This publication is a report of transportation research, education and technology transfer activities of the NEXTRANS Center from Oct 1, 2006 through September 30, 2008.

Edited by: Jessica Mehr
Designed by: Mark Leahy
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On behalf of the NEXTRANS Center, it is with great pleasure that I present our first Annual Report. This document does more than simply record our first year in operation; it shows how the NEXTRANS Center has evolved from an idea to a successful reality. We have made some great beginnings and have had key accomplishments over the past twelve months, due in large part to the efforts of NEXTRANS students, faculty, and staff, as well as the sustained support of our partners from the government, academia, and the private sector.

Here at NEXTRANS, we are dedicated to approaching problems from a holistic perspective. Challenges such as mobility, safety, and infrastructure renewal are interdependent, and therefore must be explored across multiple dimensions. The NEXTRANS Center’s goal is to develop integrated solutions based on this holistic vision. At the same time, we aim to leverage technology to further innovation, and promote partnerships between the public, private, and academic sector. Over the course of the last year, we have made a lot of progress in this mission.

Since starting our operation in Fall 2007, the NEXTRANS Center’s students, faculty, and staff have been involved in various research, education, and technology transfer programs. On the research side, the Center selected its first year projects after a formal external peer review process. These projects are currently underway, and address topics that span transportation, logistics, and related domains. Whether they are exploring the impacts of a burgeoning biofuels industry, or striving to make our roads safer and freight movements more efficient, these projects show great relevance to our nation’s current and future needs.

At the same time, NEXTRANS students have been shining on the regional, national, and international stage. In addition to providing graduate students with experiential learning opportunities, the Center strives to attract new students to the field of transportation. In its first year alone, NEXTRANS has sponsored a high school intern, recognized students from Crawfordsville High School and Purdue University, and fostered a partnership with Martin University to help diversify the transportation profession by attracting non-traditional students.

The Center’s outreach accomplishments include the NEXTRANS Seminar Series, and most notably, our Inaugural Summit on May 5, 2008. This successful Summit brought together national and regional stakeholders from government, industry and academia to explore future challenges in transportation and logistics, and foster collaboration in working towards integrated solutions.

Over time, the Center seeks to create impact by fostering partnerships that leverage limited resources to find solutions to critical national and regional transportation-related challenges, consistent with our theme. We are continuously seeking new collaborative partners from the public, private, and academic arenas, and welcome your participation in our programs and activities.

Srinivas Peeta, Ph.D.
NEXTRANS Center Director
Since 1937, INDOT has maintained a long-standing partnership with Purdue University through the Joint Transportation Research Program (JTRP). We are very pleased to open a new chapter in that relationship with our support of the NEXTRANS Center. As Chairman of the Center’s Advisory Council, I am happy to join with my fellow council members from multiple USDOT agencies, state Departments of Transportation in Federal Region V, private sector firms, professional associations and educational institutions. Together we look forward to providing vital links between NEXTRANS and the transportation community at large in order to help actualize the vision of integrated, innovative and holistic solutions. Through our advice and guidance, we will help ensure that the Center’s goals and activities in research, education, and outreach are synergistic with regional and national needs, bringing value to the larger stakeholders. Congratulations NEXTRANS on a successful first year!

Karl Browning
Commissioner, Indiana Department of Transportation
Chair, NEXTRANS Center Advisory Council
Since its inception in 1987, the University Transportation Centers Program has been advancing U.S. technology and expertise in the many disciplines comprising transportation. Its continuing mission is to fund university-based centers of excellence that will work to meet the nation’s need for safe, efficient, and environmentally-sound transportation systems for the movement of people and goods.

The NEXTRANS Center is one of ten Regional University Transportation Centers selected competitively by the U.S. Department of Transportation to serve as leaders in achieving this vision. Headquartered at Purdue University in West Lafayette, Indiana, the Center represents Region V, which includes the states of Indiana, Illinois, Ohio, Michigan, Wisconsin and Minnesota. NEXTRANS was established in 2007 based on an award from USDOT’s Research and Innovative Technology Administration (RITA), in order to implement a multidisciplinary program of transportation research, education, and technology transfer.
The theme of the NEXTRANS Center is to develop integrated and innovative solutions to transportation problems, with some emphasis on intermodal freight transportation to address regional needs and economic opportunities. In working towards these solutions, NEXTRANS recognizes that transportation goals such as mobility, safety, and infrastructure renewal are not disconnected from one another; they are inseparable elements of a seamless, sustainable, and efficient transportation system.

Because our nation’s transportation problems consist of interdependent components, NEXTRANS believes in integrated solutions. These solutions can be integrated across modes (auto, transit, freight, air, rail, and marine), sectors (public and private), or geography (within the Midwest and for the entire nation). They are innovative in that they seek to leverage technology, disparate data sources, limited resources, public-private partnerships, and novel financing strategies. Most importantly, NEXTRANS works towards these solutions by explicitly capturing the interactions between vehicle, traveler, and infrastructure. By implementing this holistic approach, NEXTRANS aims not only to develop integrated solutions, but to foster a new generation of paradigms and a highly qualified transportation workforce.

The NEXTRANS Center develops integrated and innovative solutions to transportation problems by explicitly studying the interactions between vehicle, traveler, and infrastructure.
National Needs

The NEXTRANS Center strives to be a national leader in developing integrated solutions to transportation challenges such as mobility, safety, and infrastructure renewal.

Mobility

Poor mobility is a widespread problem, causing energy wastage at a time when our nation can least afford it. For instance, in Metropolitan Chicago, a major hub for air, rail, ship, and truck-borne freight, congestion costs the region an estimated $7.3 billion per year (Chicago Metropolitan Planning Council). This kind of inefficiency has long-term negative environmental consequences, creates a transportation chokepoint in the national economy, and reduces U.S. global competitiveness. Since congestion is fast outpacing the rate of infrastructure investment, a sustainable solution does not currently seem to exist. This problem does, however, present opportunities for “out-of-the-box” thinking in generating multimodal and intermodal solutions that are effective, cost-efficient, and can leverage public transportation assets. For these reasons, innovative congestion solutions are a major goal of the NEXTRANS Center.

Safety

According to the National Highway Traffic Safety Administration, traffic accidents are the leading cause of death for Americans ages 4-34. Because of the magnitude of lives lost, safety is a primary goal for any transportation system, whether rural or urban. The fatalities, injuries, and destruction of property caused by traffic accidents motivate the need for new paradigms that can minimize safety concerns. Since research can directly link safety to congestion and poor infrastructure, NEXTRANS seeks an integrated approach to safety concerns that analyzes these relationships, as well as the interactions between vehicle and driver.
Infrastructure Renewal
Degraded pavement, roadside hazards, and lack of funding for upgrades are just some of the problems plaguing our nation’s roadways, highways, and interstates. In addition, air transportation systems have become sluggish, and there is a need for a viable rail transportation system for public transit. Maintaining, renewing, and adding to our transportation infrastructure is essential if we are to effectively address mobility and safety concerns. One approach is to develop “intelligent” transportation systems, which leverage technology to increase infrastructure efficiency. Because infrastructure renewal is linked to safety and mobility goals, NEXTRANS seeks integrated solutions, not only through research, but also through innovative financing strategies and public-private partnerships.

These challenges present opportunities for "out-of-the-box" thinking in generating multimodal and intermodal solutions that are effective, cost-efficient and can leverage public transportation assets.
Regional Need:  
An Efficient Intermodal Freight Transportation System

Region V shares the nation’s need for better mobility, safety, and infrastructure; however, these needs are amplified by the significant amount of freight transportation that takes place through this region. In 2004 alone, bottlenecks on American highways caused 240 million hours of delay and cost truckers $8 billion in lost time (INDOT). For this reason, NEXTRANS has identified an efficient intermodal freight transportation system as a major regional need.

Intermodal transportation systems, which use multiple means of transportation to move people and goods, often present a challenge due to infrastructure and funding limitations, one-dimensional thinking, and a lack of strategic and institutional coordination between the public and private sectors. There are several reasons why surmounting these challenges is important to Region V.
**Agriculture**
Region V contains 11.75% of US farmland, and produces 16% of our nation’s agricultural products (ERC, BEA). This significant agricultural economy would benefit greatly from a stronger freight transportation system. Developing public-private partnerships to create this system would reduce costs while benefiting both sectors. For example, if private sector agricultural firms introduced RFID sensor technologies to track their products throughout the entire supply-chain, the public sector could provide an associated technology-enabled transportation infrastructure. Through strategic planning, the public sector could foster a seamless intermodal transportation system by motivating the development of other modes through infrastructure advancement, government policy and incentives, and the promotion of financing strategies that attract private investment. This infrastructure would not only advance mobility and safety for the public sector, but allow the private sector to move products more efficiently.

**Biofuels**
The United States needs both short-term and long-term energy security. As fossil fuels continue to fluctuate in price, the nation is investigating the wider use of biofuels such as ethanol and biodiesel as one of the alternative solutions. Since these fuels are made from crops such as corn, soybean, and wheat—all major products of the Midwest—Region V has a potential economic opportunity, one that requires an efficient transportation system to be successful.

**Auto Industry**
The US auto industry is in need of major rejuvenation. Since Region V is home to a large section of auto production, it presents a golden opportunity for public-private partnerships. If the public and private sectors worked together to produce a more technologically advanced infrastructure, the private sector could manufacture complementary vehicles—cars and trucks with safety systems that are actually personalized to the driver and roads. This could reduce fatalities, further optimize Region V’s freight transportation, and give the US auto industry a much-needed boost in revenue.
Innovative and Integrated Solutions through Public-Private Partnerships

As the population swells and our infrastructure ages, our nation will continue to face a number of transportation challenges. Not only will new construction, maintenance, and infrastructure renewal have to be financed with limited funds, but operations must be efficient enough to utilize existing infrastructure to its fullest potential, providing safety and relief from growing congestion. Will the public sector be able to surmount these challenges alone?

If we are to meet the transportation needs of the future, NEXTRANS believes that the public and private sectors must better integrate their interests and efforts. In a standard public-private partnership (PPP), the private sector finances, builds, maintains, or operates an asset for the public sector, recovering the investment with revenues. The holistic solutions proposed by NEXTRANS require not only a new generation of paradigms and research, but a new generation of public-private partnerships that leverage the resources of both sectors through a more integrated approach.

More dynamic PPPs could provide a number of opportunities. These might include the automatic collection of private vehicle data (GPS, transponder, etc.) to provide travel data and real-time traffic information. In terms of infrastructure, both sectors could work together to develop infrastructure innovations such as reversible median lanes or dedicated freight lanes for oversize trucks between intermodal stations. High occupancy vehicles (HOVS) could be automatically detected, and new technology could allow for capacity improvements through functions such as ramp-metering, flow breakdown detection, speed control, etc. Future PPPs could also provide breakthroughs in traffic modeling, and create innovative financing strategies.
As one might imagine, achieving the regional and national goals of the NEXTRANS Center requires a great deal of collaboration. The Center’s chief participants are Purdue University, The Ohio State University (OSU), and the University of Illinois at Urbana-Champaign (UIUC), who each play a key role in research, education, and technology transfer. These major partners bring to bear their vast institutional resources, in addition to strong and sustained interdisciplinary programs in transportation.

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The Center Director is responsible for overall Center operation. He directs programs and activities, implements the Center’s Strategic Plan, manages funds, ensures compliance with UTC Program requirements, and oversees Center Staff and Research Associates. The Director reports to the Executive Director of Purdue’s Discovery Park, which provides administrative and fiduciary oversight on behalf of Purdue University. The Director also reports to the Center’s Executive Committee, and administers the Center with the advice of the NEXTRANS Advisory Council.

The seven-member Executive Committee sets strategy, approves budgets and makes final decisions on Center project funding. It is chaired by the NEXTRANS Director and includes Co-Directors from OSU and UIUC. The Executive Committee meets several times a year as required by the Center’s programs and activities.

Srinivas Peeta
NEXTRANS Center Director
Professor of Civil Engineering
Purdue University

Ray Benekohal
NEXTRANS Center Co-Director
Professor of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign

Rabi Mishalani
NEXTRANS Center Co-Director
Associate Professor of Civil and Environmental Engineering
The Ohio State University

Mark McCord
Professor of Civil Engineering / City and Regional Planning
The Ohio State University

Imad Al-Qadi
Founder Professor of Engineering
University of Illinois at Urbana-Champaign
Director, Illinois Center for Transportation

John Schneider
Assistant Vice President for Industry Research
Purdue University

Kumares C. Sinha
Edgar B. & Hedwig M. Olson Distinguished Professor of Civil Engineering
Purdue University
Director, Joint Transportation Research Program, Indiana Department of Transportation
The Advisory Council provides strategic and programmatic guidance for the NEXTRANS Center. It fosters vital links between the Center and the transportation community at large, and ensures that activities and goals are synergistic with regional and national needs and of value to the stakeholders. The council is chaired by the Commissioner of the Indiana Department of Transportation.

NEXTRANS Center Advisory Council

Karl Browning, Commissioner, Indiana Department of Transportation – Chair
Ruben L. Anthony, Jr., Deputy Secretary, Wisconsin Department of Transportation
Robert J. Bernhard, Ph.D., Vice President for Research and Professor, University of Notre Dame
Randall S. Blankenhorn, Executive Director, Chicago Metropolitan Agency for Planning
Rich Cooper, Chief Executive Officer, Ports of Indiana
Bruce Cox, Vice President and Chief Technology Officer, TransWorks
George Filley, Vice President, Product Management, NAVTEQ LLC
John C. Friend, Bureau Director of Highway – Delivery, Michigan Department of Transportation
Thea Graham, Ph.D., Manager, Strategy, Operations Planning Services, Federal Aviation Administration (FAA)
Richard Kowalewski, Acting Assistant Administrator, Chief Safety Officer, Pipeline and Hazardous Materials Safety Administration (PHMSA)
Walter Kulyk, Director, Office of Mobility Innovation, Federal Transit Administration (FTA)
David L. Lippert, Bureau Chief, Materials and Physical Research, Illinois Department of Transportation
Brian Majeska, Vice President, Sales and Product Development, SemMaterials
Fidel Saenz de Ormijana, Ph.D., Technical Director, Ferrovial Agroman US Corp
Howard Wood, Deputy Director, Division of Planning, Ohio Department of Transportation

The Center Staff consists of the NEXTRANS Center Managing Director, Research Associates, and Communications Coordinator. Together with the Center Director, they represent the Center’s administration. The Staff also works with the NEXTRANS faculty to help create and disseminate knowledge through research, education, and technology transfer activities.
If we are to meet the transportation needs of the future, NEXTRANS believes that the public and private sectors must better integrate their interests and efforts.
NEXTRANS Center Hosts Inaugural Summit

On May 5, 2008 at Purdue University, nearly 200 participants attended the NEXTRANS Center’s Inaugural Summit, titled “Exploring Partnerships for Innovative Transportation and Logistics Solutions.” The goals of the Summit were to:

- Familiarize stakeholders with the NEXTRANS Center’s vision and goals.
- Examine holistic approaches to national and regional transportation challenges by creating a dialogue between government, industry, and academia.
- Showcase the collective expertise of institutional partners and seek out new partners based on overlapping interests.
- Create a roadmap for developing integrated solutions to transportation and logistic challenges by leveraging technology, innovative financing strategies, and new types of public-private partnerships.

The Summit was sponsored by the NEXTRANS Center with additional support provided by Purdue Discovery Park, Bingham McHale, NAVTEQ, UPS and Hellman Logistics. The event drew faculty and students from the major partner Universities as well as the NEXTRANS Center’s educational partner Martin University. Representatives from four other UTCs, University of Nebraska – Lincoln, University of Wisconsin-Madison, University of Toledo and Northwestern University joined faculty from other universities in the Midwest region to exchange views and discuss opportunities for collaboration. Attending the summit from the public sector were officials from USDOT’s RITA, FAA, and PHMSA, state DOTs in Region V and various local and regional planning agencies.

The day-long program consisted of a plenary session, a networking and poster presentation session, a panel discussion, a luncheon and four parallel sessions—each carefully designed to address one or more goals of the summit.
After welcoming remarks from high-ranking officials of Purdue University and the State of Indiana, **NEXTRANS Director Srinivas Peeta** gave an introductory presentation about the Center. In it, he highlighted the urgency for integrated solutions to address the economic, energy, and environmental challenges currently impacting our nation’s transportation systems and the quality of life of its citizens. He then outlined the role NEXTRANS will play in meeting these challenges by furthering the vision of holistic solutions.

**RITA Administrator Paul Brubaker** then articulated “National Transportation Vision and Challenges” from the Federal Government perspective. He began his talk by asking the audience to imagine what it will take to make America’s transportation infrastructure a safe, modern, globally competitive model across all modes. Regardless of how overwhelming it may seem, he expressed that transformation is not only possible, but probable:

“Transformation is inevitable, whether we embrace the enterprising spirit of our country and establish ambitious goals for the near future, or wait for the tide of change to force our hand. RITA believes that two key elements will provide the catalyst for change—the application of innovative technologies, and partnering with stakeholders in the transportation community, like our UTCs, to achieve real results.” Brubaker went on to add: “Partnerships, especially those with our UTC, simply make sense. Universities already have access to leading experts in the transportation field, the resources available to conduct research, and the network of knowledge to turn ideas into real solutions. We can all agree that the best interests of society are served when we work together to solve common problems.”
An industry perspective on the future of transportation was provided by Michael Walton, the Ernest H. Cockrell Centennial Chair in Engineering at the University of Texas at Austin and past Chairman of ARTBA. Having looked at current transportation trends and the influence of market forces at the global level, he concluded that the ultimate vision for the future is the transformation of surface transportation into an effectively managed, well integrated, universally accessible and affordable system. Dr. Walton outlined several strategies that can make this transformation possible, including utilizing existing infrastructure, encouraging technology, integrating information, developing agile freight operations, increasing public awareness, and promoting partnerships.

The plenary session was followed by a networking hour, during which the NEXTRANS Center’s partner institutions showcased their collective expertise through display booths and student poster presentations. Administrator Brubaker interacted with NEXTRANS Center students from Purdue, UIUC, and OSU, as well as undergraduate students from Purdue’s Engineering School and high-school students from Crawfordsville, Indiana. He also visited display booths presented by Purdue’s Discovery Park, Research Park, and Technical Assistance Program, as well as the Illinois Center for Transportation, The Ohio State University Transportation Research Labs, and Martin University.

After the networking hour, the Summit featured a panel discussion titled “Transportation, Logistics, and Economic Development—Perspectives from the Region.” Significant and growing demands for freight transportation in Region V states pose specific challenges and opportunities for addressing national needs for mobility, safety and infrastructure renewal. Moderated by Kumares Sinha, Purdue’s Olson Distinguished Professor of Civil Engineering, this important discussion began with scene-setting presentations from five of the six state DOTs in the region.
The presentations by John Weaver (INDOT), David Lippert (IDOT), Howard Wood (ODOT), Mark Wolfgram (WisDOT), and John Friend (MDOT) focused on identifying the areas of urgent needs and promising opportunities for regional collaboration. They were followed by an interactive dialogue involving the panelists and the audience led by Randall Blankenhorn (Chicago MAP) and Rich Cooper (Ports of Indiana).

Karl Browning, INDOT Commissioner and NEXTRANS Center Advisory Council Chair, was the Master of Ceremony of the luncheon program, which included a small awards ceremony and an address by Purdue Vice Provost for Engagement Victor Lechtenberg. Citing U.S. Transportation Secretary Mary Peter’s assertion for finding “21st Century solutions to 21st-Century mobility challenges,” Provost Lechtenberg emphasized the need of partnerships between academia, government, and the industry.

This partnership theme was further explored in the parallel sessions that followed the luncheon program. These sessions took a structured approach in exploring how government-industry-university partnerships on integrated solutions could be developed in four critical areas: Intermodalism, Integration Across Goals, Leveraging Technology, and Public-Private Partnerships.

In all, this successful Summit gave high-level stakeholders in the federal, state and local governments, industry, university, and non-profit sectors an opportunity to find common grounds for integrated solutions by implementing the strategic vision of the NEXTRANS Center.

Purdue Vice Provost for Engagement Vic Lechtenberg

RITA Administrator Paul Brubaker hands out student awards
Located within the Martindale Brightwood community on the east side of Indianapolis, Martin University’s mission is to serve low-income, minority, and adult learners. First settled in the last quarter of the 19th Century, the area has a long history of heavy industry and railroad activities mixed with a minority residential population of approximately 9,000 residents. The Martindale Brightwood community is located in a high crime area where over 25% of the area’s residents live below the Federal poverty line, a ratio that is twice that for the rest of Indiana. The area has four thoroughfares that traverse the neighborhood and carry heavy loads of car and truck traffic.

In 1965, construction of the Interstate 70 route through Martindale Brightwood divided portions of the established community. It caused many residents and businesses to move and disrupted the lives of those who remained in the area. The community was further compromised when residents were moved to accommodate Rural Street and I-70 Industrial Park. The neighborhood does not meet the income requirements of many retailers; hence, there is a lack of mid-level retail and specialty stores. Much of the area does not have a major grocery or drugstore within...
walking distance, and the streets and sidewalks for many blocks are in need of repair. There are a significant number of abandoned buildings and houses in the community, which tends to create an environment that fosters and perpetuates a high crime rate.

In partnership with the NEXTRANS Center, Martin University has undertaken a community outreach project that will engage its students in exploring the negative impacts of the I-70 renovation project on the Martindale Brightwood neighborhood, focusing in particular on its senior citizens. An environmental science course has been developed to train students in survey research methodologies and collect data from the area residents through questionnaires. In the first phase of the project, with guidance, interaction and mentoring from Purdue faculty and graduate students, collected data will be analyzed to identify the key issues of concerns resulting from the highway construction project. The results will be used in the second phase of the project to facilitate focus group discussions to gain insights about the transportation needs of the senior citizens in the area. Finally, results from both the opinion survey and focus group discussions will be disseminated to the local community, public and business leaders through workshops and outreach events to derive innovative solutions for mitigating the negative impacts of the I-70 renovation project.

This undertaking will provide opportunities for Martin’s non-traditional students to learn about transportation research methodologies and engage in community development efforts. It will also expose and attract them to alternate career options, helping to diversify the field of transportation.
The NEXTRANS Center’s research projects are selected based on national and regional significance, peer evaluations, and a holistic approach that ensures the various dimensions of the Center theme, the USDOT priorities, and the multiparty arrangements are being satisfied.
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As gas prices continue to fluctuate, Americans are changing their transportation habits, and crying out for alternative, home-grown fuels. Due to increased world demand, supply disruptions from hurricanes, and turmoil in the Middle East, the price of oil skyrocketed from approximately $26/barrel in July 2003 to a whopping $134/barrel in July 2008 (EIA). Although gas prices have recently fallen due to economic turmoil, Americans are still looking to biofuels such as ethanol to temper U.S. dependence on foreign oil and provide long-term energy security.

Almost all of U.S. ethanol is currently made from corn; however, this is expected to change in the near future (Texas State Energy Conservation Office). In 2007, The Energy Independence and Security Act established a Renewable Fuel Standard mandating that 36 billion gallons of ethanol be used by 2022, and specifying that no more than 15 billion should come from corn. This limitation on corn-based ethanol is based on the concerns that going beyond this level could have adverse impacts on the environment as well as induce higher food costs. Consequently, and due to a number of other challenges, there has been a growing interest in cellulosic ethanol, which many believe has a higher potential to replace gasoline.

Cellulosic ethanol can be produced from a wide range of feedstocks, including agricultural waste products such as corn stover (stalks and leaves), and non-food crops such as switchgrass. These energy sources are cheaper than corn, more environmentally friendly, and could potentially be produced all over the country (Texas SECO). In addition, because it would be made from
dedicated energy crops or the non-food byproducts of current crops, cellulosic ethanol would not cause food prices to increase. Due to these benefits, the Energy Independence and Security Act of 2007 aims to move the United States from no cellulose ethanol production today to at least 16 billion gallons by 2022. This means researchers must work quickly to make cellulose-based ethanol commercially feasible, and examine its potential impacts on our transportation infrastructure. The cellulose ethanol industry could become larger than the corn ethanol industry.

The growth of the ethanol industry could be a major mechanism for rural economic development, especially in Region V. Cellulosic ethanol will provide the opportunity for farmers to sell agricultural waste such as corn stover, in addition to growing dedicated energy crops on less desirable land. The emergence of this cellulose-based ethanol industry will create a number of new transportation needs in Region V, along with new business opportunities for transportation firms.

**Research Objectives:**
The overall aim of this study is to estimate the transportation system impacts of different levels of cellulose production in Indiana. The birth of this industry means that large amounts of cellulosic material will have to be transported to central processing plants, since more bulk material is needed to make ethanol from cellulose than corn. For this project, researchers are identifying the optimal sizes and locations of cellulosic plants in Indiana, based on the potential cellulosic production in each part of the state. This entails developing cellulose supply curves for products such as switchgrass and corn stover in each sub-region, then using an integer programming model to determine the best places for cellulosic plants. Researchers can then use a scenario approach to examine the different levels of cellulosic production in Indiana, and the potential impacts each will have on the transportation system. This will help determine freight logistics, compare transportation modes and routes, and evaluate what infrastructure improvements are needed to accommodate new transportation patterns.

Determining these transportation requirements is crucial to ensuring the long-run competitiveness and sustainability of the Indiana ethanol industry. In addition, studying the future of biofuels in Indiana will provide insight and guidance to the other states in Region V, as well as the entire nation.
In recent years, natural disasters such as Hurricanes Katrina, Rita, and Gustav have illustrated the need to better understand the intricacies of mass evacuation. Such evacuations are called for whenever a natural or man-made extreme event (hurricane, flooding, hazmat release, bomb, etc.) strikes a populated area, exposing the population to life-threatening danger. While strategic planning for evacuations has recently improved in states such as Louisiana, our nation still desperately needs more integrated, effective, and efficient solutions for evacuating citizens.

In terms of transportation, a successful evacuation requires efficient use and coordination of roadway capacities, traffic management personnel, public transportation vehicles, and various emergency response resources. This can prove quite challenging due to the unpredictability of disasters in terms of size, intensity, and lead time. Short-notice disasters, such as hurricanes and floods, provide enough lead time for agencies to plan evacuation routes in advance, based upon the expected location and scope of the disaster. Citizens are then given advisories on which major roadways to use. Despite this advance notice, however, evacuees are often detained for hours in traffic jams, creating life-threatening risks and citizen exhaustion.

No-notice disasters are unexpected, and therefore even more challenging in terms of evacuation. A dam burst or a biochemical attack, for example, would generate highly unpredictable pedestrian and vehicle traffic flows, potentially crippling the transportation system until it becomes inoperable.

Because the circumstances surrounding a disaster are uncertain, a successful evacuation response requires not only long-term plan-
ning, but also strategies for how to operate during the immediate aftermath, once the extent of the disaster and its effects on the infrastructure are known. A recently completed JTRP project (SPR 2874, Peeta and Kalafatas, 2006), addressed the long-term planning stage of evacuation response, specifically how the infrastructure of potential evacuation routes could be strengthened. This does not, however, address the operational needs that arise during the actual event. Parts of the transportation infrastructure might be crippled, and in the absence of information, citizens may use the most familiar route, leading to uneven use of road capacity.

There is also a third element of the operational stage that often goes ignored: route choice behavior and how it affects traffic dynamics. Most planning and operational strategies are concerned with how best to supply citizens with the infrastructure needed to evacuate; however, one must also take into account the demand for these resources. Human behavior must be considered: the likeliness of certain groups to evacuate, when they will leave, what mode they will choose, and their likely route choices.

Research Objectives:
The aim of this study is to integrate supply and demand concerns into a single framework that can help determine real-time evacuation strategies. This will provide an operational tool that can dynamically route vehicles under evacuation, responding to the real-time conditions unfolding in the traffic network. These conditions include evolving traffic patterns (demand) and the available road capacity in the aftermath of the disaster (supply).

In order to capture both of these components, researchers will develop behavior models that can predict route choice and its effects on real-time traffic demand. To model the supply-side, researchers will use a dynamic software tool to characterize traffic flow patterns that arise during an evacuation. Then, they will use an optimal evacuation strategy model to identify the best destinations, routes, flows, departure times, and possible infrastructure improvements.

By linking supply and demand to form an integrated framework, this study will seek to decrease evacuation time and congestion-related accidents, thus potentially increasing the number of lives saved.
As our nation settles into a deep economic crisis, it is more important than ever that transportation agencies use their funding resources wisely. This poses a particular challenge in terms of pavement maintenance, since all pavements inevitably deteriorate over time. Typically, this deterioration occurs at an ever-increasing rate: small distresses develop, making the pavement much more susceptible to larger distresses. This means correcting small pavement defects not only makes the road condition immediately better, but also slows the rate of pavement deterioration by correcting these defects before they can develop into costlier problems. Because of this, pavement maintenance and rehabilitation are crucial to keeping transportation infrastructure safe and cost-effective.

In order to determine where and when to perform this crucial maintenance, State Highway Agencies must first accurately evaluate the structural condition of in-service pavements, preferably through methods that do not damage the road (nondestructive testing). A strong Pavement Management System depends on utilizing nondestructive testing and sensor technologies to accurately estimate pavement geometry and layer material properties. Agencies can then incorporate the pavement’s structural condition, its remaining life for maintenance and rehabilitation purposes, as well as its life cycle cost into their maintenance plans.

The primary means of evaluating the structural condition of pavement is by measuring the surface deflection in response to a load. To obtain this data, a nondestructive Falling Weight Deflectometer
(FWD) is used to simulate the deflection of pavement caused by a fast-moving truck. The FWD generates a load pulse, which is transmitted to the pavement through a circular load plate. This momentarily deforms the pavement underneath into a bowl shape (the deflection basin).

After measuring the extent of surface deflection, researchers then use finite element analysis to backcalculate information on the pavement’s properties. Backcalculation takes a measured surface deflection basin and attempts to match it with the calculated surface deflection basin of a pavement structure with known layer material properties. This allows testers to approximate layer material properties and how the pavement will respond to loading. However, to obtain the maximum amount of information about the pavement’s condition, one must also know the thickness of the individual pavement layers. This poses a problem, since it is difficult to measure the thickness of each layer without utilizing destructive means, such as pavement coring.

**Research Objectives:**

For this NEXTRANS project, researchers have developed an innovative methodology, called SOFTSYS (Soft Computing Based Pavement & Geomaterial System Analyzer) that can evaluate the structural condition of pavement with more accuracy and efficiency. SOFTSYS interprets the results of FWD data in an original way, allowing testers to determine pavement layer properties as well as layer thicknesses from field testing data without the need for destructive methods such as pavement coring. Because SOFTSYS can estimate pavement layer thicknesses in addition to their stiffness properties, it is a much more efficient way to evaluate structural condition. Using only FWD test results as inputs, SOFTSYS calculates all the necessary properties for pavement evaluation. For this purpose, it uses a combination of two soft computing techniques: artificial neural networks (ANNs) and genetic algorithms (GAs).

In addition to completing SOFTSYS, researchers will also compare and verify SOFTSYS results with those of ILLI-PAVE Finite Element (FE) solutions, and validate SOFTSYS against actual field data where Ground Penetrating Radar (GPR) or pavement coring can be used.

The major outcome of the SOFTSYS methodology will be to improve the management of assets in transportation infrastructure. Selecting the type of maintenance required without accurate knowledge of the pavement’s structural condition can lead to costly consequences. This technology ensures that infrastructure renewal and maintenance is being performed when and where it should be, allowing transportation agencies to utilize their resources more effectively and assess pavement condition more reliably in an automated manner.
For almost a decade, investigators have been monitoring The Ohio State University’s Campus Area Bus Service (CABS), which transports three to four million passengers every year. Up until now, this system has operated with a “homemade” communications and information system called BLIS (Bus Location and Information System), which utilizes GPS-based automatic vehicle location (AVL).

Through a joint effort with OSU’s Transportation and Parking (T&P) department, College of Engineering, Department of Civil and Environmental Engineering and Geodetic Science, and Clever Devices, Inc., NEXTRANS investigators are currently working to replace BLIS with a state-of-the-art “smart bus” system. This new system will include advanced automatic vehicle location (AVL), automated passenger counting (APC), and passenger information systems capabilities. It also provides a unique opportunity to develop an infrastructure for transportation research and educational activities: the OSU Campus Transit Lab (CTL).

The research and educational activities of the CTL will relate to the role and impacts of applying emerging information technologies to optimize the performance of public transit systems. The CABS system is attractive for development of the CTL, since it is large enough to serve as a realistic operating environment of a public transit service, yet small enough to allow for more...
detailed system-wide observations.

Researchers are pursuing at least two areas that will rely on the use of CTL data: simulation of bus route operations, and validation/application of transit passenger origin-destination (OD) flow estimation. Simulating bus route operations allows for analysis and improvement of various transit functions, including performance monitoring, operating strategy development, and service provision. Estimating transit passenger OD flows from AVL and APC data provides an opportunity to enhance the quality of transit network design, service planning, route frequency determination, and schedule coordination. Until both of these research activities can rely on CTL data for development, testing, and application, manually collected field data emulating CTL data is being used. Results from this research will provide insights on how to achieve improved transit planning and operations in a cost-effective manner. Such improvements will attract increased ridership to this efficient and sustainable mode of passenger transportation.

In addition to these projects, educational activities are aimed at incorporating CTL data into existing OSU courses. Students may utilize CTL data in courses including civil engineering, statistics, and data analysis for arts and science majors. The technology will also be integrated into educational projects by NEXTRANS partners, either by incorporating CTL data into established courses, or encouraging CTL site visits for NEXTRANS funded students. The course projects and problem sets generated through these educational activities will ground the learning environment in field-based applications, potentially attracting more students to the field of public transportation.
Estimating AADT From Combined Air Photos and Ground Based Data: System Design, Prototyping, and Testing

Investigators: Mark McCord, Prem Goel, The Ohio State University

Average Annual Daily Traffic (AADT) is one of the most fundamental measures of traffic flow. Because of its importance to planning, design, and trend analysis, state DOTs and transportation agencies around the world commit substantial resources to collecting this data. Currently, AADT estimates are largely collected by in-highway traffic counters operated by traffic monitoring crews. In addition to disrupting traffic and placing crews in danger, this system is costly, forcing states with limited resources and large highway infrastructure to collect data on a multi-year cycle.

In response, the investigators of this project have developed an alternative method that combines older, ground-based traffic data with traffic information contained in recent air photos. Since state DOTs and engineering offices collect thousands of air photos for mapping and inventory, there is potentially a massive amount of data available that could be exploited at minimal cost. This project aims to build on previous work by putting this approach to direct use in Ohio. This will confirm the system’s accuracy, evaluate its performance, and help develop an efficient way to use it on a widespread basis. Producing more accurate AADT estimates from existing data will mean fewer expensive, dangerous, and disruptive ground-based traffic counts, increasing mobility and safety while decreasing cost.

Length Based Vehicle Classification on Freeways From Single Loop Detectors

Investigator: Benjamin Coifman, The Ohio State University

Roadway usage, particularly by large vehicles, is one of the fundamental factors determining the lifespan of highway infrastructure. Unfortunately, Weigh in Motion (WIM) and other classification stations are difficult and costly to maintain. Many highways utilize dual loop de-
Detectors to measure vehicle length and classify vehicles based on this measurement. Single loop detectors, on the other hand, can only roughly estimate speed, and thus, length. By conventional means these estimates are too noisy to be used for accurate vehicle classification.

This research seeks to develop a reliable length based vehicle classification algorithm for single loop detectors (and non-invasive detectors that emulate single loop detectors), in which traffic would be sorted into three (or more) bins based on length. Most of the states in Region V already use a large number of single loop detectors to monitor real-time traffic and count vehicles without classifying them. Thus, if researchers are able to provide accurate length-based classification using single loop detectors, existing detector infrastructure could be leveraged to integrate new data at minimal cost. This would allow for more extensive classification abilities in urban areas via the real-time traffic monitoring stations, allowing traffic management systems to better monitor freight traffic in metropolitan centers.

Optimal Conditioning Sampling of Infrastructure Networks

Investigators: Rabi Mishalani, Prem Goel, The Ohio State University

The life-cycle of infrastructure systems (roadways, railways, runways, pipelines) is a complex and dynamic process. Over the past two decades, new non-destructive technologies have been developed to evaluate infrastructure condition, allowing this information to be considered when making maintenance and rehabilitation decisions. However, in order for this information to reduce life-cycle costs, agencies must also consider the cost of inspection, and make smart decisions in terms of condition sampling.

The condition of a field—a section of infrastructure in which condition behaves homogeneously—is determined by collecting samples of damage measurements. However, various sources of uncertainty affect condition information in this sampled data. In order to make the most effective maintenance and rehabilita-
the definition of “homogenous section” is quite rudimentary. This research is expected to provide important improvements in both of these directions, leading to a more robust definition of infrastructure networks.

Pavement Damage Due to Different Tire and Loading Configurations on Secondary Roads
Investigator: Imad L. Al-Qadi, University of Illinois at Urbana-Champaign

Introduced in 2000, wide-base tires offer the trucking industry significant economic advantages over traditional dual-tire systems. These include improved fuel efficiency, increased hauling capacity, reduced tire cost and repair, and superior ride and comfort. They also compare favorably to dual-tire systems in terms of safety and operation, and provide substantial environmental advantages due to decreased gas emissions.

While the newest wide-base tires were designed to minimize pavement damage, researchers have yet to evaluate the type of damage they may cause on secondary roads. This study seeks to address this issue by simulating vehicle loading and predicting pavement responses utilizing the finite element (FE) method. Researchers will develop the necessary finite element models to simulate secondary roads using a three-dimensional (3D) approach. Almost all aspects (model dimensions, element types and thickness, far field simulation, etc.) of the proposed model will be optimized to approach the actual behavior of pavement systems. This includes simulating tread patterns for dual and wide-base tire configurations, incorporating advanced constitutive model for hot-mix asphalt into the FE model, and validating the developed FE models as related to available experimental measurements. Comparing the damage caused by wide-base tires to that caused by conventional dual-tire systems is important due to the rapidly increasing number of these tires being used by trucks in Region V and beyond.

Traffic Flow Characteristics and Capacity in Intelligent Work Zones
Investigator: Rahim Benekohal, University of Illinois at Urbana-Champaign

Every year, bottlenecks created by work zones cost time, money, and lives. Because of this, various Intelligent Transportation Systems (ITS) are implemented in the United States to manage traffic flow in work zones (WZ). These ITS techniques include automated speed photo enforcement, dynamic lane management, variable speed control, and speed or time display. The traffic flow in these ITS-enabled work zones can be different than in regular work zones, due to the new interactions created between drivers and ITS infrastructure.

The goal of this study is to investigate the traffic flow characteristics in intelligent WZ, taking into account the effects of ITS technologies on traffic flow and driver behavior. This will allow researchers to determine more accurate methods for computing work zone delay, speed, capacity, and user cost. To achieve this, a theoretical relationship will be developed based on understanding the complexity of traffic flow characteristics in breakdown/recovery mode...
in WZ bottlenecks, and field data will then be collected and analyzed to examine the validity of the theory. This research will help to reduce congestion and improve safety in WZ, by improving our understanding of how vehicle, driver, and infrastructure interact.

Development of a Finite Element Based Thermal Cracking Performance Prediction Model
Investigators: William Buttlar, Glaucio Paulino, University of Illinois at Urbana-Champaign
In cold-climate regions such as the Midwest, low-temperature cracking of hot-mix asphalt (HMA) continues to be a leading cause of premature pavement deterioration. Recent advances in fracture testing and modeling of HMA materials have provided new insights into the mechanisms behind this cracking, as well as design strategies. These models, however, still have not been implemented into standalone programs that can be easily used by the transportation field at large.

This project extends the scope of an existing study by more explicitly capturing the interactions between vehicle and infrastructure. Researchers will ultimately deliver a user-friendly, computationally efficient program that can be used to analyze and design against thermal cracking in asphalt pavements. This will help prevent unnecessary infrastructure damage in cold regions around the world.

Sensor Network Design for Multimodal Freight Transportation Systems
Investigator: Yanfeng Ouyang, University of Illinois at Urbana-Champaign
As freight movement continues to grow in the Midwest, there is an increased demand for a more efficient and sustainable transportation infrastructure. At the same time, developments in sensing and information technology hold the promise to allow efficient monitoring, assessment, and management of complex transportation systems. The establishment of sensor networks could significantly improve the visibility of freight movements, which would lay the foundation for effective infrastructure planning, traffic management, and congestion relief.

This project aims to investigate the possibility of combining various off-the-shelf sensors to improve granularity and accuracy of traffic data. It will also develop an analytical framework to quantify the benefits and costs of deploying multiple types of sensors, and develop discrete network optimization models that can select optimal sensor locations and communication configuration. This research integrates a broad spectrum of related issues and how they influence one another, including network capacity planning, renewal, expansion, and real-time traffic management. In addition to addressing Region V’s need for a more efficient freight transportation system, it also addresses the urgent national need for intermodal connections amongst existing transportation networks, by employing advanced optimization, information control, and decision-making tools.
A Decision Support Tool for Vehicle Infrastructure Integration: Advancing Data Fusion Algorithms for Traffic Management Applications
Investigator:  Srinivas Peeta, Purdue University
About half of the 43,000 deaths that occur each year on U.S. highways result from vehicles leaving the road or traveling unsafely through intersections (UDOT). Vehicle Infrastructure Integration (VII) is one way to save lives and prevent congestion through the use of technology. A key concept in VII is that (probe) vehicles serve as data collectors and anonymously transmit traffic information to transportation agencies. This information can then be used to implement proactive strategies to increase safety and relieve congestion.

This research seeks to explore vehicle-to-vehicle information networks to understand the interplay between the information communicated and traffic conditions on the network. A longer-term goal is to advance the VII initiative by developing a decision support tool for processing and storing large amounts of real-time (probe) data. Researchers are developing new route guidance strategies and new data fusion algorithms for travel time estimation, which will determine the benefits of information-exchange between vehicles. In addition, this work will have impacts on congestion management through the use of advances in sensor and wireless technologies. By taking into consideration cumulative traffic stream characteristics (speed, flow, and density) and their macroscopic relationships to one other, researchers will be able to better predict and estimate congestion.

Analysis of Travel-Time Reliability on Indiana Interstates
Investigator:  Fred Mannering, Purdue University
Travel-time reliability is a key performance measure in any transportation system, affecting the routes commuters choose and impacting the on-time reliability of freight shipments. In this study, extensive amounts of data are being gathered from interstates in Indiana (specifically Indianapolis-area interstates where extensive real-time data are collected). These data will be used to develop statistical models to estimate travel-time reliability based on explanatory variables (weather, accidents, etc.) as well as time-varying elements associated with recurrent congestion.

The traditional measure of a transportation system’s performance has been a level-of-service (LOS) measure that is largely based on traffic density during peak hours. This research will provide a new basis for monitoring the effectiveness of highway improvements, incident response systems, new vehicle/highway technologies, etc. In addition to the Highway Capacity Manual definition of LOS, roadways may eventually have a separate travel-time reliability rating similar to the traditional A through F scale used to measure LOS. This information would be useful in developing strategies to mitigate congestion and decrease delays due to traffic-influencing events, thus resulting in improved system-wide performance and productivity.
Investigation of Emergency Vehicle Crashes in the State of Michigan

Investigator: Peter T. Savolainen, Wayne State University

Emergency vehicle crashes are particularly problematic in Michigan, which is among four states that account for 37.5% of the country’s ambulance-involved fatalities. One common cause of these crashes is the failure of drivers to identify approaching emergency vehicles in time to react and yield the right-of-way. To combat this, an innovative emergency vehicle alert system (EVAS) was recently installed at three intersections in the City of Dearborn Heights. The EVAS utilizes Vehicle Infrastructure Integration (VII), which allows emergency vehicles approaching an intersection to transmit a signal to the traffic signal infrastructure, activating the device and providing a visual cue warning motorists that an emergency vehicle is approaching.

An evaluation of an EVAS aimed at addressing this particular problem has recently been completed. This project supplements the previous research by providing a comprehensive investigation of emergency vehicle crashes in the State of Michigan to identify other factors contributing to crash occurrence and resultant injuries. Researchers will identify driver, vehicle, and environmental characteristics that affect emergency vehicle crash frequency and severity of injuries. By identifying critical safety factors, these crashes can be reduced through the development of a comprehensive action plan.


Investigators: Srinivas Peeta, Purdue University; Shoe-Ren Hu, National Cheng Kung University

In typical road traffic corridors, freeway systems are generally well-equipped with traffic surveillance systems. These systems, including vehicle detector (VD) and/or closed circuit television (CCTV), are typically used for traffic management purposes and/or to gather timely information for traffic control. However, other facilities in the same traffic corridor, especially arterials and surface streets in the vicinity of the freeway, often lack detector/sensor systems. Since most traffic management frameworks in the literature assume the availability of data on all links of the corridor, this begs the question: How can agencies effectively manage congestion when there is not enough money available to equip all roads with detectors?

The aim of this research is to develop a new mathematical programming framework to identify optimal locations for vehicle detectors (VDs). The strategic installation of VDs will not only aid traffic monitoring, but also provide information to infer network origin-destination (OD) patterns. Through this study, though agencies will not have traffic counts for every link of the network, they can infer OD demand patterns by using strategically placed detec-
This ability to infer traffic flow states for the entire network with limited resources will aid real-time traffic management and control.

**Uncertainty-Based Tradeoff Analysis Methodology for Integrated Transportation Investment Decision-Making**

*Investigator: Samuel Labi, Purdue University*

In the wake of increased travel demand, greater user expectations, and aging infrastructure, transportation agencies are grappling with how to best utilize their funds. Traditionally, investment decisions have been made by analyzing the deterministic outcomes of investments in each program area separately (mobility, safety, pavement or bridge condition, etc.), a strategy that does not always result in globally optimal solutions. What is needed is a multiple-criteria approach that duly considers uncertainties in the decision variables and consequently on project impacts. On the basis of such an approach, agencies can properly investigate the trade-offs (and uncertainties thereof) between different performance measures or program areas, to aid in scenario analysis and decision-making.

This project complements an ongoing Indiana Department of Transportation (INDOT) study, and aims to help transportation agencies arrive at globally optimal decisions where there is uncertainty in the project impact levels due to uncertainty in the decision or input variables. Researchers are working to establish problem contexts and to develop solution algorithms for uncertainty-based decision making and tradeoff analysis. This research will allow transportation agencies to consider all program areas individually while seeking globally optimal solutions, helping to achieve the goal of maximizing utilization of limited resources. In addition, the study results will be expected to serve as a theoretical foundation for future studies that involve higher levels of decision-making, such as how to integrate multiple modes or multiple sectors.
In the wake of increased travel demand, greater user expectations, and aging infrastructure, transportation agencies are grappling with how to best utilize their funds.
As outlined in its theme, the NEXTRANS Center aims not only to develop integrated solutions, but to foster a new generation of paradigms and a highly qualified transportation workforce. As the University Transportation Centers Program stressed in its 2005-2007 Progress Report, transportation is fundamentally about people—the people who conceive, create, manage, and operate our nation’s transportation systems. In order to cultivate the next generation of transportation leaders, the NEXTRANS Center uses the combined resources of its partner universities to educate and attract students at all levels. NEXTRANS provides Center-supported students with interdisciplinary training, holistic thinking skills, and a tech-savvy education that incorporates USDOT education, human resources, and diversity goals.

To ensure that students are provided with both classroom-based and experiential learning opportunities, NEXTRANS graduate assistants conduct extensive research related to the Center’s theme, under the direction of faculty members. The Center also strives to attract talented undergraduate and high school students to its programs and the field of transportation. In its first year alone, NEXTRANS has sponsored a high school intern, recognized students from Crawfordsville High School and Purdue University, and fostered a partnership with Martin University to help diversify the transportation profession by attracting non-traditional students.

Region V Student Highlights, 2007 - 2008

Kalafatas and Peeta Win Best Paper Award at the AATT 2008 Conference

A paper co-authored by NEXTRANS Center Ph.D. student George Kalafatas and Director Srinivas Peeta won the Best Paper Award at the 10th International Conference on Applications of Advanced Technologies in Transportation (AATT 2008) in Athens, Greece. It received the Best Paper Award in Traffic Engineering from among 800 papers from over 25 countries.

The paper, titled “A direct bridge between dynamic traffic assignment and graph theory,” proposed an innovative modeling approach for dynamic traffic systems and operations. The contributions are twofold. From an applications standpoint, traffic systems can be simulated with significantly reduced computational times. This is an important step towards real-time route guidance in congested traffic networks, as crucial estimates for the network status can be provided faster to drivers. From a theoretical standpoint, dynamic traffic systems are modeled with an exact graph theoretic representation. This enables the elegant illustration of the synergy between transportation engineering and graph theory.
NEXTRANS Students Showcase Research Projects

Graduate students from Purdue University, University of Illinois at Urbana-Champaign, and The Ohio State University got an opportunity to showcase their research projects to RITA Administrator Paul Brubaker and other federal, state and private sector officials and faculty attending the NEXTRANS Summit on May 5, at Purdue University. In addition to describing the problem statement, methodology, goals and objectives, and significance and benefits of the project, students were asked to indicate which research dimensions of the Center were being addressed.

Eleven students participated: five from Purdue and three students each from the University of Illinois at Urbana-Champaign and The Ohio State University. The posters highlighted the diverse project portfolio of the NEXTRANS Center showcasing the integration of goals, methodology, and technology, covering the issues of mobility, safety and infrastructure renewal, and addressing regional and national needs in transportation and logistics. Names of participating students, institutional affiliation and the title of the poster are provided in Table 3 below.

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<th>Student Name</th>
<th>Institution</th>
<th>Title of Poster</th>
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<td>Qiang Bai</td>
<td>Purdue</td>
<td>Analysis of Trade-offs in Highway Project Selection for Integrated Asset Management</td>
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<td>Cheng Chen</td>
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<td>OSU</td>
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<td>Anuj Sharma</td>
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<td>Improving Signal Operations by Modeling the Driver’s Mental Conflict on the onset of Yellow</td>
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<td>M. Wang</td>
<td>UIUC</td>
<td>Effects of Speed Photo Enforcement on Speeding in Work Zones</td>
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<tr>
<td>Fanyu Zhou</td>
<td>OSU</td>
<td>Incorporating Aerial Image-Based Information in AADT Estimation</td>
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Anuj Sharma’s Poster on Traffic Signal Strategies, Presented at NEXTRANS Inaugural Summit

**NEXTRANS Graduate Students:**

- Anwaar Ahmed, OSU
- Kivanc Avrenli, UIUC
- Qiang Bai, Purdue
- Sarah Brechbill, Purdue
- Cheng Chen, OSU
- Eshan Dave, UIUC
- Indrajit Ghosh, Wayne State
- Salvador Hernandez, Purdue
- Yu-Ting Hsu, Purdue
- Yuxiong Ji, OSU
- George Kalafatas, Purdue
- Seoungbum Kim, OSU
- Ho Lee, OSU
- Sophie Leon, UIUC
- Xiaopeng Li, UIUC
- Maria Martchouk, Purdue
- Onur Pekcan, UIUC
- David Perkis, Purdue
- Justin Quear, Purdue
- Craig Rismiller, Purdue
- Anuj Sharma, Purdue
- Amit Singh, Purdue
- Brandon Srohl, OSU
- Hao Wang, UIUC
- M. Wang, UIUC
- Fanyu Zhou, OSU
UIUC Sweeps FAA Design Challenge for Airport Operations and Maintenance

On June 2, 2008, the Federal Aviation Administration (FAA) Design Competition for universities announced the award winners for the Airport Operation and Maintenance Design Challenge. Students from the NEXTRANS Center’s major partner, the University of Illinois at Urbana-Champaign (UIUC) won first, second, and third prizes in this category.

The selection was made by a panel of FAA, industry, and academic experts. The winners were:

**First Place:** “Long-Lasting Pavement Structure Rehabilitation: Hot-Mix Asphalt Overlay with Steel Reinforcement Netting Interlayer System” by Hao Wang and Jonguen Baek (Advisor: Imad Al-Qadi)

**Second Place:** “Aircraft Wander Effects on Unbound Aggregate Layers” by Phillip Donovan (Advisor: Erol Tutumluer)

**Third Place:** “A Fast and Automated Approach for Monitoring Groove Deterioration at Airport Pavements” by Hasan Ozer (Advisor: Imad Al-Qadi)

(Courtesy: Illinois Center for Transportation)
Approximately fifty-five percent of the gasoline in the United States is consumed by passenger vehicles traveling “the last mile” in the global supply chain. There are many reasonable and feasible alternatives to meeting transportation needs of this “last mile” besides gasoline powered passenger vehicles. Moreover, increased urbanization is significantly increasing the opportunities for replacing single passenger vehicles with alternative transportation powered by renewable energy.

Against this backdrop, Purdue undergraduate engineering students in Professor Larry Nies’ class were charged with developing a conceptual design for a transportation system for a large urban area that is exclusively powered by renewable energy collected locally (within 100km). The students were divided into fifteen teams, with five teams each assigned to work on the Greater Metropolitan areas of Chicago, Houston and Seattle. The task was to analyze the current transportation system in these areas and provide a conceptual design for meeting the transportation and transportation energy needs for the year 2050.

The designs were entered into a poster competition on March 3rd which was on display at the Purdue Memorial Union. Posters were evaluated for the quality of the analysis and assessment of the transportation needs, clarity of the presentation, and feasibility of the design. The teams with the best posters in each group were invited to present at the NEXTRANS Inaugural Summit on May 5 and receive “Achievement in Sustainable Design” awards and certificates from Administrator Paul Brubaker.
National Merit Scholar Completes Internship at the NEXTRANS Center

NEXTRANS is pleased to congratulate its first high school intern, Jim Caraher. Jim graduated in the Spring of 2008 from Crawfordsville High School, where he was Salutatorian of his class. At Crawfordsville, he was involved in the National Honor Society, Math and Science Teams, Tech Club, Libro Club, French Club, and Chess Club. He played soccer and track, and advanced to the state finals this year in the 800m run. Jim is a National Merit scholar and has also been awarded an Elks State Scholarship, the David Wells Science Award, and Purdue’s prestigious Stephen C. Beering Scholarship.

For his NEXTRANS Internship, Jim assisted graduate student Sal Hernández, a Ph.D. Candidate in Purdue’s Civil Engineering Program, in conducting research to identify innovative, collaborative approaches to help carriers maximize the utilization of their truck capacities. Their research involved disseminating surveys that will be used to develop new operational models that can help LTL carriers enhance capacity utilization in order to increase revenue.

Jim recently began his undergraduate studies at Purdue and plans to major in Engineering. He will continue working with Sal Hernández, in conjunction with NEXTRANS, throughout his Freshman year.

Problem Based Learning (PBL) Project Links Students to Transit Challenge

A few years ago in 2005, it came to the attention of Crawfordsville High School (CHS) students and Helen Hudson, their English teacher, that the local train station, which few seemed to know about, was abysmally run-down even though an Amtrak train passed through each morning (to Chicago) and each evening (en route to NYC). The students, whose laptop computer grant mandated them to take on a problem-based learning project, saw their opportunity. During the first Spring, the students cleared off scores of bags of trash and planted a garden where the junky trash, weeds and scrub trees had been. They made plans to repaint the station and brought the opportunity to use public transportation to the community’s notice. Since then, classes taught by Hudson have continued to pitch in by putting up a welcome sign, cultivating a garden on the site, and replacing the station’s floor.
The students and their teacher, Hudson, received local and regional awards for their work. In 2006, a group of students traveled to Washington D.C. to present their projects for the National Association of Rail Passengers. They received the National Association of Railroad Passengers’ Youth Leadership Award, an award only given twice in 40 years, and also spent time lobbying for legislation that would provide much-needed funding to Amtrak. During the Fall of 2006, they were honored with Amtrak’s Champion of the Rails award. The students have written editorials, organized Crawfordsville Rides the Train public awareness trips, and continued to care for the little Crawfordsville Amtrak station and the adjacent garden that they have landscaped and planted. The classes have also made efforts to promote rail travel closer to home. Their most recent effort, “C’ville Rides the Train,” is a weekend trip to Chicago to encourage Crawfordsville residents to take the train more often. Since the beginning of the project, the number of people riding the train from Crawfordsville has gone up by as much as 33 percent.

At the NEXTRANS Inaugural Summit, students from Hudson’s class participated by presenting a poster about the history of the project, setting up a display booth featuring their awards and honors, and attending the day’s sessions on transportation challenges and solutions. Their booth and presentations drew keen interest and broad attention from the Summit participants. Chelsea DeLarm, a member of the group, received special recognition from RITA Administrator Paul Brubaker for her work going above and beyond the call of duty.

Helen Hudson explains project accomplishments.
Approximately fifty-five percent of the gasoline in the United States is consumed by passenger vehicles traveling "the last mile" in the global supply chain.
The goal of the NEXTRANS Center’s technology transfer program is to make the results of research available to potential users in a form that can be directly implemented, utilized or otherwise applied. Two key elements of technology transfer include transferring knowledge to transportation professionals, and creating opportunities for commercialization of research results. In addition to the new knowledge presented in the classroom, transportation professionals are informed of the findings of the Center through reports, seminars, workshops, published papers, newsletters, and the NEXTRANS website.

**Technology Transfer Highlights**

**Integrated Solutions Case Studies Presented at Purdue Road School**

Held at Purdue since 1914, the Purdue Road School consistently attracts well over 1,000 Indiana local and state officials, consultants, and suppliers each year. During the 94th annual conference held this year during March 24-26, an all-time record of 1,730 attendees was set. NEXTRANS Center participated in the conference by setting up a display booth featuring its research and programmatic activities while disseminating information about its upcoming events.

The Center also organized a session titled, “Integrated Solutions for Transportation: Perspectives and Practice.” Presided by the Center’s Managing Director Mahmud Farooque, the session began with a conceptual overview from NEXTRANS Director Srinivas Peeta highlighting how integrated perspectives can lead to better transportation decision-making. His presentation was followed by case studies in the areas of on-demand air transportation and portfolio analysis, presented respectively by Purdue Professors Daniel DeLaurentis (Aeronautics and Astronautics Engineering) and Samuel Labi (Civil Engineering). An interactive dialogue between the presenters and the audience followed, focusing on additional examples and other potential applications.
The fifth annual Indiana Logistics Summit was held in Indianapolis on September 25-26, 2007, with more than 300 participants attending. Key presenters included Governor Mitch Daniels, former U.S. Secretary of Transportation Norman Mineta, Interim Purdue Provost Vic Lechtenberg, and Michael Gallis of Michael Gallis Associates.

The conference was an opportunity for Purdue University to demonstrate its expertise in the sector of transportation, distribution and logistics (TDL). The sponsors of the Summit included Purdue University, the Ports of Indiana and Conexus Indiana.

The Summit featured presentations by members of industry and academia, including representatives from Purdue, Indiana University, Ivy Tech and Vincennes University.

In his presentation titled “NEXTRANS Center: Objectives and Mechanisms for Collaboration in
Logistics,” NEXTRANS Director Srinivas Peeta discussed the background, quick stats, vision, organization and theme of the new Center. He also discussed the Center’s major regional goals, including:

- Developing a secure and efficient intermodal freight transportation and logistics system.
- Examining transportation/logistics related to the agricultural economy and biofuels.
- Relating USDOT’s VII initiative to the rejuvenation of the auto and ancillary industries.
- Exploring transportation opportunities related to very light jets.

Director Peeta proceeded to outline the Center’s collaboration potential for logistics. This entails leveraging the Center as a platform for coordinated actions, a partner for research proposals and projects, a consultant for technical and strategic issues, and a venue for providing national visibility for transportation issues and opportunities.

NEXTRANS Center Seminar Series Brings Scholars to Purdue and OSU

On April 1, 2008, Professor Shinya Kikuchi, Charles E. Via Jr. Professor of Civil and Environmental Engineering, Virginia Tech, delivered the inaugural lecture of the NEXTRANS Seminar Series at Purdue’s School of Civil Engineering. In a talk entitled “Making Decision, Judgment, and Adjustment under Unclear Circumstances in Transportation Analysis,” he spoke to a standing room only crowd of students from the transportation engineering program and faculty from the Schools of Civil Engineering, Industrial Engineering and Computer Science Department.

Professor Kikuchi talked about how transportation planning decisions usually take place in vague, multi-objective and multi-constraint environments, in which priorities are not clearly defined. Decisions in this environment must be sensible to the desire of each stakeholder, and as such, the mathematical process should be faithful to the concerns of each stakeholder as much as possible. The lecture included a discussion of the issues of uncertainty in transportation analysis, followed by a presentation of the proposed optimization scheme (fuzzy optimization) that incorporates the concerns of the stakeholders in a conversational manner. Kikuchi spent time with students, faculty and staff after the presentation for a question and answer session.
On April 22, 2008, **Professor Hani Mahmassani**, William A. Patterson Distinguished Chair in Transportation at Northwestern University, visited Purdue to give a talk on “Regime Change: Uncongesting Traffic Flow through Dynamic Pricing and Real-Time Information.”

His talk highlighted the role of pricing and real-time information in the management of transportation networks and delivery of transportation services. Mahmassani discussed methodological implications and approaches for both off-line evaluations of these strategies as well as real-time operational decision-making in this context. Following the talk Professor Mahmassani interacted with faculty and students to exchange views and provide further elaboration.

On June 5, 2008, **Professor Yoram Shiftan**, Technion, Israel Institute of Technology, visited with faculty and students at The Ohio State University to deliver a lecture titled, “The Use of Activity-Based Modeling to Analyze the Effect of Land-Use and Public Transport Policies on Travel Behavior.”

Advances in the study of travel behavior have led to the development of activity-based models that treat travel as a derivation of the demand for personal activities. In Professor Shiftan’s talk, an improved activity-based approach was illustrated through a case study based on the Portland activity-based model combined with a stated-preference residential choice model. It indicated that the use of utility-based accessibility measures to integrate models of residential choice, workplace, and auto ownership with a full activity-based model has the potential to further improve our understanding of the impact of land-use policies on travel behavior and the effectiveness of such policies.
Government, Industry, and Academia Engage in Dialogue For Integrated Solutions at the NEXTRANS Inaugural Summit

Technology transfer was one of the major goals of the NEXTRANS Center’s Inaugural Summit, held on May 4, 2008 (See page 16). The Summit convened with an ambitious purpose: to explore, identify, develop, and pursue lines of engagement that transcend the traditional modes of interaction between government, industry, and academia. Traditional partnerships and collaborations between these sectors are limiting, and insufficient when facing the transportation challenges of the future. The diversity and magnitude of these challenges points to a need for multi-pronged, linked, and long-term strategies. These integrated and holistic approaches must take advantage of technological innovations, economic opportunities, and foster active engagement with stakeholders in the public, private, and nonprofit sectors.

Each component of the NEXTRANS Inaugural Summit was designed to project multiple perspectives into the same problem-solving space. Of course, bringing these voices together is only the beginning of designing solutions that can be sustained over time. Over the course of the day, the Summit program transitioned from broad to specific, steering stakeholders towards the goal of yielding an integrated research agenda for the NEXTRANS Center.

Multiple Perspectives at the NEXTRANS Inaugural Summit

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<td>• Regional Planning Agencies</td>
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<td>Parallel Sessions</td>
<td>Integrated Solutions in Transportation – Intermodalism, Integration Across Goals, Leveraging Technology, Public-Private Partnerships</td>
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The afternoon portion of the program aimed to foster a three-way dialogue. After the moderator provided an overview of the discussion topic, representatives from government, industry, and academia each gave presentations that addressed a set of five questions. The interactive discussion that followed identified major challenges, opportunities, potential points of collaboration, and new topics for research initiatives.

**Government-Industry-Academia Focus Group Flow Chart**

- **Integration of Modes**
- **Integration Across Goals: Safety, Mobility and Infrastructure Renewal**
- **Integration of Technology**
- **Integration of Public-Private Partnership**

- What do you see as the future challenges in the subject of discussion from your perspective?
- Which of these challenges do you perceive requires a holistic perspective, a systems approach and integrated solutions?
- Where do you see the greatest need and opportunity for government-industry-academia partnership?
- Given the multiple dimensions involved, how should integrated solutions change the way we approach transportation and logistics problems and challenges?
- What gaps do you see in terms of research in this context and what role University Transportation Centers can play in filling them?
The salient points from each panel discussion were then introduced in the summary session, which examined common challenges and opportunities, especially in terms of intermodalism, integration, technology, and public-private partnerships. This discussion further justified the NEXTRANS Center’s integrated approach of explicitly capturing the interactions between vehicle, traveler, and infrastructure, while recognizing the opportunities that can be leveraged through technology, partnerships, investments, and innovation.

**Major Challenges and Opportunities Highlighted in the Parallel Sessions**

The NEXTRANS Inaugural Summit successfully achieved a number of technology transfer goals, and helped redraw the lines of engagement necessary to change our regional and national transportation systems. Together, the perspectives provided by industry, government, and academia provided a robust landscape of prospects from which new research, education, and outreach opportunities can be designed to advance the NEXTRANS Center’s mission.

This Inaugural Summit proved to be one of the Center’s major first-year achievements, establishing not only the goals of the NEXTRANS Center, but also the dialogues and partnerships it will take to achieve them.
Integrated and holistic approaches must take advantage of technological innovations, economic opportunities, and foster active engagement with stakeholders in the public, private, and nonprofit sectors.
Resources Consulted

Bureau of Economic Analysis (BEA), U.S. Department of Commerce (DOC), Washington, D.C.
Available: http://www.bea.gov/

Economic Research Service (ERS), U.S. Department of Agriculture (USDA), Washington, D.C.

Available: http://www.eia.doe.gov/


“Indiana Multimodal Freight & Mobility Plan,” Indiana Department of Transportation, Indianapolis, IN, October 2007.
Available: http://www.in.gov/indot/5475.htm

“Moving at the Speed of Congestion: The True Costs of Traffic in the Chicago Metropolitan Area,” Metropolitan Planning Council, Chicago, IL, August 2008.

“Pavement Interactive,” University of Washington.

Research and Innovative Technology Administration (RITA), U.S. Department of Transportation, Washington, D.C.

Texas State Energy Conservation Office (SECO), Austin, TX.
Available: http://www.seco.cpa.state.tx.us/


“Vehicle Infrastructure Integration Fact Sheet,” U.S. Department of Transportation, Intelligent Transportation Systems (ITS), Washington, D.C.