alexander Skabardonis, with talks by Larry Orcutt, Division Chief, Research and innovation, Caltrans, Neil Schuster, CEO, ITS America, and Lyle Saxton, FHWA, retired.

Technical sessions and breakout sessions followed, on the following topics:

- ATMIS, moderated by Roy Bushey, Caltrans, Retired
- AVCSS, moderated by Roberto Horowitz, UC Berkeley Professor of Mechanical Engineering
Traffic Operations & Safety, moderated by Frank Quon, Caltrans
Transit Operations, moderated by Jim Cunradi, AC Transit
Future Directions Breakout Discussions, Day 2
Traffic Operations & Safety, moderated by Robert Copp, Caltrans
Transit Operations & Policy, moderated by Mark Miller, PATH

Link to complete PATH @ 20 Agenda.