



# **Northwestern University Transportation Center**



## **NUTC 2010 Progress Report**

# DIRECTOR'S MESSAGE



Northwestern has a long and distinguished tradition in transportation research and education. Among the first in the world to recognize transportation as an interdisciplinary field, the Transportation Center was founded at Northwestern in 1954. It has since played a key role in defining the field through fundamental as well as application-driven and industry-relevant research, along with excellent educational programs that continue to produce transportation leaders in academia, industry, and government. The distinction attained by our alums over the years is the best testimonial to the profound impact that the Center has exerted on the transportation field and the transportation industry over the past half century.

Over its history, the Center has gone through several cycles of leadership, with different foci for research and education, reflecting topical concerns and changing economic, social, and political concerns. However, two things have remained constant: (a) close engagement with the transportation industry, and (b) the overarching quality and commitment of the students who are the core mission of our programs. This is very much still the case today, as the tradition lives on, and the Center continues to renew itself and engage faculty and students with new perspectives on old and new problems.

Transportation remains at the intersection of several major issues and challenges for our society. Energy and sustainability, economic growth and development, quality of life in congested cities, deteriorating infrastructure, constrained financial resources, and inefficient institutional structures are among the litany of concerns voiced by citizens and officials alike in industrialized as well as less industrialized nations. All these have transportation at their core— sometimes as part of the problem, always very much part of the solution. Against these challenges, there is no shortage of opportunities— through emerging technologies affecting all aspects of transportation supply, advanced methodologies, novel operational and management concepts, and increasingly diverse models and platforms for service delivery. In addition, the strong interconnection and inexorable convergence between physical and virtual mobility (*telemobility*), call for novel paradigms and approaches to moving people, goods, and information.

Addressing these high-level strategic problems is part of the Center's mission, while continuing to advance the state of fundamental and applied knowledge in areas of traditional strength. With over 50 faculty affiliates from all parts of Northwestern's world-class programs, the Transportation Center offers a unique think-tank and laboratory for cutting-edge research "that matters" on a global scale. With its strong industry engagement and international orientation, it is an ideal academic partner for high-impact collaborative research with government institutes and industry R&D units.

There is a never dull moment for transportation researchers, and no shortage of opportunities for intellectual and professional engagement through the Transportation Center. This progress report is intended to highlight some of the recent accomplishments of our faculty and student researchers, and the broad scope of activities conducted by our Center in research, education, outreach and industry engagement.

Beyond world-class and field-defining research, the Transportation Center is first and foremost about *community*—a community of students and faculty, of researchers and dedicated staff members, loyal alums, our industry partners through the Business Advisory Committee (BAC), our special interest groups in aviation (*Icarus Society*) and rail (*Sandhouse Gang*), and a growing network of collaborators and friends in the region and around the world. We hope that this progress report will convey the vibrancy, diversity, and inclusiveness of this community, and as such further contribute to strengthening the connection with our wider constituency. I hope you enjoy browsing and reading through it as much as we enjoyed conducting the activities it highlights.

Sincerely,



Hani Mahmassani  
Director  
Northwestern University Transportation Center  
William A. Patterson Distinguished Chair of Transportation



# FACTS AND FIGURES

1712

The year that the oldest item in the Transportation Library's collection, *The General History Of The Highways: In All Parts Of The World, More Particularly In Great Britain* was published

56

The number of faculty who are part of NUTC

74

The number of companies part of NUTC's Business Advisory Committee

1954

The year the NUTC was founded

30

The number of academic and industry-related seminars hosted by NUTC in 2009-10

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# CENTER OVERVIEW

The Northwestern University Transportation Center (NUTC) is recognized as a leading interdisciplinary education and research institution serving industry, government and the public through a comprehensive research agenda, academic degree programs, executive education programs, and an array of outreach activities. NUTC is a collective asset of Northwestern University, the United States, and the worldwide transportation community.

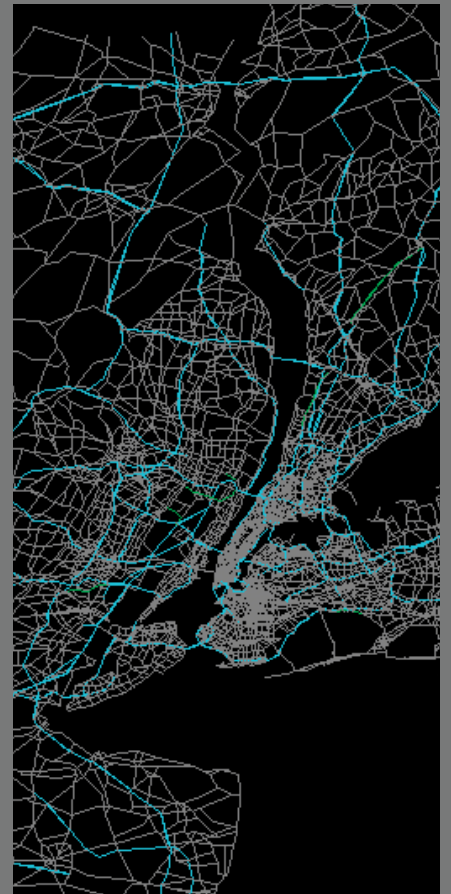
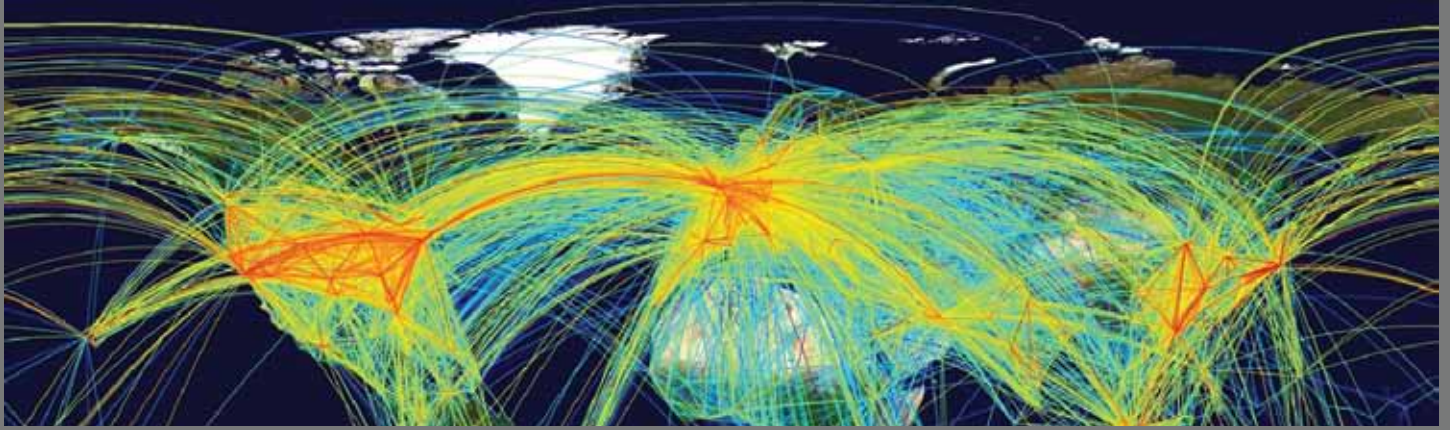
Since its inception in 1954, the Center's mission has been to make substantive and enduring contributions to the movement of materials, people, energy, and information and in so doing influence national and international transportation policy, management, operations and technological developments. The pursuit of the Center's mission is rooted in its interdisciplinary approach to transportation and logistics education and research. The strength of the Center lies in the quality and productivity of its faculty, its focus on both scholarly and applied research, and an awareness of and responsiveness to the continual changes impacting the transportation and logistics industries.

**“It was revolutionary when it was conceived. It is a very dynamic environment.”**

Hani Mahmassani

NUTC exists to develop and share improved understanding of the economics and science of transportation and logistics systems. The Center brings together academic researchers, students, business affiliates, and others in open exploration of ways to make transportation and supply chain operations more productive, efficient, safe, secure, environmentally friendly, and socially beneficial.





# SYNERGISTIC CENTERS

The Center's effective role in educating the university community and promoting awareness of transportation-related research needs and opportunities has led to a breadth and depth of activity in transportation-relevant subjects that is unmatched on any university campus. These programs and centers provide enhanced opportunities for students and faculty to learn about and engage in a wide range of subjects affecting the complex and diverse transportation industry. The activities they generate are open to the campus community, and generally to the transportation community beyond Northwestern. These activities contribute to a rich intellectual and professional experience in virtually all aspects of transportation systems research and education. Examples of NUTC's synergistic programs and centers are below.

## Infrastructure Technology Institute (ITI)

ITI is a University Research Center of Excellence supported by the US Department of Transportation, Research, and Innovative Technology Administration. Its theme is to develop strategies and tools to protect and improve the condition, capacity, and performance of the nation's highway, railroad, and mass transit infrastructure systems. Researchers at ITI develop advanced methods for monitoring infrastructure condition and performance to assist owners and operators with critical decisions concerning structural integrity, renewal, and rehabilitation.

## Initiative for Sustainability and Energy (ISEN)

ISEN is an umbrella organization at Northwestern University designed to create, advance, and communicate new science, technology, and policy for sustainability and energy. Its particular focus is on sustainable energy supply, demand, and use. Its goal is to integrate the University's efforts in energy, sustainability, and outreach. Argonne National Laboratory is ISEN's primary research partner.

## Northwestern Institute for Complex Systems (NICO)

NICO is an institution that brings together scholars from across the university to study complex, emergent behavior of systems of interdependent actors.



## Institute for Sustainable Practices

This partnership between Argonne National Laboratory and Northwestern will facilitate joint research and educational initiatives to achieve sustainability in human and ecological systems. The institute's scope encompasses energy and other natural resources, and its work will include development of tools for assessing and monitoring sustainability.

## Center for Energy Efficient Transportation

The Center for Energy Efficient Transportation engages in fundamental research in the physical sciences aimed at enabling the development of energy-efficient vehicles.

## Center for Operations & Supply Chain Management (COSCM)

Based in the Kellogg School of Management, COSCM studies operational research questions in supply chains and other business contexts. It offers executive education and other programs that consistently rank among the nation's best.



## The Transportation Library

The Transportation Library was founded in 1958 to support NUTC's curricula and research programs. Containing over 450,000 items, the Transportation Library of Northwestern University is one of the largest transportation information centers in the world, encompassing information on all transportation modalities, including: air, rail, highway, pipeline, water, urban transport and logistics. It also includes a significant collection on law enforcement, police management, and traffic enforcement. Its collection of environmental impact statements is one of the most complete in the world.

The Transportation Library's staff produce TRANweb, a web-based periodical index of transportation and law enforcement articles and conference proceedings. Researchers from around the world, in the fields of transportation, law enforcement, and environmental impact assessment are encouraged to use the Transportation Library in accordance with its policies and procedures.



Published in 1712, *The General History of the Highways: In All Parts of the World, More Particularly in Great Britain*, is the oldest item in the Transportation Library's collection.

## CCITT Center for the Commercialization of Innovative Transportation Technology

Moving Research to Realization for Surface Transportation

During the past year, NUTC became the home for the Center for the Commercialization of Innovative Transportation Technology (CCITT). Launched at Northwestern in 2006, CCITT is part of a nationwide University Transportation Center program operated and funded by the Research and Innovative Technology Administration of the U.S. Department of Transportation. CCITT's mission is to foster the commercialization or implementation of innovative technologies for multiple modes of surface transportation including, but not limited to, railways, mass transit, highways and waterways. To accomplish this mission, CCITT awards funding to Northwestern faculty to conduct late-stage research projects that reduce technical risk barriers that stand in the way of technology adoption by industry and transportation agencies.

A diverse array of innovative solutions to transportation challenges have been completed and proposed, such as: super-tough steel for transportation infrastructure in

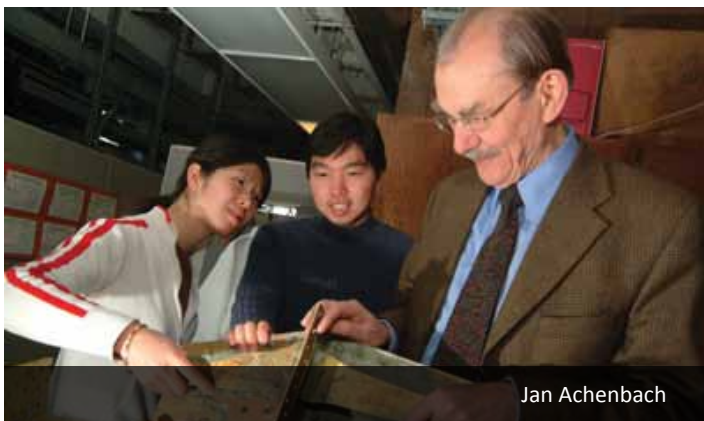
extreme cold environments and tank cars transporting cryogenic liquids; reliable route guidance software for intelligent traffic systems (ITS); fiber optic devices for structural health monitoring of bridges; intelligent compression of traffic video data for ITS; business intelligence software for improved rail maintenance operations; video traffic analysis detection software for abnormal event detection; and software logistics models to improve disaster relief operations.

Key numbers:

- Projects funded – 9
- Faculty members engaged – 10
- Departments – 5
- Students supervised – 13
- CCITT funding – \$546,000
- Cost matching – \$665,000



# FACULTY AFFILIATES AND RESEARCH



Jan Achenbach

## Jan D. Achenbach

Walter P. Murphy and Distinguished McCormick School Professor of Mechanical Engineering and Applied Mathematics; Former Director of the Center for Quality Engineering and Failure Prevention  
Airworthiness assurance of aircraft structures; ultrasonic methods in quantitative nondestructive evaluation; fracture mechanics

## Henry Binford

Associate Professor of History and Urban Affairs, Weinberg College of Arts and Sciences  
Urban historian specializing in the evolution of subcommunities within cities; redevelopment of cities; history of transportation relating to growth of cities

## David E. Boyce

Adjunct Professor of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science; Professor Emeritus of Transportation and Regional Science, University of Illinois-Chicago  
Urban travel and location forecasting models; transportation network analysis and modeling; history of urban travel forecasting methods and practice

## Ronald R. Braeutigam

Associate Provost for Undergraduate Education; Harvey Kapnick Professor of Business Institutions; Professor of Economics, Weinberg College of Arts and Sciences  
Applied microeconomic theory and industrial organization; regulatory economics

## Dirk Brockmann

Associate Professor of Engineering Sciences and Applied Mathematics and Northwestern Institute on Complex Systems, McCormick School of Engineering and Applied Science  
Physics of Complex Systems; complex networks; human mobility networks; spatial disease dynamics; social networks; anomalous diffusion processes; stochastic processes; pervasive computing

## Fabián E. Bustamante

Associate Professor of Electrical Engineering and Computer Science, McCormick School of Engineering and Applied Science  
Design, deployment and evaluation of large-scale distributed systems in both wide-area and mobile networks; experimental systems, in particular operating systems and distributed computing

## Clarke L. Caywood

Professor of Integrated Marketing Communications, Director of Graduate Program in Corporate Public Relations, Medill School of Journalism  
Marketing and communications; crisis management and communications; stakeholder relationship management; political and deceptive messages and advertising

## Roger Chen

Post-Doctoral Fellow, NU Transportation Center, McCormick School of Engineering and Applied Science  
Travel demand forecasting; dynamics of user behavior; complex systems; analysis of activities; transportation sociology; environmental, climate and health impacts

## Wei Chen

Professor of Mechanical Engineering, McCormick School of Engineering and Applied Science  
Engineering design; optimization under uncertainty; demand modeling; computational design methods; decision-making; automotive engineering

## Sunil Chopra

IBM Distinguished Professor of Operations Management & Information Systems, Kellogg School of Management  
Supply chain management and operations; design of communication and distribution networks; supply chain risk

## James G. Conley

Clinical Professor of Technology, Kellogg School of Management; Professor of Industrial Engineering and Management Sciences, McCormick School of Engineering and Applied Science  
Product design and development technologies; intellectual property strategies; intellectual capital; innovation management



Noshir Contractor

## Noshir Contractor

Jane S. & William J. White Professor of Behavioral Sciences; Professor of Industrial Engineering & Management Science, Communication Studies and Management & Organizations, Kellogg School of Management  
Social and knowledge networks; theories, statistical and computational methods; organizational theory

## Anne Coughlan

Professor of Marketing, Kellogg School of Management  
Distribution channel management and design; pricing strategy; reverse channels for product returns; competitive strategy

**David A. Dana**

Dean for Faculty and Research, Northwestern University School of Law  
 Environmental and land use law, regulation and policy (e.g. methods of allocating carbon credits; regulation and technological change in the automobile industry; eminent domain reform and urban sprawl)

**Irina S. Dolinskaya**

Assistant Professor of Industrial Engineering and Management Sciences, McCormick School of Engineering and Applied Science  
 Optimal path finding; analysis of dynamic systems and networks; large scale and computationally demanding dynamic programming problems; applications include vessel, autonomous vehicles and robot routing

**Jing Dong**

Post-Doctoral Fellow, Transportation Center, McCormick School of Engineering and Applied Science  
 Transportation network analysis; real-time traffic operations; dynamic pricing; intelligent transportation systems

**David C. Dunand**

James N. and Margie M. Krebs Professor of Materials Science and Engineering, McCormick School of Engineering and Applied Science; Co-director of Initiative for Sustainability and Energy at Northwestern (ISEN)  
 Light-weight metallic materials (alloys, composites, foams and sandwiches) for energy-efficient transportation; high-temperature alloys for energy-efficient internal-combustion and jet engines

**Pablo Durango-Cohen**

Associate Professor of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science  
 Transportation infrastructure management; modeling and analysis of production control systems; capacity management; statistical performance modeling; contract analysis and design

**Steven Franconeri**

Assistant Professor of Psychology Director of Undergraduate Studies, Cognitive Science, Weinberg College of Arts and Sciences  
 Guidance and capture of visual attention and awareness; visual cognition; object tracking

**Aaron J. Gellman**

Professor of Transportation, The Transportation Center, McCormick School of Engineering; Adjunct Professor of Management & Strategy, Kellogg School of Management  
 Transportation management, economics and policy; aviation management; regulation; financial analysis; the management of technology and innovation; technology forecasting

**Robert J. Gordon**

Stanley G. Harris Professor in the Social Sciences, Weinberg College of Arts and Sciences  
 Macroeconomic theory; monetary theory; airline economics; airline management; airline history; airline customer experience

**Kimberly A. Gray**

Professor of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science  
 Urban sustainability; brownfield and urban redevelopment; environmental impacts of transportation on ecological and human health; energy efficient technology

**Brian Hanson**

Associate Director of the Roberta Buffett Center of International and Comparative Studies; Lecturer in Political Science, Weinberg College of Arts and Sciences  
 International political economy; globalization; international trade; the changing role of the state in world politics.

**Paul M. Hirsch**

James L. Allen Distinguished Professor of Strategy and Organizations; Chair, Management and Organizations Department, Kellogg School of Management  
 Organizational change; mass communication; the sociology of culture

**Joel Horowitz**

Charles E. and Emma H. Morrison Professor of Market Economics, Weinberg College of Arts and Sciences  
 Econometrics; travel demand modeling; urban transportation; air quality

**Thomas N. Hubbard**

John L. & Helen Kellogg Professor of Management and Strategy, Kellogg School of Management  
 Industrial organization; trucking industry; economics of strategy; applied econometrics; economics of technology

**John C. Hudson**

Professor of Anthropology; Director of the Geography Program; Associate Director of Environmental Sciences Program, Weinberg College of Arts and Sciences  
 Cultural and physical geography of North America; biogeography; economic geography; cartography and mapping; geographic information systems

**Albert Hunter**

Professor of Sociology; Director of Urban Studies, Weinberg College of Arts and Sciences  
 Transportation in urban areas; public policy; urban sociology; community; ethnicity, culture and literature; methods



Karen Smilowitz (page 13)



Diego Klabjan (page 12)

# FACULTY AFFILIATES AND RESEARCH

## **Arthur P. Hurter**

Professor Emeritus of Industrial Engineering and Management Sciences, McCormick School of Engineering and Applied Science

Logistics; applied microeconomic analysis; routing and risk analysis; facility locations; plant and equipment investment and replacement

## **Seyed Irvani**

Associate Professor of Industrial Engineering and Management Sciences, McCormick School of Engineering and Applied Science

Stochastic modeling and analysis; production and logistics; optimization of queueing systems; manufacturing and supply chain management; white collar work and service operations systems; analysis of integrated production and maintenance policies

## **Bret Johnson**

Associate Director of the NU Transportation Center; Director of the Center for the Commercialization of Innovative Transportation Technology (CCITT); McCormick School of Engineering and Applied Science

Technology transfer and commercialization; technology based economic development; space and technology innovation policy

## **Richard Joseph**

John Evans Professor of International History and Politics; Roberta Buffett Center of International and Comparative Studies, Weinberg College of Arts and Sciences; Senior Fellow, The Brookings Institution  
Growth, governance, and sustainable development; comparative democratization; African politics; HIV prevention strategies; energy, environment and transportation

## **William L. Kath**

Professor of Engineering Sciences & Applied Mathematics, Neurobiology and Physiology Center for Photonic Computing and Communication; Co-Director of Northwestern Institute on Complex Systems

Computational neuroscience; fiber optics; wave propagation; nonlinear dynamics; complex systems

## **Diego Klabjan**

Associate Professor of Industrial Engineering and Management Sciences, McCormick School of Engineering and Applied Science

Business intelligence and analytics in air transportation, logistics, railway industry, retail, and supply chain management

## **Frank S. Koppelman**

Professor Emeritus of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science

Travel demand modeling and prediction; yield management; urban, regional and intercity transportation planning; development of advanced travel demand modeling concepts and methods

## **Raymond J. Krizek**

Stanley F. Pepper Professor of Civil & Environmental Engineering; Director of Master of Project Management Program, McCormick School of Engineering and Applied Science

Injectability & mechanical properties of grouted sands; disposal of waste slurries; problems involving soil-structure interaction; engineering behavior of dredged materials; dynamic response of soils

## **Pei Wei Lin**

Research Associate to the NU Transportation Center, McCormick School of Engineering and Applied Science

Traffic simulation; traffic safety



Hani Mahmassani

## **Hani S. Mahmassani**

William A. Patterson Distinguished Chair in Transportation; Director, NU Transportation Center

Multimodal systems planning and management; dynamic network modeling and optimization; user behavior dynamics; real-time freight and logistics systems; telemobility

## **Therese McGuire**

ConAgra Foods Research Professorship in Strategic Management; Professor of Management & Strategy; Director, Guthrie Center for Real Estate Research & Real Estate Management Program

State and local public finance; fiscal decentralization; property tax limitations; education finance; regional economic development

## **Leon N. Moses**

Professor Emeritus of Economics, Weinberg College of Arts and Sciences  
Applied microeconomic analysis; logistics and transportation economics; economics of regulation safety and risk; urban and regional economics

## **Barry L. Nelson**

Charles Deering McCormick Professor of Teaching Excellence; Chair, Department of Industrial Engineering & Management Sciences, McCormick School of Engineering & Applied Science

Computer simulation of dynamic; stochastic systems; design and analysis of simulation experiments



Yu (Marco) Nie

## **Yu (Marco) Nie**

Assistant Professor of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science

Network optimization; traffic flow theory; traffic simulation



**Maciek Nowak**

Assistant Professor of Information Systems and Operations Management, Graduate School of Business, Loyola University Chicago  
 Vehicle routing and tracking; supply-chain management; operations research and management; logistics and data analysis; quantitative methods; heuristic search

**John C. Panzar**

Professor Emeritus of Economics, Weinberg College of Arts and Sciences  
 Theoretical and policy issues relating to network industries (telecommunication, electric transport, air transport and postal services); industrial organization; regulatory economics; applied microeconomic theory

**Kalyan Raman**

Professor of Integrated Marketing Communications, Medill School of Journalism; Professor of Marketing, Kellogg School of Management  
 Integrated Marketing Communications, Marketing Mix Optimization Issues; sales force compensation; brand name recall and implications for advertising and market structure; pricing; diffusion models; supply chain management; reference prices; customer relationship management

**Mark A. Ratner**

Professor of Chemistry, Weinberg College of Arts and Sciences; Co-Director, Initiative for Sustainability and Energy at Northwestern (ISEN)  
 Organic electronics and photovoltaics; energy storage materials, particularly electrochemical; energy concentration routes, including exciton fission; agent-based modeling of complex systems

**Kathryn Reid**

Research Assistant Professor of Neurology, Northwestern Feinberg School of Medicine  
 Impact of sleep loss and circadian disruption on human performance; health and safety with emphasis on the impact of shiftwork

**Ian Savage**

Associate Chair, Department of Economics; Distinguished Senior Lecturer, Weinberg College of Arts and Sciences  
 Transportation safety; transportation economics; urban transit

**Joseph L. Schofer**

Associate Dean for Faculty Affairs; Professor of Civil and Environmental Engineering; Director of Infrastructure Institute of Technology, McCormick School of Engineering and Applied Science  
 Urban transportation policy planning; data information and decision making in transportation; traveler behavior and market research; intelligent transportation systems; pedestrian and motor vehicle safety



Joseph Schofer

**Karen Smilowitz**

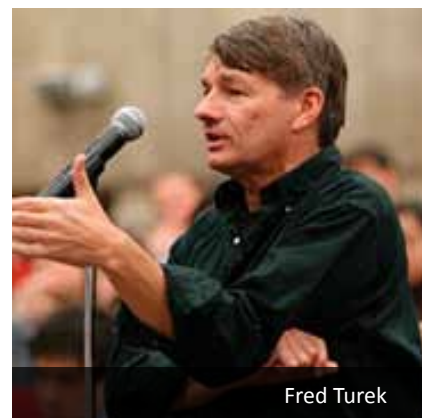
Junior William A. Patterson Professor of Transportation; Associate Professor of Industrial Engineering and Management Sciences, McCormick School of Engineering and Applied Science  
 Design and operations of logistics network; vehicle routing and scheduling; supply-chain management; applications in commercial and non-profit settings

**Joseph A. Swanson**

Clinical Professor of Finance, Kellogg School of Management; President, Jos. Swanson & Co.  
 Corporate bankruptcy; econometrics; investment banking; mechanism design; regulation; transportation

**Fred W. Turek**

Director of Center for Sleep and Circadian Biology; Charles E. and Emma H. Morrison Professor of Biology, Department of Neurobiology & Physiology, Weinberg College of Arts and Sciences  
 Investigation of circadian rhythms and their importance to human health, safety, performance and productivity; relationship between abnormal sleep-wake cycles on fatigue and alertness in the workplace and transportation industry



Fred Turek

**Jan A. Van Mieghem**

Harold L. Stuart Professor of Managerial Economics; Chair of Department of Managerial Economics & Decision Science; Professor of Operations Management, Kellogg School of Management  
 Operations management and strategy; supply-chain management and analysis; management and investment under uncertainty (e.g. pricing and dynamic control of stochastic processing networks)

**Michael D. Whinston**

Robert E. and Emily H. King Professor of Business Institutions; Co-Director, Center for the Study of Industrial Organizations, Department of Economics, Weinberg College of Arts and Sciences  
 Industrial organization; antitrust and regulation; incentives; microeconomic theory; and game theory

**Dengfeng Yang**

Post-Doctoral Fellow, NU Transportation Center, McCormick School of Engineering and Applied Science  
 Network optimization and telecommunications

**Kuilin Zhang**

Post-Doctoral Fellow, NU Transportation Center, McCormick School of Engineering and Applied Science  
 Multimodal network equilibrium and optimization; travel demand analysis and discrete choice models; rail-based intermodal freight transportation systems; congestion pricing; simulation of large-scale complex systems

# FACULTY AWARDS

## INVESTITURE OF NEW CHAIRS

### Wei Chen

Wilson-Cook Chair Professor in Engineering Design  
McCormick School of Engineering and Applied Science

## AWARDS AND APPOINTMENTS

### Jan Achenbach

2010 Theodore von Karman Medal, American Society of Civil Engineers  
World Class Universities Fellow, Korean Ministry of Education, Science and Technology  
Mindlin Medal, American Society of Engineers  
Honorary Foreign Member, National Academy of Sciences of the Republic of Korea

### David Boyce

Honorary Member, Japan Section of the Regional Science Association International

### Fabian Bustamante

National Science Foundation CAREER Award Recipient

### Dirk Brockmann

Young Scientist for Socio- and Econophysics, German Physical Society Physics of Socio-Economic Division

### Wei Chen

Chang Jiang Scholar, Chinese Education Ministry  
Executive Committee Member, Chair of Technical Committees, ASME Design Engineering Division  
Member, National Academy on Mathematical Foundation of Verification, Validation, and Uncertainty Quantification

### David Dunand

TMS-SMD Distinguished Scientist/Engineer Award, 2009  
James N. and Margie M. Krebs Professorship

### Pablo Durango-Cohen

Faculty CAREER Development Program Award Recipient,  
National Science Foundation

### Robert Gordon

Member, LUISS University International Group on Economic Policy

### Paul Hirsch

President, Western Academy of Management

### Hani Mahmassani

2010 Outstanding Intelligent Transportation Systems Application Award, Institute of Electrical and Electronics Engineers (IEEE)  
Chair, 2011 Second International Conference on Evacuation Modeling

### Yu (Marco) Nie

Louis Berger Junior Professor, Northwestern University

### Ian Savage

Member, National Research Council Committee for the Review of the Federal Railroad Administration's Research and Development Program

## FELLOWS OF SOCIETIES

### Don Norman

Fellow, Design Research Society

### David Boyce

Fellow, American Society of Civil Engineers

### Mark Ratner

Fellow, American Chemical Society

## ENDOWED AND KEYNOTE LECTURES

### Jan Achenbach

Plenary opening lecture, Korean Society of Non-Destructive Testing

### Hani Mahmassani

Keynote lecture, "Evacuation plan design: objectives, formulations and algorithms," ICEM 2009 International Conference on Evacuation Modeling

Plenary lecture, "Network models and transportation system intelligence: challenges and opportunities," Transport and Crowd Management Forum 2010, Hajj Research Institute

Plenary lecture, "Developments in integrated modeling of activity-travel demand and dynamic network flows," 3rd TRB Conference on Innovations in Travel Modeling

Keynote lecture, "Taming volatility in the route market: the case for intelligence," Dynamic Route Guidance and Coordinated Traffic Control Workshop, National Science Foundation and Rutgers University

## NOTEWORTHY ACHIEVEMENTS

### Clarke Caywood

Research on leading brands in the US was cited by the federal trademark courts as critical evidence in a national brand protection case for the agricultural industry

### Irina Dolinskaya

Co-organized seminar on Humanitarian Logistics for the Dean's Centennial Seminar Series, McCormick School of Engineering and Applied Science, Northwestern University

### Robert Gordon

Co-organized conference "Cornucopia Quantified: The Economics of New Goods," Centre for Economic Policy Research

### Hani Mahmassani

International Advisory Committee, TRB-INRETS joint conference on "Does Traffic Data Support Traffic Models?" Annecy, France  
Scientific Committee, IEEE Conference on Intelligent Transportation Systems and Controls (ITSC 2010)  
Co-Chair, Transportation Operations and Safety Scientific Theme, 2011 1st T&DI Congress Steering Committee, American Society of Civil Engineers

### Maciek Nowak

Invited Presentation "Incorporating Operational Complexity in the Periodic Vehicle Routing Problem," Production and Operation Management Society

### Michael Whinston

Leverhulme Trust Visiting Professorship at Oxford University

### Ian Savage

Co-Chair of the World Conference on Transport Research's special interest group on safety analysis and policy, and a member of the organization's Scientific Committee  
Co-organized the sessions on safety at the 2010 World Conference on Transport Research which featured 64 papers in thirteen sessions  
Invited guest editor for special issue on safety in the journal *Research in Transportation Economics*

### Karen Smilowitz

Organized a symposium on "Doing Good with Good OR" at the American Association for the Advancement of Science's 2011 Annual Meeting

### Joseph Schofer

Chair, Special Policy Project Committee on Strategies for Improved Passenger and Freight Travel Data, Transportation Research Board, National Academies  
Chair, Special Policy Project Committee on Equity Implications of Alternative Transportation Finance Mechanisms, Transportation Research Board, National Academies  
Host, The Infrastructure Show, a podcast show about US infrastructure



# COLLABORATION HIGHLIGHTS

Joseph Schofer organized the "2nd Annual William O. Lipinski Symposium on Transportation Policy"

Karen Smilowitz organized a symposium on "Doing Good with Good OR" at the American Association for the Advancement of Science's 2011 Annual Meeting

Argonne Transportation Analysis Group  
 -Workshop under new Initiative for Sustainability and Energy at Northwestern (ISEN)  
 -Researcher seminars and visits

Illinois Center for Transportation (UIUC)  
 Strategic coordination and partner on projects with Illinois Department of Transportation (IDOT)

David Boyce organized the "Symposium on Transportation Network Design and Economics Honoring Martin Beckmann" at NUTC

Bret Johnson and NUTC co-organized Illinois Governor's "Beyond Transportation: The Economic Impact of Rail in Illinois" Summit

Aaron Gellman testified before Congress on the United Airlines-Continental Airlines Merger

Clarke Caywood's research on leading brands was cited by the federal trademark courts as critical evidence in a brand protection case for the agricultural industry

Hani Mahmassani is working with the US DOT Federal Highway Administration's weather-related traffic management research program

Industry Research Partners  
 Boeing, Coyote Logistics, Echo Global Logistics, FedEx, Ingram Barge, Norfolk Southern, Philips, Ryder



Federal Government

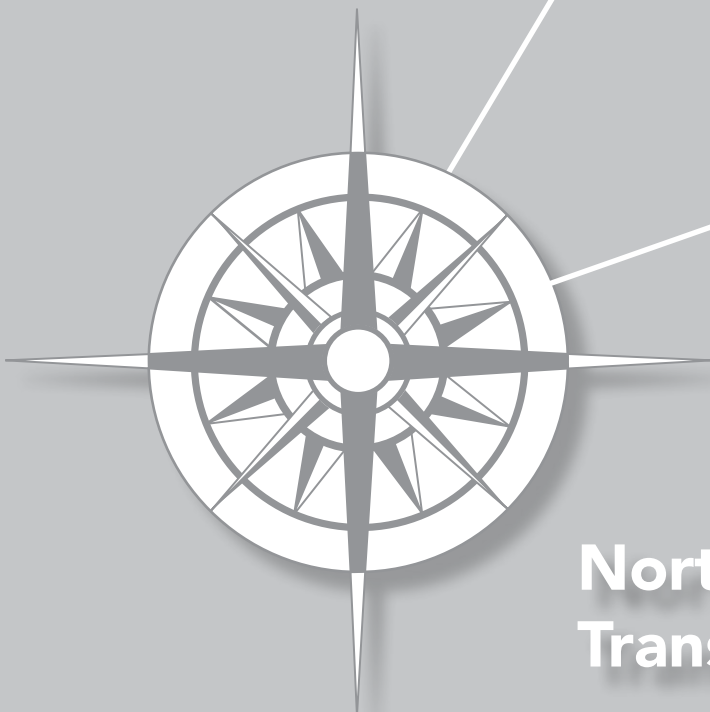
Regional Activities

Local & State Government

Industry Research

Local Government  
 -City of Lake Forest, Illinois  
 -Chicago Metropolitan Agency for Planning (CMAP)  
 -Regional Transportation Authority (RTA)  
 - Chicago Transport Authority (CTA)

State Government  
 -Governor of Illinois' Office  
 -Chicago Region Environmental and Transportation Efficiency Program (CREATE)  
 -Illinois Department of Transportation (IDOT)  
 -Illinois Tollway Authority



## Northwestern University Transportation Center

Hani Mahmassani chairs the Second International Conference on Evacuation Modeling (ICEM 2011) organized by NUTC

Hani Mahmassani served on International Advisory Committee of the TRB-INRETS joint conference on "Does Traffic Data Support Traffic Models?" in Annecy, France

Ian Savage, member of Scientific Committee of the World Conference on Transport Research, co-chairs the special interest group on safety analysis and policy and co-organized the conference's sessions on safety in Lisbon, Portugal

Robert Gordon serves as one of eight members on the LUISS University International Group on Economic Policy

## Symposia, Conferences, & Committees

Robert Gordon co-organized the conference "Cornucopia Quantified: The Economics of New Goods" in Barcelona, Spain

Hani Mahmassani served on Scientific Committee of the IEEE Conference on Intelligent Transportation Systems and Controls (ITSC 2010) in Madeira, Portugal

Four NUTC faculty participated in the TRISTAN Triennial Symposium on Transportation Analysis in Tromso, Norway

Jan Achenbach presented plenary open lecture at the Korean Society of Non-Destructive Testing

NUTC is providing technical assistance to the Ministry of Transport in the Kingdom of Saudi Arabia in developing a national Transportation Research Center

Aaron Gellman serves on the Panama Canal Authority Advisory Board

## International Agencies



Hani Mahmassani organized the Strategic Research Workshop for the Hajj Research Institute's Center for Research Excellence in Crowd Transport in Jeddah, Kingdom of Saudi Arabia

## International Activities



# EMERGING CHALLENGES

Research at the NU Transportation Center is driven by major challenges facing the transportation industry and modern society. Transportation is the lifeblood of the economy, and mobility is a critical determinant of quality of life in the world's cities and regions. Mobility, safety, environment, energy, and security have been at the forefront of the policy agenda for transportation agencies for many years; competitiveness, globalization, collaboration, uncertainty, and technological change are major drivers of strategic and operational decision-making for the transportation enterprise.

The portfolio of research projects and activities at NUTC is dynamically evolving to anticipate, identify, and characterize significant challenges and problem areas faced by the transportation industry, in both private and public sectors (and increasingly at their interface). Faculty and student researchers work together with industry and agency partners at devising methodologies to analyze these problems, formulate strategies, design solutions, and eventually work towards engaged implementation and evaluation. Building on the core strengths of its faculty researchers, enhanced through collaborative arrangements with other research centers and entities, the NU Transportation Center has identified eight emerging challenge areas:

- Re-inventing the user experience in transportation
- Transportation energy and sustainability: Technology, economics, markets, and behavior
- Humanitarian logistics
- System Intelligence in transportation
- Designing interventions in transportation: Behavior change
- Coping with disruptions and extreme events
- Freight mobility and intermodalism for global competitiveness
- Telecommunications and mobility: the evolving connection

Diverse in scope, these areas share the following characteristics: (1) impact on society and/or industry; (2) fundamental and methodological challenges; (3) cross-disciplinary; and (4) strategic dimension. As such, they form the focus of current collaborative and strategic initiatives with industry, mission agencies and other research entities. This report highlights three of the emerging challenges.

## Reinventing the User Experience in Transportation

Our everyday experience with travel and transportation appears to have reached all-time low. Just as one thinks highway congestion cannot possibly get any worse, it does, and more time is wasted, fuel burned, and meetings, possibly flights, are missed. Travel by air, once considered an experiential luxury, has long ago become a prime opportunity for extended delays, cancellations, and cramped seats, before it got compounded by the baffling stages of progressive humiliation through security screening. Public transportation, essential to the mobility of many in large cities around the world, frequently subjects its users to long and unpredictable waits under inclement weather. Freight service is subject to disruption and delay due to a variety of factors, increasing logistics costs and interfering with timely supply chain operations.

Yet in many other realms of personal consumption, new technologies and devices continue to please and delight consumers. Through clever design and a keen focus on the user experience, personal communication devices have become virtual hubs for social interaction, instant connectivity



and context-specific information, and common products (e.g., coffee) have become the center of community oases, succeeding at providing, paradoxically, personalization to a mass audience. Might there not be something to be learned for transportation system providers from the approach followed by leading companies that have succeeded in these other realms of the everyday user experience?

Drawing upon the lessons of highly successful consumer products and service concepts, reinventing the user experience might call for rethinking the very definition of the output of a transportation system, or of the nature of the service provided by a transportation company. This means rethinking the total





experience—from origin to final destination, recognizing that travel is part of a more elaborate activity pattern, and exploiting the contribution of personal communication and information devices and technologies in that process. This kind of thinking calls for a multidisciplinary perspective that blends the creative contributions of product/service designers, the insight of behavior researchers, along with the skills of planners and transport system specialists.

The next wave of intelligent transportation system development holds the promise of customization and personalization—delivering information and services that better meet individual conditions and user preferences. NUTC researchers, for example, are devising novel operating concepts and advanced methodologies that provide the intelligence required for flexible real-time operation of transport systems, and can deliver personalized information to travelers. NUTC researchers have also teamed up with the designers at the internationally renowned Bruce Mau Design firm, based in Chicago and Toronto, and the Institute of Massive Change (led by Bruce Mau) in addressing the challenge of reinventing the public transit user's experience. Still in its initial stages, the effort is in discussion with major transit properties to serve as a laboratory for testing the team's ideas, as well as with selected private companies with interest and innovation capability in this arena.

On the freight side, quality-of-service issues are paramount to system users and logistics managers. Tracking technologies have made considerable inroads in certain segments of the industry, enabling visibility through all stages of the transport process and beyond. Companies that take a complete logistics perspective are able to provide market responsiveness while controlling cost. Electronic platforms that dynamically match loads with carrier assets are transforming some sectors of the industry. NUTC researchers are partnering with selected BAC member companies in pushing the frontier in freight service design and reliability through advanced methodologies that

exploit real-time tracking and transaction records to better design and control all aspects of the transportation and logistics process.

Leading this effort at NUTC is Dr. Hani Mahmassani, with involvement of researchers at the Segal Design Institute at Northwestern. Other researchers include Drs. Marco Nie, Joseph Schofer, Noshir Contractor, and Wei Chen.

## Humanitarian Logistics

The devastation caused by the 2010 earthquake in Haiti was compounded by the significant logistical challenges of distributing relief to those in need. The urgency and magnitude of the needs under extreme conditions are matched only by the primitive nature of the methods and approaches used to meet these needs. Advances in information technologies, optimization techniques, networking power, and the decision sciences have yet to be applied to the critical and most challenging problems that arise in disaster relief distribution operations. These problems further differ in substantial and substantive ways from those that are addressed under “normal” conditions—they are more chaotic, highly time-sensitive, fall under incomplete or non-existent information, occur in rapidly changing environments, require difficult and ethically challenging trade-offs, and must be deployed in an organizational void with uncoordinated, decentralized, and unsupervised agents.

Researchers at Northwestern are bringing modern optimization techniques, information systems and the decision sciences to



the challenging classes of problems that arise in the planning and deployment of relief operations under extreme conditions.

Currently, faculty are studying several core optimization problems in disaster relief, including distribution of relief supplies, evacuation planning in advance of disasters, optimal staging and management of evacuation operations of vehicles and crowds during and after a disaster. The researchers are also studying classes of online distribution and logistics problems with direct applicability to the kind of dynamic environments encountered in relief operations. The researchers see an opportunity to bring together a cluster of faculty throughout the Northwestern campus from the McCormick School of Engineering and Applied Science, the Kellogg School of Management, the Medill School of Journalism, and the School of Communication to synthesize these research efforts. Over time the core areas of study will expand to address problems related to infrastructure diagnosis, repair and management, information and communication technologies (e.g., role of ad hoc reconfigurable networks), policy, ethics, as well as medical care delivery.

Junior William A. Patterson Chair in Transportation Karen Smilowitz (Industrial Engineering and Management Science), will lead this initiative with help from William A. Patterson Chair Hani Mahmassani (Civil and Environmental Engineering), Marco Nie (Civil and Environmental Engineering), Pablo Durango-Cohen (Civil and Environmental Engineering), Irina Doliskaya (Industrial Engineering and Management Science), Fabian Bustamante (Electrical Engineering and Computer Science), David Corr (Structural Engineering), Clarke Caywood (Integrated Marketing Communications), Noshir Contractor (Industrial Engineering and Management Science; Communication Studies; Management & Organizations), Paul Leonardi (Industrial Engineering and Management Science; Communication Studies), and Sarang Deo (Managerial Economics & Decision Sciences).



## Transportation Energy & Sustainability

In the United States, transportation activities account for approximately thirty percent of overall carbon emissions. The desire to reduce this contribution and decrease reliance on uncertain fuel supplies drive the recent surge in transportation energy and sustainability related research. Engineering and science-oriented research on production processes of alternative fuels needs to be augmented with analysis of systemic impacts and consequences for transportation and the economic/societal systems it supports. New technologies benefit from appropriate government policies and bear many uncertainties spanning from financial and investment to governmental and infrastructure related.

Affiliated faculty members at Northwestern utilize a variety of analytical (data mining and forecasting), decision-making and route modeling, optimization and information technology skills to the topics of market adoption, infrastructure building, carbon footprint accounting, life-cycle analysis, and supply chain management. NUTC faculty is experienced in both developing and applying numerous operational, economic, and financial models to solve diverse energy, environmental systems, economics, and policy problems. Northwestern University Transportation Center faculty members have substantial expertise in the development of new materials benefiting transportation energy efficiency. NUTC also works closely with two programs on campus: the Initiative on Sustainability and Energy at Northwestern (ISEN) led by affiliated faculty members David Dunand and Mark Ratner; and the Center for Energy Efficient Transportation (CEET) led by affiliate faculty member Harold Kung. During the 2009-10 year, NUTC and ISEN co-hosted a workshop, *The Greening of Transportation: The Benefits, Risks & Unknowns*, and discussed various actions being undertaken by industry to achieve sustainable transportation operations.

The emerging research area of transportation sustainability and energy engages several faculty researchers including Diego Klabjan, Pablo Durango-Cohen, Joseph Schofer, Hani Mahmassani, and Frank S. Koppelman.

# CORE RESEARCH AREAS

Research at the Center is oriented toward analytic and empirical studies focusing on transportation and logistics systems and the development of advanced methods for systems and network planning, management, and operations. Through research, the Center's objective is to support the development of new insights, concepts, and tools which can be utilized by industry, business, and government to support more efficient and responsive transportation services and systems.

The ongoing research work of the Center is centered around several broad areas of investigation including:

- Logistics and Supply Chain Management
- Network Modeling and Planning
- Transportation Demand, Economics and Forecasting
- Transportation Asset Management
- Transportation Policy
- Human Performance and Transportation Safety
- System Operations

The next few pages will highlight selected recently completed or ongoing studies in each of these areas.

## Logistics and Supply Chain Management

*Global Dual Sourcing: Tailored Base-Surge Allocation to Near- and Offshore Production*

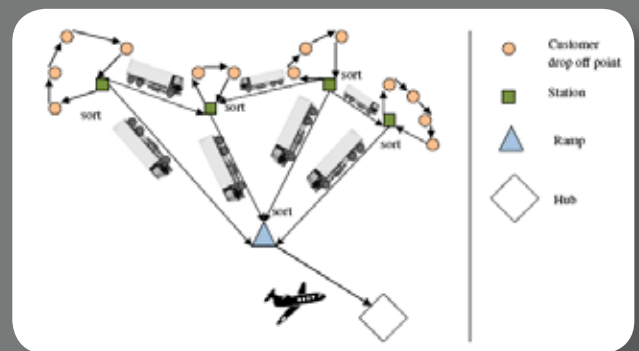
Gad Allon, Jan A. Van Mieghem

Van Mieghem and Allon sought to untangle a real-world dilemma that many businesses face: designing an optimal sourcing strategy when choosing between two global suppliers, one low-cost but distant and sluggish, the other expensive but near and nimble. When designing a sourcing strategy in practice, a key task is to determine the average order rates placed to each source because that affects cost and supplier management. The researchers considered a firm that has access to a responsive nearshore source (e.g., Mexico) and a low-cost offshore source (e.g., China). The firm must determine an inventory sourcing policy to satisfy random demand over time. Unfortunately, the optimal policy is too complex to allow a direct answer to the researchers' key question. Therefore, the team analyzed a tailored base-surge (TBS) policy which splits demand allocation into base and surge demands. The constant base allocation allows the offshore facility to focus on cost efficiency, whereas the nearshore facility's quick response

capability is utilized only dynamically to guarantee high service. The research goals were to (i) determine the allocation of random demand into base and surge capacity, (ii) estimate corresponding working capital requirements, and (iii) identify and value the key drivers of dual sourcing. The team presented performance bounds on the optimal cost and prove that economic optimization brings the system into heavy traffic. Van Mieghem and Allon also analyzed the sourcing policy that is asymptotically optimal for high-volume systems and presented a simple "square-root" formula that was insightful to answer the researchers' questions and sufficiently accurate for practice, as was demonstrated with a validation study.

*Intra Market Optimization for Express Package Carriers with Station to Station Travel and Proportional Sorting*  
Luke Schenk, Diego Klabjan

The flow of packages and documents in collective groups, called splits, of an express package carrier consists of picking up the packages at customers' locations by a courier and bringing them to a station for sorting. Next the splits are transported either in bulk or by containerized conveyances to a major regional sorting facility called the ramp. In this work, the research team focused on the afternoon and evening operations related to stations and the ramp. Klabjan and Schenk dealt with the sorting decisions at the stations

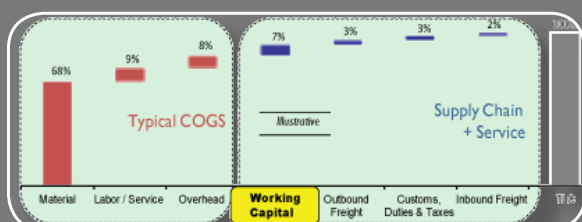


and the ramp, as well as the transportation decisions among these locations. The team has developed an analytics-based information system based on state of the art optimization techniques. The solution methodology employed is based on an intricate model capturing complex business and engineering requirements, and it substitutes a laborious process based on judgmental assessments of engineers. The system was tested on several instances from an international express package carrier. The researchers' solutions are substantially better than the current best practice.

*The Period Vehicle Routing Problem with Service Choice*

Michal Tzur, Peter Francis, Karen Smilowitz, Maciek Nowak and Tingting Jiang

The North Suburban Library System (NSLS) delivers interlibrary loan materials to libraries in the Illinois suburbs north of Chicago. The NSLS approached researchers at Northwestern to address critical operational and budget constraints on their interlibrary loan operations at a time of stagnant funding and increased demand. The project spanned several years with a team of faculty, graduate and undergraduate students. This work led to





the development of a new variation of a vehicle routing problem in the operation research literature. The period vehicle routing problem (PVRP) is a variation of the classic vehicle routing problem in which delivery routes are constructed for a period of time (for example, multiple days). Researchers considered a variation of the PVRP in which service frequency is a decision of the model. They refer to this problem as the PVRP with service choice (PVRP-SC). Researchers also explored modeling issues that arise when service choice is introduced and suggested efficient solution methods. Contributions are made both in modeling this new variation of the PVRP and in introducing an exact solution

method for the PVRP-SC. In addition, the researchers proposed a heuristic variation of the exact method to be used for larger problem instances. Computational tests show that adding service choice can improve system efficiency and customer service. They also presented general insights on the impact of node distribution on the value of service choice. Jan Hayes, NSLS Assistant Director, noted that the project allowed NSLS to “expand our knowledge and understanding of principles and practices which has helped us in the long term with making decisions” and “NSLS was able to implement some changes almost immediately.”



## Transportation Network Modeling and Planning

### *Toward More Reliable Mobility: Improved Decision Support Tools for Transportation Systems*

Yu (Marco) Nie, Hani Mahmassani (funded by the National Science Foundation)

Urban transportation systems are affected by uncertainties of various sorts, such as accidents, extreme weather, man-made disasters, special events, and random travel and activity behavior. Taken individually or in combination, these factors could adversely affect and perturb the quality of transportation services. In particular, travel behavior researchers have established that unanticipated long delays on highways typically produce much worse frustration among motorists than “predictable” ones. Integrating travel reliability into transportation network analysis methods thus presents a pressing challenge that has motivated this research. To address this challenge, this project aims to develop a coherent theoretical and methodological framework that includes the following components:

- Stochastic dominance, a well-developed theory in economics and finance, is adapted to model travelers’ risk-taking behavior in route choice, part of a unified approach to decision-making under uncertainty in transportation systems.
- Theoretically-justified and observationally-

validated stochastic performance models, developed to describe and predict the distributions of travel times in highway networks.

-Advanced routing algorithms designed to help drivers choose routes with random travel times.

-Novel mathematical models to account for uncertainty in travel times, to capture its effects on how travelers make travel decisions (route, departure time, mode, etc.), and to evaluate its implications for overall performance and service quality of transportation infrastructure.

Case studies will be conducted using actual data for a testbed regional network to demonstrate and assess the use of these new analytical tools to predict future system performance, thereby supporting reliable planning and operations decisions.

Ultimately, the research will contribute to enhanced urban mobility and better quality of life through better time use and more efficient activity participation and scheduling. The results from this research will be integrated into teaching through different forms (curriculum development, teaching tools, case studies, etc.) and thereby contribute to the training members of the future transportation workforce. Through this project, a web-based application of reliable route guidance will be developed and made available to other researchers and the general public. Potentially, this tool will benefit numerous motorists and freight carriers and increase the public awareness on travel reliability issues.

### *Incorporating Reliability Performance Measures in Operations and Planning Modeling Tools*

Hani Mahmassani (funded by Strategic Highway Research Program, SHRP-2, in collaboration with Delcan, Inc. and PB Americas, Inc.)

The objectives of this research are to advance the state of the art in planning and operations models to produce measures of reliability performance of proposed system changes, as well as to determine how travel demand forecasting models can use reliability measures to produce more realistic estimates of travel patterns. This project draws upon Mahmassani’s previous work with PB Americas Inc. on Improving Our Understanding of How Highway Congestion and Pricing Affect Travel Demand, also funded by SHRP-2. This project develops approaches and tools to incorporate reliability as an input, and a key output, in traffic models used for both operations and planning applications.



The researchers have proposed a unifying framework for reliability analysis, applicable in conjunction with any particle-based micro- or meso- simulation model that produces trajectories. Vehicle trajectories are a central building block in this framework. Demonstration of the methodology uses a simulation-based Dynamic Traffic Assignment platform. In addition, to capture travel time variability introduced by random events, a repeatable framework is in development for modeling and evaluating incidents and events. Traffic flow breakdown, modeled as an inherently stochastic event with structural dependence on state variables

of the system, is a key variability-inducing phenomenon. The reliability-improving measures highlighted in this work include information supply and dynamic pricing. Effectiveness increases considerably when applied in real-time on the basis of predicted conditions. The research presents possible applications of travel time reliability in operations-oriented models.



## Transportation Demand, Economics, and Forecasting

### *Modeling Household Activity-Travel Interactions as Parallel Constrained Choices*

John P. Gliebe and Frank Koppelman

The daily activity-travel patterns of individuals represent all the trips and stops (for work, school, recreation, etc.) for all household members. In many households, the actual activity patterns include interactions with other household members in the form of joint activity participation (eating or shopping together) and shared rides. Explicit representation of joint activity patterns is a widespread deficiency in all or almost all operational activity travel pattern models and remains a relatively underdeveloped area of travel behavior research. In this research, Koppelman and Gliebe identified multiple cases of joint activities and/or trips which are represented in spatially defined tour patterns found in weekday household survey data. Patterns that include such joint activities or travel are the result of inter-agent decision making (in this case, decisions of the adults in a household).

Using pairs of household decision makers as subjects, the team developed a structural discrete choice model that predicts the

separate, parallel choices of full-day tour patterns by both persons, subject to constraints imposed by their joint selection of one or more joint activities or trips including the option of no interaction. The researchers applied this model to the household survey data, drawing inferences from the household and person attributes that prove to be significant predictors of joint pattern choices. Examples of these attributes include commitment to work schedules, auto availability, commuting distance, and the presence of children in the household. Parameterization of an importance function in the models shows that in making joint activity-travel decisions, significantly greater emphasis is placed on the individual utilities of workers relative to non-workers and on the utilities of women in households with very young children. The model and methods are prototypes for tour-based travel forecasting systems to represent the complex interaction between household members in an integrated model structure. Inclusion of these joint patterns can dramatically influence the sensitivity of travel patterns to changes in transport policies and services.

### *Improving our Understanding of How Pricing and Congestion Affect Travel Demand*

Hani Mahmassani funded by Strategic Highway Research Program, SHRP-2; in collaboration with PB Americas, Inc.)

The National Academy of Science awarded this project to PB Americas, Inc. with Mahmassani as co-principal investigator, to

model user responses to pricing, congestion and reliability of travel time in planning tools. The study completed an inventory of available datasets to support the research, and demonstrated an integrated application of user response models with a simulation-based DTA platform for the New York region Best Practice Model network. The research can be conceptualized in three interconnected levels of behavioral rigor and practical application, with varying levels of sophistication:

Level 1 – Behavioral Foundations: the first level is intended for a deep understanding and quantitative exploration of travel behavior. These models seek to address the full range of possible short and long-term responses, with particular focus on route, departure time and mode choice dimensions.

Level 2 – Advanced Operational: the second level relates to relatively advanced, yet operational, Activity-Based (AB) models, integrated with state of the art DTA (Dynamic Traffic Assignment) models. These models allow for the incorporation of a wide range of possible short- and long-term responses that are embedded in the choice hierarchy. The integrity of operational models requires that each and every choice dimension be allocated a proper “slot” in the hierarchy, with upward and downward linkages to related choices. Operational/computing time requirements often limit the total number of choice dimensions and alternatives, but this restriction is lessening with time.

Level 3 – Opportunities for Prevailing Practice: the third level relates to existing model systems used by most metropolitan planning organizations and state departments of transportation, in the form of aggregate trip-based models (frequently referred to as 4-step models). Though rather restrictive in design, such models offer opportunities for meaningful and immediate contributions to the state of travel demand modeling practice.

### ***The Dynamics of Fare and Frequency Choice in Urban Transit***

Ian Savage

This study investigates the choice of fare and service frequency by urban mass transit agencies. A more frequent service is costly to provide but is valued by riders due to reduced waiting times at stops and faster operating speeds on less crowded vehicles. Empirical analyses in the 1980s found that service frequencies were too high in most of the cities studied. For a given budget constraint, social welfare could be improved by reducing service frequencies and using the money to lower saved fares. The cross-sectional nature of these analyses meant that researchers

were unable to address the question of when and why the oversupply occurred. This study seeks to answer that question by conducting a time series analysis of the bus operations of the Chicago Transit Authority from 1953 to 2005. The analysis finds that it has always been the case that too much service frequency was provided at too high a fare. The imbalance between fares and service frequency became larger in the 1970s when the introduction of operating subsidies coincided with an increase in the unit cost of service provision.

## **Transportation Asset Management**

### ***Intelligent Structural Health Management of Civil Infrastructure***

Sridhar Krishnaswamy

After the catastrophic I-35W bridge collapse in 2007, engineers have been pursuing alternative inspection techniques to better monitor civil infrastructure for structural health. One current technique involves using piezoelectric (PZT) sensors to “listen” to the acoustic emissions (AE) of a structure. This technique helps monitor problems like crack propagations or structural fatigue. However, PZT sensors are susceptible to electromagnetic interference, have limited operating frequencies, are vulnerable to signal loss over long cable runs, and lose measurement sensitivity over time requiring frequent calibration (and therefore additional labor and costs). Also, the deployment of each PZT sensor requires a preamplifier which further drives up costs.

As an alternative to PZT sensors, Krishnaswamy and Balogun are developing a rugged spectral demodulation system for optical readout of distributed FBG sensor arrays that can be used as a tool for AE monitoring of large infrastructure. FBG sensors are inexpensive, readily available, light-weight, immune to electromagnetic noise sources, and do not require pre-amplification. Using the spectral demodulation with FBG sensors, it is possible to

replace the bulky PZT sensors and cables with fiber optics that take up less space and are less susceptible to signal degradation. Moreover, the fiber optics can be permanently mounted to civil infrastructure. In 2009, the research team developed a laboratory breadboard prototype of the FBG monitoring system. During 2010, the team will work with the Infrastructure Technology Institute at Northwestern to install the system on a bridge structure in the Chicago area and compare its performance in parallel with a PZT installation. Several optic sensor manufacturers and system integrators have already expressed interest in the FBG system and could be natural partners for commercialization.

### ***Maintenance Optimization for Transportation Systems with Demand Responsiveness***

Pablo Durango-Cohen, Pattharin Sarutipand

The researchers presented a quadratic programming framework to address the problem of finding optimal maintenance policies for multi-facility transportation systems. The proposed model provides a

computationally-appealing framework to support decision-making, while accounting for functional interdependencies that link the facilities that comprise these systems. In particular, the formulation explicitly captures the bidirectional relationship between demand and deterioration. That is, the state of the facility (i.e., its condition or capacity), impacts the demand/traffic; while simultaneously, demand determines a facility’s deterioration rate. The elements that comprise transportation systems are linked because the state of a facility can impact demand at other facilities. The study provided a series of numerical examples to illustrate the advantages of the proposed framework. Specifically, the team analyzed ample network topologies and traffic patterns where it is optimal to coordinate (synchronize or alternate) interventions for clusters of facilities in transportation systems.





# Transportation Policy

## *A Structural Model of Safety and Safety Regulation in the Truckload Trucking Industry*

Ian Savage

This research models the effects of various public policies to improve safety within a structural model of the trucking industry. The structural model describes how trucking firms choose their level of safety by balancing the cost of preventing crashes against the financial consequences of a crash. This choice occurs within an interregional trade model that sets the market prices and quantities for the commodities that are transported between geographically dispersed markets. After specifying the first-best, full-information equilibrium, the research models the effects of two common market failures. The first is the myopic underestimation of crash costs by some trucking firms. The second is a more general problem that some of the external costs of truck crashes (such as congestion at the crash site) cannot be legally recovered from trucking firms. The research then investigates the choice of policies to protect other road users, and those who live along the highway, from these market failures. The paper compares two alternative public policies: (1) levying post-crash fines and making shippers bear secondary liability

for damages incurred in crashes, and (2) imposition of a minimum safety standard, in conjunction with a requirement to hold insurance, and assessing penalties for non-compliance with the standard. The different policies are ranked on the basis of their economic desirability and the likelihood that they will be selected by voters in a political economy.

## **Communication Matters: Communicating the Value of Transportation Research**

Joseph Schofer (with Johanna Zmud, Julie Paasche, Mia Zmud, Timothy Lomax, Judy Meyer)

The comprehensive document resulting from this National Academies study provides transportation researchers, planners, managers, and others with professional advice on how to design, plan, and execute effective communication campaigns that

convey the value of research projects or programs. It covers the elements of good communication practices, the communication process, evaluation and feedback, and targeting specific audiences. This is a practical document, offering quick tips, detailed how-to descriptions, and useful resources and templates. The guidebook is organized into the following four chapters and two appendices: (1) Signs of Good Communication Practices; (2) The Communication Process; (3) Planning and Evaluating Your Research Communication; (4) Putting It All Together: Communicating to Specific Audiences; (Appendix 1) Transportation Case Studies; and (Appendix 2) Non-Transportation Best Practices.



# Human Performance in Transportation Safety

## *Chasing the Silver Bullet: Measuring Driver Fatigue Using Simple and Complex Tasks*

S. Baulk, S. Biggs, Kathryn Reid, C. Van Den Heuvel, D. Dawson

Driver fatigue remains a significant cause of motor-vehicle accidents worldwide. New technologies are increasingly utilized to improve road safety, but there are no effective on-road measures for fatigue.

While simulated driving tasks are sensitive, and simple performance tasks have been used in industrial fatigue management systems (FMS) to quantify risk, little is known about the relationship between such measures. Establishing a simple, on-road measure of fatigue, as a fitness-to-drive tool, is an important issue for road safety and accident prevention, particularly as many fatigue related accidents are preventable. This study aimed to measure fatigue-related performance decrements using a simple task (reaction time – RT) and a complex task (driving simulation), and to determine the potential for a link between such measures, thus improving FMS success. Fifteen volunteer participants (7 males, 8 females) aged 22–56 years (mean 33.6 years), underwent 26 hours of supervised wakefulness before an 8 hour

recovery sleep opportunity. Participants were tested using a 30 minute interactive driving simulation test, bracketed by a 10 minute psychomotor vigilance task (PVT) at 4, 8, 18 and 24 hours of wakefulness, and following recovery sleep. Extended wakefulness caused significant decrements in PVT and driving performance. Although these measures are clearly linked, our analyses suggest that driving simulation cannot be replaced by a simple PVT. Further research is needed to closely examine links between performance measures and to facilitate accurate management of fitness to drive, which requires more complex assessments of performance than RT alone.



### ***Human Mobility and Spatial Disease Dynamics***

Dirk Brockmann, Vincent David, and Alejandro Morales Gallardo

The understanding of human mobility and the development of qualitative models as well as quantitative theories for it is of key importance to the research of human infectious disease dynamics on large geographical scales. This is epitomized by the recent outbreak and subsequent worldwide dissemination of H1N1 in 2009, the spread of SARS in 2003, and recurrent seasonal outbreaks of influenza epidemics. In today's globalized world, mobility and traffic have reached a complexity and volume of unprecedented degree. Multi-scale human mobility networks exhibit a number of essential features. For instance, they exhibit strong heterogeneities (i.e., the distribution of weights, traffic fluxes, and population sizes of connected communities ranging over many orders of magnitude). Although the interaction magnitude in terms of traffic intensities decreases with distance, the observed power-laws indicate that long range interactions play a significant role in spatial disease dynamics. A key goal of the research is to infer dynamical aspects of spatial disease dynamics from topological features of transportation and mobility networks and the systematical incorporation of comprehensive mobility

datasets into large scale computational models for geographic disease spread. The researchers developed computational techniques for understanding large scale transportation and mobility networks using complex network theory, optimization algorithms, methods from statistical mechanics, and nonlinear dynamics and interactive analysis tools. The long term goal of the research efforts is the development of quantitative computational forecast systems for the spread of emergent infectious diseases in the same spirit as weather forecast systems work today. Another line of research focuses on the systematic use of pervasive proxy data for human mobility. The emergence of geo-aware cell phones, large scale social networks and massive datasets on mobility that are collected on the internet make it possible to measure indirectly mobility or mobility related aspects of human behavior with unprecedented precision and scale. For instance, using the geographic circulation of millions of single dollar bills we discovered universal scaling laws in human mobility in the United States.

### ***Modeling Human Behavior and Intelligent Agent-Based Traffic Flow Simulation***

Hani Mahmassani (in collaboration with Lu Sun, Catholic University)  
The dynamics of driver behavior, taken

at the individual level and as part of a group, evolving over time and space was systematically studied as a complex system. This three year study, funded by the National Science Foundation, put forward a comprehensive, multidisciplinary research approach to characterize and model human cognitive driving behavior and subsequent response in traffic flow systems. By developing behavior-based models of human decision-making in traffic situations and integrating the behavior models in computer simulation systems, the study addressed fundamental questions in traffic science and contributed to improving the fidelity and reliability of the current state of the art of traffic flow simulation. Of particular interest in this study was driving behavior under extreme conditions, including inclement weather, and natural and man-made disasters. The key features of the approach are to capture cognitive aspects of risk-taking behavior of drivers in difficult driving situations, and to introduce a continuous representation of driving episodes in highway traffic. The resulting models can capture conflict engagement in driving and possible accident occurrence, thereby allowing evaluation of safety-related measures.



## Sleep During a 24 Hour Biphasic Work/Rest Schedule in American Waterways Operators

Fabian Preuss, Kathryn J. Reid, Fred W. Turek

Crew in the United States inland waterways towboat barge industry often have two rest/sleep and two work intervals per 24 hour period. This schedule is necessitated by the unique work schedule of six hours of work followed by a six hour break. Crews on such a schedule often maintain the 6:6:6:6 schedule for extended periods of time (e.g., 14-28 days). The aim of this study was to examine sleep-wake behavior in American Waterways Operators during normal operations. Results of the study showed that when sleeping at an optimum circadian phase, crew on the front watch only slept 3.7 hours during a 6 hour rest period. In general there was no difference in sleep between crew working on the front or back watch. It has been suggested that a schedule change to 7:7:5:5 or 8:8:4:4 would enable crew to obtain seven to eight hours of sleep during the major rest period. However, these data suggests that even with extended sleep opportunities (7-8 hours), crews will not be able to obtain 7-8 hours of sleep. This data demonstrates the need for



Photo credit: Gregory Thorpe

an anchor sleep/nap sleep strategy for operations under a 24 hour split schedule. This strategy would encourage crew to sleep for a longer period during one rest period and nap during the other rest period in order to obtain 7-8 hours of sleep.

## System Operations

### Incorporating Weather Impacts in Traffic Estimation and Prediction Systems

Hani Mahmassani (in collaboration with SAIC, Inc. and University of Virginia; funded by the Federal Highway Administration, US DOT)

The objectives are to develop weather-sensitive traffic flow and user behavior models, and incorporate them in existing traffic estimation and prediction systems (TrEPS). This included enhancement of the capabilities in mesoscopic dynamic traffic simulation-assignment tools, such as DYNASMART. The enhancements provided for modeling traffic behavior under inclement weather, and capturing

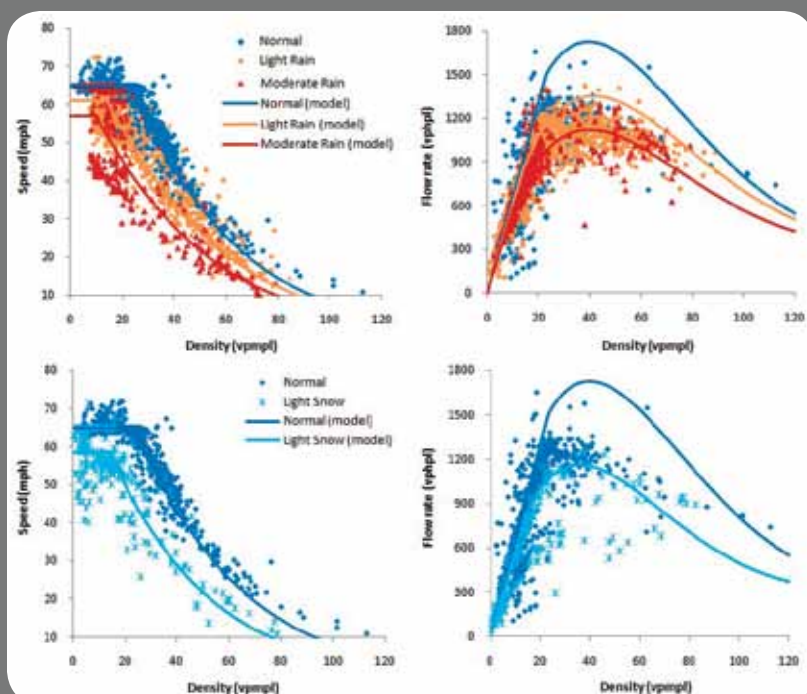
user responses to inclement weather, both with and without the presence of advisory and control strategies.

As a result of this project, the DYNASMART TrEPS can now capture the effects of adverse weather on traffic patterns through both supply and demand side modifications to the model. The basic methodology developed can be readily applied in other simulation-based DTA tools. New weather-related features include:

**Weather Scenario Specification:** these can be represented as either network-wide or link-specific weather condition.

**Weather Adjustment Factors:** the effect of weather on supply-side traffic parameters, such as free flow speed and capacity, are specified based on three weather condition parameters: visibility (mile), rain precipitation intensity (inch/hr) and snow precipitation intensity (inch/hr) by means of empirically-calibrated Weather Adjustment Factors (WAF). These are applied to 18 supply-side traffic properties for links within the impacted region to simulate traffic conditions under the weather condition.

**Weather-related Variable Message Signs (VMS):** three weather-related VMS





functionalities are provided to model traffic advisory and control:

(1) Speed Reduction Warning – via a VMS warning sign indicating low visibility (e.g., fog) or slippery road (e.g., rain and snow), speed reduction behavior under adverse weather can be simulated;

(2) Optional Detour – VMS suggests that travelers re-evaluate their current route based on the generalized cost that includes travel penalties of the added delays caused by adverse weather; and

(3) Variable Speed Limit (VSL) – vehicle speed can be regulated through the speed limits posted on VMS in correspondence with prevailing weather conditions.

The results of this study are currently under further development in a new FHWA-funded project targeting implementation in selected study areas.

### ***iTRAC: Intelligent Compression of Traffic Video***

Sotirios Tsafaris, Aggelos Katsaggelos

Non-intrusive video imaging sensors are commonly used for traffic surveillance. Traffic analysis applications require high-quality video information that is generally achieved with wired (e.g., fiber optic cable) networks. However, the widespread deployment of wired networks for intelligent traffic monitoring and analysis is constrained

by the vast cost of installation and infrastructure requirements. A solution to this roadblock is the use of wireless communication networks, but these generally provide lower video bandwidth and thus lower video quality. With wireless communications, video compression techniques, such as the newly proposed H.264 standard, are required to pump the video at high enough frame rates (bit rates) for useful application. In turn, video compression can severely compromise the ability to perform traffic monitoring and tracking tasks.

Because of this, Tsafaris and Katsaggelos are developing iTRAC, an intelligent algorithmic software module to be used in conjunction with the H.264 video compression encoding standard. In general, software tracking algorithms use video histograms to compare one video frame to the next. However, compression techniques can severely distort the

histograms, and therefore the ability to track objects. Unlike existing applications, the research team will employ kurtotic video segmentation techniques on the compressed video information to distinguish moving objects (e.g., cars) from stationary objects (e.g., trees). In partnership with Ingenient Technologies, a provider of embedded multimedia software solutions, iTRAC will then be integrated into the logic of hardware video compression encoders for commercial applications, including traffic monitoring.



# SPONSORED RESEARCH HIGHLIGHTS 2009-10

## Active Research Projects Through NUTC 2009-10

Principal Investigator (PI): Pablo Durango-Cohen

-“Career: An Integrated Framework,” National Science Foundation

PI: Aggelos Katsaggelos

-“Video Traffic Analysis for Abnormal Event Detection,” Center for the Commercialization of Innovative Transportation Technology (USDOT)

PI: Diego Klabjan

-“Business Intelligence for Gang Scheduling,” Center for the Commercialization of Innovative Transportation Technology (USDOT)

-“Information System for Infrastructure Deployment in Support of Future Vehicles,” Center for the Commercialization of Innovative Transportation Technology (USDOT)

PI: Sridhar Krishnaswamy

-“Intelligent Structural Health Monitoring of Vehicle Bridges,” Center for the Commercialization of Innovative Transportation Technology (USDOT)

PI: Hani Mahmassani

-Tier II University Transportation Center, Center for Commercialization of Innovative Transportation Technology, U.S. Department of Transportation

-“SHRP 2 C04: Improving Our Understanding of How Highway Congestion and Pricing Affect Travel Demand,” PB Americas, Inc. (Transportation Research Board)

-“Incorporating Weather Impacts in Traffic Estimation and Prediction Systems,” Science Applications International Corp. (Federal Highway Administration)

-“Cargo Screening Cost Model Evaluation,” Quasars, Inc. (Transportation Security Administration)

-“SHRP 2 L04: Incorporating Reliability Performance Measures in Operations and Planning Modeling Tools,” Delcan Corporation (Transportation Research Board)

-“Effectiveness of Speed Enforcement Techniques in Illinois,” Illinois Center for Transportation, University of Illinois at Urbana-Champaign (IDOT)

-“Clearview Front in Traffic Signs: Assessing IDOT Experiences and Needs,” Illinois Center for Transportation, University of Illinois at Urbana-Champaign (IDOT)

-“International Air Cargo: Market Trends and Opportunities” The Boeing Company (co-PI: Karen Smilowitz)

-“Strategic Research Priorities for the Transport and Crowd Movement CORE Workshop,” Center for Research Excellence in Hajj and Omrah, Umm Al-Qura University

-“Implementation and Evaluation of Weather Responsive Traffic Estimation and Prediction System,” Science Applications International Corp. (Federal Highway Administration)

PI: Yu (Marco) Nie

-“Providing Reliable Route Guidance Using the Gary-Chicago-Milwaukee Traveler Information System,” Center for the Commercialization of Innovative Transportation Technology (USDOT)

-“Toward More Reliable Mobility: Improved Decision Support Tools for Transportation Systems,” National Science Foundation (co-PI: Hani Mahmassani)

-“Develop Travel Reliability Inventory for Highway Networks,” Illinois Center for Transportation, University of Illinois at Urbana-Champaign (IDOT)

PI: Joseph L. Schofer

-“Flood-induced Traffic Delays within Des Plaines Watershed,” U.S. Army Corps of Engineers

PI: Karen Smilowitz

-“Decision-Making Tools for Distribution Networks in Disaster Relief,” Center for the Commercialization of Innovative Transportation Technology (USDOT) (co-PI: Irina Dolinskaya)

# SPECIAL RESEARCH EVENTS



Back row (left to right): John McDonald, David Boyce  
 Front: Anna Nagurney, Martin Beckmann, Hani Mahmassani,  
 T. John Kim



## Symposium on Transportation Network Design and Economics Honoring Martin Beckmann

On January 29, 2010, NUTC hosted a special one-day symposium in honor of Professor Martin Beckmann focusing on topics related to his seminal work on transportation network equilibrium and efficiency theory. Martin Beckmann is credited with establishing the basic principles of user behavior on congested transportation networks, as well as for optimal network vehicle flows. His 1956 book, *Studies in the Economics of Transportation* (co-authored with C. Bartlett McGuire and Christopher B. Winsten), is recognized as the work that launched the subfield of transportation network economics.

The symposium brought together leading academic researchers to discuss the impact of Beckmann's contribution on a wide range of related transportation problems. One focus of the discussion addressed the design of transportation and similar networks (e.g., communications, electric power, the Internet). A second focus of the symposium was on decision-making related to pricing, expansion, operation, and maintenance of public and private systems. Professor Beckmann spoke on the topic of vehicle and passenger flows in mass transportation and reflected on his long and distinguished career. The program included individual presentations, a panel of speakers, and lively round-table discussion.

The symposium was organized and led by NUTC faculty member David Boyce and Ann Nagurney, John F. Smith Memorial professor of finance and operations at the University of Massachusetts at Amherst. Other faculty speakers included T. John Kim, endowed professor of urban and regional systems at the University of Illinois, Urbana-Champaign; John F. McDonald, Gerald W. Fogelson distinguished chair in real estate at Roosevelt University, Chicago; Yanfeng Ouyang, assistant professor of civil and environmental engineering at the University of Illinois, Urbana-Champaign and NUTC faculty members Karen Smilowitz, Dirk Brockmann, Yu (Marco) Nie, Diego Klabjan, Irina Dolinskaya, Ian Savage, and Hani Mahmassani.



Photo credit: Robert Herman



## Federal Railroad Administrator Joseph Szabo Addresses NUTC Sandhouse Gang

During April's NUTC Sandhouse Gang meeting, Joseph Szabo, Federal Railroad Administration (FRA) Administrator, spoke on why he believes rail is the future of transportation in America. Szabo explained current projects in operation that will improve the rail infrastructure in Chicago and Illinois. With more than \$8 billion in federal funding allotted to the development of high speed rail, thousands of jobs would be created in Illinois. Other topics of discussion included how to improve interstate rail networks, how rail would be competitive with airplanes and automobiles, and how development of rail would lead to a culture of rail ridership.

Nominated March 20, 2009, and confirmed by the United States Senate on April 29, 2009, Joseph C. Szabo is the twelfth FRA Administrator, responsible for overseeing the operations for the eight hundred plus person organization; managing a comprehensive railroad safety assurance program and regulatory initiatives; enforcing railroad safety laws and regulations; developing and implementing national freight and passenger rail policy and financial assistance programs; and overseeing wide-ranging advanced research and development projects to support improved railroad safety. Szabo has been a longtime member of the Center's Sandhouse Gang.



Joseph C. Szabo and Sandhouse Gang Moderator Norm Carlson

# SPECIAL RESEARCH EVENTS

## Illinois Governor's Summit

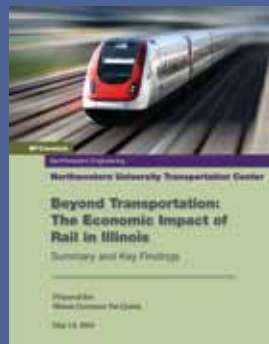
### Beyond Transportation: The Economic Impact of Rail in Illinois

In partnership with NUTC and the Environmental Law Policy Center, Illinois Governor Pat Quinn hosted *Beyond Transportation: The Economic Impact of Rail in Illinois*, an invitation only summit to foster a strategic vision for rail investment in Illinois. Approximately 150 people attended the summit, including members of Congress and senators, heads of planning agencies and non-governmental advocacy organizations, business owners, transportation and economic development experts, university faculty and students. The summit identified a strong interrelation between economic development and investments in inter-city and intra-regional passenger and freight rail infrastructure.

Four breakout panel discussions examined areas for potential economic impact: local development/redevelopment/tourism; manufacturing; global connectivity; and innovation and sustainability. NUTC Director Hani Mahmassani served as the moderator for the connectivity panel while affiliate faculty member and Kellogg Graduate School of Management Professor Therese McGuire led the local development panel. The panels highlighted opportunities for rail-based investment to generate economic benefits through higher levels of connectivity and spatial synergy for businesses and individuals, strengthening the position of Illinois and the Midwest as a globally competitive interconnected mega-region. The summit was also supported by NUTC Associate Director Bret Johnson, Research Associate Pei-Wei Lin, and graduate students Laurence Audenaerd, Christopher Lindsey, and Charlotte Whitehead.

Based on the proceedings, the NUTC produced a Summary and Key Findings report for the Governor. The high level findings were:

- Illinois has the necessary elements of a strong rail system-related manufacturing base that is poised for expansion, but it requires adequate demand
- Consistent and ongoing investments will be required to



develop and maintain the infrastructure and networks to realize sustainable economic benefits from intermodal passenger travel and freight movement

- Well-integrated intermodal passenger and freight mobility across the Midwest has the potential to bring real economic benefits through enhanced business connectivity and increased job opportunities
- Investments in rail require a regional commitment and regional planning to improve the likelihood of economic returns and job creation

NUTC's recommendations include:

- Comprehensive planning that takes a mega-regional perspective
- Long-term view of the joint development of economic activity and supporting transportation infrastructure and services for both passengers and freight
- Systematic design of the specific sections, stations, services and schedules to maximize attainment of the economic development impact
- Provision of financing mechanisms that ensure predictable revenue streams to allow for completion of a meaningful network of services and continue operation and maintenance of the resulting system—exclusive reliance on federal funds or special appropriations will not create the stability and predictability necessary to achieve the desired benefits
- Investment in educating the cadre of professionals needed to plan, design, operate and maintain the new high speed rail and existing freight rail networks and services, and training the large pool of skilled labor required for its operation. In all of these, the engagement of stakeholders and support of the public is essential

## Pedestrian-Rail Safety Symposium

On June 22, 2010, NUTC, in collaboration with the City of Lake Forest, Illinois, organized and hosted a symposium focused on pedestrian safety around railroads. A recent and significant increase in pedestrian-train accidents and fatalities in the greater Chicago area prompted officials and rail safety advocates at the symposium to address two major issues: pedestrian distraction due to portable electronic devices such as cell phones and iPods, and the implications stemming from the planned introduction of high speed trains to the rail system. The goal of the symposium was to generate recommendations to encourage change in pedestrian behavior and reduce the number of accidents.

The interdisciplinary symposium brought together university researchers with practitioners from railroads, police departments and local municipalities. The format of the symposium allowed participants to share experiences on what has worked, what has not, and to brainstorm innovative ideas. After introductory speakers presented data and opened the discussion, attendees broke into subgroups to discuss ideas and develop recommendations focusing on the three “E”s: Education and communication, Engineering and design, and Enforcement. Summaries of the symposium’s deliberations are being shared widely to encourage public discussion and action.





# BUSINESS ADVISORY COMMITTEE



## About the Business Advisory Committee

Since its inception in 1954, the Northwestern University Transportation Center has maintained strong ties with industry through its Business Advisory Committee (BAC). The BAC is made up of industry executives from a wide variety of firms and organizations involved in providing and purchasing transportation, logistics, and supply chain operations. Membership includes senior-level executives from shipper and carrier firms, freight-forwarders, trade associations, financial organizations, and consulting firms. The Center’s industry connections link the Northwestern community to challenging problems as well as to opportunities to learn and test solutions in real world settings. Members serve as advisors to the Center, providing important insights into the transportation-related issues and problems they face in their businesses. Unequaled by any academic transportation advisory board in the country, the BAC has long been a major force behind the Center’s success.

In 2010 the Center established distinct levels of membership – Leadership, Sustaining, Individual,

and Associations. Each category carries with it a set of membership benefits, as well as a suggested level of commitment and financial support for NUTC's research, education, and outreach activities.

Benefits to all members include access to Northwestern's world-class faculty, opportunities for networking with industry peers, invitations and involvement in special programs and events, insights into cutting-edge research and industry trends, discounted tuition fees for NUTC's executive programs, and access to Northwestern's renowned Transportation Library and its bright student population.



The Committee meets twice yearly on the Evanston campus to foster an exchange of ideas among BAC members and the Center faculty, staff, and students. The meetings are designed to explore areas of interest and relevance to the BAC member companies. Each meeting features working sessions, panel discussions and speaker presentations, as well as an opportunity for the members to network with one another.

## Fall 2009 Meeting

The meeting agenda featured a welcome by McCormick School of Engineering and Applied Science Dean Julio Ottino and comments by Sunil Chopra, Interim Dean of the Kellogg School of Management, about the connections between NUTC and Kellogg. Center Director, Hani Mahmassani, gave a high-level report on NUTC and highlighted its programs, goals, and achievements. The meeting also featured two topical panel sessions, *Cyber Security – Protecting Transportation Data and Assets* and *Anti-Trust Policy Developments and Transportation*. Highlights from the panel sessions are below.

### *Cyber Security – Protecting Transportation Data and Assets*

Panel Speakers: Yan Chen, Associate Professor of Electrical Engineering and Computer Science; Joel Brenner, Senior Counsel at the National Security Agency; Rob Talley, Manager of Enterprise Security at BNSF; Aaron Gellman, Professor of Transportation (Moderator)

After an extensive background on the development of the internet and its proliferating access and use around the globe in both business and society, a discussion took place on how hostile parties are using loopholes and lax discipline of users to not only commit crimes for monetary gain (e.g., account numbers, personal identity information, etc.) but to disrupt operations for perhaps political gain or sport (e.g., hackers). Numerous examples of actual or potential breaches in security -- many of them resulting from innocent or accidental activities (e.g., music downloads) or lack of adequate precautions (e.g., taking business files home) -- were given. Many, but not



all, of these illegal entries occur in the developing economies as part of organized crime. The session concluded with a discussion of the wide and costly range of measures that corporations must take to protect their computers and other corporate and customer assets.

#### *Anti-Trust Policy Developments and Transportation*

Panel Speakers: John Nannes, Partner at Skadden, Arps, Slate, Meagher & Flom, LLP; Louis Dupart of the Normandy Group; Fred McChesney, James B. Haddad Professor of Law; Justin Zubrod, Managing Partner at Justin Zubrod & Company (Moderator)



The panel provided an overview of antitrust policy, philosophy, application and enforcement in both criminal and civil cases, mergers, and firm behavior and the differences in policy and enforcement between Republican and Democratic administrations. In addition, the panel highlighted the degree of change in personnel under the new administrations at the Federal Trade Commission, Department of Justice, and the Surface Transportation Board who will be responsible for administering the policies. Finally, the panel discussed the implication of stimulus funding for high speed rail (using underlying freight rail infrastructure) and if and how a new regulatory regime addresses such grants might be used to implement new competition philosophies (as occurs now in airport grant programs).

The meeting's evening speaker was John McKean, Executive Director at the Center for Information Based Competition. McKean, a best-selling author, delivered the evening presentation, *Managing Customers Through Economic Cycles*. He discussed strategies and tactics that companies can use to optimize their business' marketing and sales approaches to survive and thrive in up and down economic cycles.

## Spring 2010 Meeting

Following welcoming comments by McCormick School of Engineering and Applied Science Dean Julio Ottino, Jay Walsh, Northwestern University Vice President in the Office of Research, spoke to BAC members regarding the role the Center and its research is playing in a number of University initiatives and programs, including its links to the Initiative for Energy Sustainability at Northwestern (ISEN). The meeting agenda included the following two panel sessions, *Intermodal Logistics: Development & Management Perspectives* and *The Battle for Freight - Direct vs. Indirect (New Business Models, New Channels, New Partners)*. Highlights are below.

#### *Intermodal Logistics: Development & Management Perspectives*

Panel Speakers: Ann Drake, CEO at DSC Logistics; Mike Mullen, CEO at CenterPoint Properties; Thomas Plowman, General Director of Industrial Products Sales at BNSF Railway; Joseph Schofer, Associate Dean of the McCormick School of Engineering and Applied Science (Moderator)

The panel looked at the development of large scale freight hubs around the country and their relevance in the global economy. They explored





what impact intermodal hubs have on rail and trucking operations and on economic development in the hosting communities.

*The Battle for Freight - Direct vs. Indirect (New Business Models, New Channels, New Partners)*

Panel Speakers: John Bowe, President of Americas at APL Limited; Dan Spellman, Vice President of Logistics Development and Supply Chain Services at Caterpillar Logistics Services; Doug Waggoner, CEO at Echo Global Logistics; Justin Zubrod, Managing Partner at Justin Zubrod & Company (Moderator)

The panel explored the changing face of freight operations which are increasingly shifting from the traditional operating providers such as truck, rail and intermodal to agents, 3PLs, forwarders, brokers and other middleman. The panel looked at the competition for freight between direct or traditional sales forces vs. agents who own no assets and can choose among carriers. The panel members concluded that intermediaries have an important role going forward. They provide a useful service for both sophisticated and inexperienced customers and carriers and will continue to play that role as the economy recovers and capacity becomes scarce.

The BAC meeting also featured brief reports highlighting several research initiatives underway at the Center including:

*Optimal Path Finding in Dynamic Environment with Application to Vessels and Autonomous Vehicles*

Irina Dolinskaya

Associate Professor of Industrial Engineering and Management Sciences

*Supporting Sustainable Development of Transportation Infrastructure: Developing a Modeling Framework to Integrate Life-Cycle Assessment within Decision Models*

Elaine Croft McKenzie

PhD Candidate of Civil and Environmental Engineering

*Workforce Management in Periodic Routing Operations*

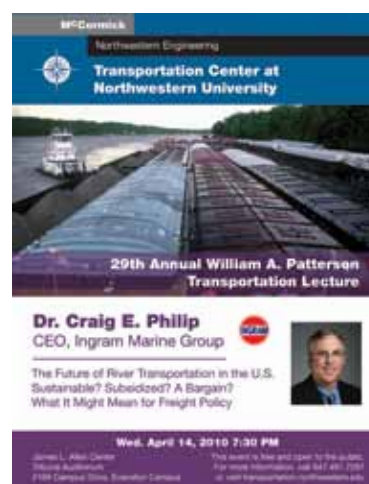
Karen Smilowitz

Junior William A. Patterson Professor of Transportation

Associate Professor of Industrial Engineering and

Management Sciences

The evening speaker and 2010 William A. Patterson Distinguished Lecturer was Dr. Craig E. Philip, CEO of Ingram Marine Group. Philip, leads the largest barge company in the United States, delivered his talk, *The Future of River Transportation in the U.S. – Safest, Sustainable, Subsidized...A Bargain? What It Might Mean for Freight Policy*. Philip shared his views on the present state of the domestic marine transport industry and how future policy may shape its future.



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Ingram Barge  
Company



Mr. Douglas R.  
Waggoner  
CEO  
Echo Global  
Logistics



Ms. Gloria Ysasi-Diaz  
VP, Logistics  
Management  
W.W. Grainger, Inc.



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McCormick  
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McCormick Jahncke  
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Senior Counsel  
Former Partner  
Covington &  
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Berger, Newmark &  
Fenichel P.C.



Mr. Justin Zubrod Sr.  
Managing Partner  
Justin Zubrod &  
Co., LLC



# INDUSTRY FOCUSED RESEARCH

NUTC is committed to engaging industry, notably the companies represented in the Business Advisory Committee (BAC), in relevant, innovative research. The opportunity to conduct such research requires effective communication with industry partners through proactive outreach, critical listening, innovative thinking, patience, trust, and relationship building, among other factors. NUTC strives to embrace these characteristics as it engages its BAC partners and other valuable and important companies, agencies, and research institutions.

Over the last year, the Center has conducted technical “knowledge exchanges” with several BAC companies. It actively hosts these information and idea sharing opportunities and also travels to corporate locations to get a firsthand look at technical, operational, and management challenges. In some instances NUTC hosts multiple sessions, often at both the home of NUTC in Evanston, and our industry partner’s site. Notable exchanges have occurred this past year with CAT Logistics in Morton, Illinois, with a follow up scheduled in Evanston, Echo Global Logistics in Chicago on two occasions, and Navteq in Chicago and Evanston. An exchange is currently in development with Teradata. NUTC hosted a similar meeting with non-BAC company, Veolia Transportation. The Center’s ultimate goal is to define a unique research project with each company or a broader based research initiative that may attract the support of multiple companies.

NUTC has recently completed or has several robust research projects in place funded by or with data provided by our BAC companies, including Boeing, CH2M Hill, Coyote Logistics, FedEx Express, General Motors, Norfolk Southern, Philips, Ryder System, Sabre Holdings, United Airlines, and UPS. Examples of industry partner research are below.

**Boeing** – Boeing funded a project for NUTC to evaluate the evolving characteristics of the international cargo sector. This research project complements ongoing studies in one of the Center’s core research areas, logistics and supply chain management. The project also allows affiliate faculty members and graduate students to broaden their understanding of the international cargo and freight markets. Professors Hani Mahmassani and Karen Smilowitz are leading this investigation, in collaboration with Zubrod Associates, Inc., and with support from post-doctoral research fellow Roger Chen and graduate students Lan Jiang and Christopher Lindsey.



**Coyote Logistics** – This project involved an empirical study and a network analysis of spot-market broker operations in supply chain management. By modeling the connections between brokers and the vendors they contact, NUTC defined metrics that correlate the strategies for selecting the vendors with profitability, which allows for the identification of new operating policies. The outcome demonstrated that it is not just the number of interactions



between brokers and vendors that impact profitability, but also the quality of those interactions. Professor Karen Smilowitz and former Industrial Engineering and Management Science faculty member Tito Homem-de-Mello supervised graduate student Michael Huang and undergraduate student Michael Batres as they developed an approach to quantify the quality of interactions and demonstrate the extent to which this approach can yield operating policy guidelines and also serve as a tool to evaluate the performance of individual brokers.

**Fedex Express** – In this research project with FedEx, Professor Diego Klabjan led a study to streamline the transportation and sorting costs. Express package carriers move large quantities of packages from several stations to the ramp with various conveyance types such as containerized or bulk trucks and aircraft. Packages are first sorted at each station and then many of them are resorted at the ramp based on the destination. From the ramp the packages are then moved with larger aircraft to their hubs and then to the final destination. Results of the study show that large cost savings can be obtained by accurately forming containers at stations in order to bypass resorting at the ramp.



**Ingram Marine Group** – In 2009, NUTC faculty members Fred Turek and Kathryn Reid partnered with NUTC BAC member Craig Phillip on a sleep study. Members of the research team spent five months in 2009 studying the sleep problem of Ingram workers on five towboats. They found that some crew members got as little as 3.7 hours of sleep during the six-hour break. Recent studies showed that performance levels depend on the total number of sleep hours per day, so crew members ostensibly could perform the same whether



Photo credit: Gregory Thorpe

they slept for six hours at a time or had a four-hour “anchor” sleep period one time and a two-hour nap later. The researchers

encouraged crew members to develop “novel napping strategies” that included having the anchor sleep at night, when the body’s circadian biology wants it to sleep, and napping during the day to reach at least seven hours of sleep. Crew members slept longer thanks to the researchers’ intervention, but the data set was too small for the researchers to reach any significant conclusions. They concluded that further studies should be done under towboat simulation conditions rather than with actual working crews.

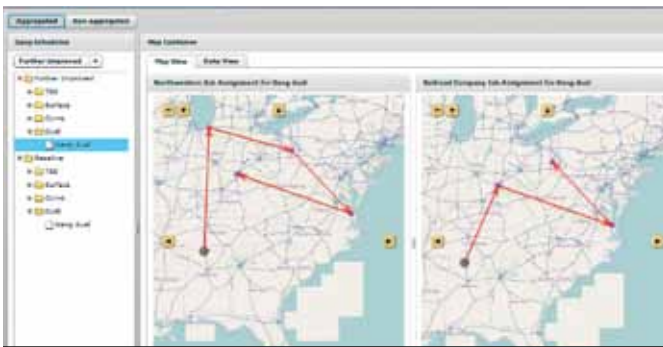


Illustration of gang job assignment routing maps produced by Diego Klabjan’s web-based software

**Norfolk Southern** – With funding from CCITT, an information system for gang scheduling is being developed in participation with Norfolk Southern, based upon fundamental decision support techniques developed by Professor Diego Klabjan and his graduate students and post-doctoral researchers. Railways employ several “gangs” of track maintenance workers throughout the year to maintain a good state of repair of the system. The goal of this project is to develop a decision support system for budget allocation that will enable the efficient scheduling of gangs at the tactical and operational level. Through an intuitive and user-friendly interface, the users have options in giving preferences to specific items and units in a multi-unit library system.



**Philips** – Philips funded a project to measure and report CO2 emissions associated with shipments throughout Philip’s supply chain. This effort is part of a new focus of companies and researchers to quantify emissions from all parts of a business, including manufacturing, transportation, and service operations. Primary challenges of the study involved collecting data from a large group of independent shippers and carriers, and applying appropriate methodologies to this data to calculate CO2 emissions. Northwestern also provided Phillips with recommendations for improvements and



mitigation strategies for future emissions reporting, including standardization of data collection, incorporating the multi-modality of shipments, and promoting fuel-based emissions calculations. Elaine Croft McKenzie, PhD candidate in Civil and Environmental Engineering, is leading the effort to develop best-practice standards throughout the supply chain for Philips and others, under guidance of Professor Pablo Durango-Cohen.

**Ryder System** – Ryder funded a project that addressed the problem of dealing with massive amounts of freight shipment data that is often not “clean” enough to use for effective analytical and computational processing. Ryder System, Inc., one of the world’s leading logistics service providers, collects and stores an abundant amount of freight shipment data, which is utilized for cost and data analysis. The main objective of this research project was to design a data cleansing tool and to disseminate it within the Ryder organization. Bill Pun, a graduate student in Industrial Engineering and Management Sciences, conducted the study under guidance of Professor Diego Klabjan.



**UPS** – Junior William A. Patterson Professor of Transportation Karen Smilowitz conducted hands on research as part of a research project on the Consistent Vehicle Routing Problem.



Karen Smilowitz (right) with UPS driver Jim Brooks





# INDUSTRY WORKSHOPS

## The Greening of Transportation Benefits, Risks, and Unknowns

On November 4, 2009, leaders from rail, transportation logistics, trucking, and energy production discussed trends, developments, strategies, and goals for the greening of transportation as part of the NUTC Business Advisory Committee pre-meeting workshop, *The Greening of Transportation – The Benefits, Risks and Unknowns*. Speakers included: Carl Gerhardstein, Director of Environmental Systems, CSX Corporation – *Environmental Stewardship in Rail Operations*; Steve Holic, Supply Manager NAM Forwarding & Distribution & Senior Director, Philips General Purchasing, Philips Electronics – *Factoring Carbon Emissions into the Supply Chain Decision Making Process and Annual Reporting*; Tarsem Jutla, Chief Engineer Logistics Development, CAT Logistics Services, Inc. – *CAT Logistics: A Commitment to Sustainable Development*; Steve Matheys, Executive Vice President, Chief Administration Officer, Schneider National – *A Transportation Providers' Commitment and Holistic Approach to Providing Green Transportation*; Prabhakar Nair, Senior Manager of Marketing & Planning, Renewables SBU of UOP – *Biofuels: Unlocking the Potential*. Industrial Engineering and Management Science Professor Diego Klabjan moderated the discussion.

Three themes emerged from the workshop. First, standard transportation procurement attributes such as cost, quality, and service are still the name of the game, but greening attributes

are rapidly approaching in the rear-view mirror. While the lowest cost carrier still usually wins, the carriers bolster their relationship with the shipper by jointly collaborating on sustainability efforts. Second, greening (sustainability) is a strategic corporate initiative. It is becoming a common practice to develop a corporate level strategic sustainability plan. The corporation's transportation carbon footprint is an important component of this plan. Successful implementation requires multiple business units to work together to seamlessly implement the corporate plan. Furthermore, the key efforts and initiatives in individual units must be dispersed throughout and linked to goals for the entire organization. Third, it is important to think broadly, but start small and expand a transportation sustainability initiative. Many transportation companies have moved beyond basic energy efficiency efforts such as switching from incandescent to LED lighting in their facilities and retrofitting trucks or locomotives. More far-reaching steps are underway by many corporations, including but not limited to: substantial recycling efforts, remanufacturing of assets, use of electric vehicles, deployment of fuel-cells for power generation, and experimentation with or gradual switch to biofuels. In most cases, corporations have pilot tested green practices before considering a corporate wide rollout.

In summary, the *Greening of Transportation* workshop demonstrated that sustainable practices are materializing in many ways, from the proliferation of new greening projects and technologies to the development of new technology innovations and business strategies. The journey toward sustainable transportation is a long road. Steady and gradual persistence is needed.





## Cross Border Workshop Highlights Research Opportunities

NUTC and CCITT, in collaboration with the Canadian Consulate in Chicago, hosted an industry workshop, *Border Crossing Issues and Prospects for Freight* at the Spring 2010 Business Advisory Committee meeting. The workshop featured a diverse group of speakers, including Robert Harrison, Deputy Director for the Center of Transportation Research at the University of Texas, Austin; Kniffen Kelly, Director of Transportation Solutions, UPS; Mike Tamilia, Senior Manager, Customs and Transborder Operations, CN Railroad; and Dan Ujcz, Managing Director, Canada-United States Law Institute, Case Western Reserve University School of Law. Professor Aaron Gellman moderated the session.

The workshop had two primary goals: 1) to identify potential bottlenecks in cross border operations and, 2) to stimulate near and long term research opportunities for NUTC and CCITT affiliated faculty members. Key findings included:

- Infrastructure at border crossings for freight movement requires near term attention; policy and strategy are driven by infrastructure constraints.

- Climate change priorities provide an opportunity for US-Canada and US-Mexico to adopt similar guiding principles for freight.

- Customs and Border Patrol (CBP) can learn from the private sector, but entrenched cultures of various private industries across the supply chain can stifle change.

- A tremendous amount of data is available that can be exploited by university researchers.



Kniffen Kelly, UPS' Director of Transportation Solutions, addresses attendees at the *Border Crossing* workshop.

# EXECUTIVE EDUCATION

The Northwestern University Transportation Center is well-known in the area of executive education, having offered a regular series of non-degree executive program courses for transportation and logistics professionals throughout most of its history. Developed for professionals engaged in and committed to the transportation and logistics fields, the courses provide exposure to a full range of management techniques and decision-making skills. The purpose of these programs is to provide industry participants with the necessary skills needed to function effectively and excel in the increasingly competitive global transportation and logistics business environment. All NUTC Executive Programs offer a rigorous and comprehensive educational experience and are taught by leading authorities in the field.

**"I found the course tremendously helpful in equipping us with the tools and techniques necessary to inform policy makers about the various aspects of infrastructure pricing. It was particularly useful in conveying the underlying economic principles of pricing to support large-scale infrastructure investment."**

2009 Pricing Infrastructure Participant  
Michael H. Shiffer, PhD  
Vice President for Planning,  
Strategy & Technology  
Translink (South Coast British Columbia  
Transportation Authority)




## **Coping with Carbon: Sustainable Strategies for the Transportation and Logistics Enterprise**

**September 14-16, 2010**

*Coping with Carbon* is an innovative and specially designed executive program for transportation and logistics professionals in both the private and public sectors. It focuses on the economics of carbon emission regulation, management, and enforcement as well as the emerging technologies which can enable carriers and supply chain managers to limit carbon emissions.





## Freight Transportation: Strategies for a Changing Landscape

October 12-14, 2010

This customized executive program is aimed at transportation and logistics executives and those who invest in or serve the sector. It focuses on the rapidly changing domestic and international transportation industry, including air, rail, trucking, marine, pipeline, package, and non-asset sectors such as third party logistics and brokerage.



## Pricing Transportation Infrastructure

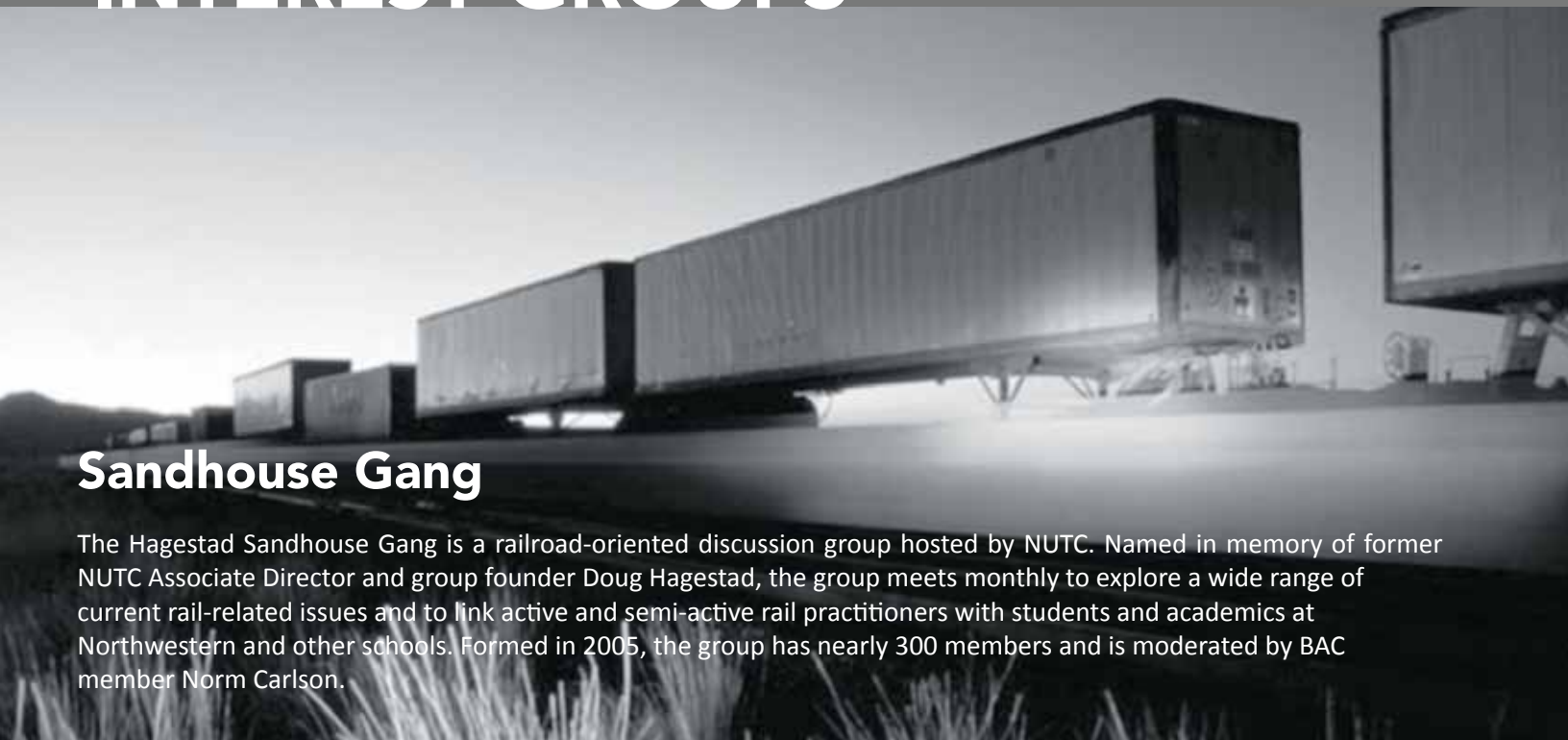
October 18-20, 2010

*Pricing Transportation Infrastructure* is a specially designed executive program for infrastructure professionals in both the private and public sectors. The course focuses on the economics of pricing transportation infrastructure for highways, port facilities, railroads, waterways, and airports.





# AVIATION AND RAIL INTEREST GROUPS



## Sandhouse Gang

The Hagestad Sandhouse Gang is a railroad-oriented discussion group hosted by NUTC. Named in memory of former NUTC Associate Director and group founder Doug Hagestad, the group meets monthly to explore a wide range of current rail-related issues and to link active and semi-active rail practitioners with students and academics at Northwestern and other schools. Formed in 2005, the group has nearly 300 members and is moderated by BAC member Norm Carlson.

## Icarus Society

The Icarus Society provides a public forum for the discussion and dissemination of a wide range of national and international issues impacting the aviation industry. The goal of the society is to share knowledge and ideas about all things relevant to aviation today with the widest possible audience. Formed in 2006, the Icarus Society promotes in-depth dialogue about airlines, aircraft manufacturing, aviation services, technology, government oversight, and significant elements of business aviation.





## 2009-10 Meetings

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September 2, 2009

Ray Lang

Senior Director: Government Affairs  
AMTRAK

*Development of High Speed Rail on AMTRAK's  
Chicago Hub and Planning for New Services from  
Chicago*

October 1, 2009

Richard Harnish

Executive Director

Midwest High Speed Rail Coalition  
*Chicago to St. Louis – in an Hour and 52 Minutes*

December 1, 2009

Anthony B. Hatch

ABH Consulting

*Transportation Industry Financial Update*

January 26, 2010

Richard J. Kloster

FTR Consulting Group

Advanced Rail Equipment Solutions, Inc.

*An Outlook for the North American Rail Car Fleet:  
The Rise... The Fall... The???*

February 23, 2010

Lee A. Clair

Partner

Norbridge

*Biomass as a Renewable Energy and the  
Implications for the North American Railroads*

April 13, 2010

Joseph C. Szabo

Federal Railroad Administrator

Federal Railroad Administration

*FRA Initiatives*

April 29, 2010

William S. Leber, Jr.

Senior Manager of Business Development

Collaborative Air Traffic Management

Lockheed Martin Aviation Solutions - Civil

*Behind the Scenes in Airlines Operations:*

*From Airport Delays to Volcanic Ash*

May 25, 2010

Dr. Hongchang Li

Beijing Jiaotong University

*High Speed Rail in China ... On or Off the Track?*

July 13, 2010

Larry Kaufman

Transportation Journalist, Consultant and

Author

*From Bankruptcy to Prosperity:*

*A Half Century of Railroad History*

August 2, 2010

Michael J. Shiffer, Ph. D.

Vice President, Planning, Strategy & Technology

TransLink (South Coast British Columbia

Transportation Authority)

*A Chicagoan's Transportation Odyssey: Adventures  
in Planning for Automated Trains, Electric Buses and  
Smart Roadways in Vancouver*

# 2009-10 SEMINAR SERIES

Each year the Center's Seminar Series features world class speakers from academia, government, and industry. The goal of the Seminar Series is to compliment the classroom curriculum by exposing students and faculty to cutting edge ideas, new and exciting research initiatives and trends, and to provide an opportunity for face to face interactions with the leading minds working in their fields. Below are speakers from the 2009-10 Seminar Series.

August 12, 2009

David Bunch

Professor of Management

University of California, Davis

*Economic Incentives for New Vehicle Purchases to Reduce Greenhouse Gas Emissions (Feebates): An Analysis of Policy Options for California*

September 17, 2009

Amelia Regan

Professor of Computer Science

University of California, Irvine

*Freight Data Availability: Gaps and Inaccuracies*

October 1, 2009

Richard Harnish

Executive Director

Midwest High Speed Rail Coalition

*Chicago to St. Louis in an Hour and 52 Minutes*

October 8, 2009

Kevin J. Krizek

Associate Professor of Planning, Design, and Civil Engineering

University of Colorado, Denver

(McCormick Alum '93)

*Wrestling with How to Measure Bicycling's Benefits*

November 12, 2009

Robert Dial

Professor Emeritus

University of Texas at Austin

*The Design, Performance, and Implications of Algorithm B: A Fast and Frugal Wardrop Equilibrium Solver*

November 19, 2009

Patricia Lyon Mokhtarian

Professor of Civil and Environmental Engineering

Chair, Transportation Technology and Policy Graduate Program

University of California, Davis

*If Telecommunication Is Such a Good Substitute for*

*Travel, Why Does Congestion Continue to Get Worse?*

December 3, 2009

Jeff Schoenberg

Illinois State Senator

9th Legislative District

*How Optimal Is Optimal? Revealing the Realities of Implementing Transportation Solutions*

January 21, 2010

David Levinson

Associate Professor of Civil Engineering

Richard P. Braun/CTS Chair in Transportation Engineering

University of Minnesota

*The Fall and Rise of the I-35W Mississippi River Bridge*



Martin Beckmann



January 28, 2010  
 Martin Beckmann  
 Professor Emeritus of Economics  
 Brown University  
 Professor Emeritus of Applied Mathematics  
 Technical University of Munich  
*Equilibrium and Efficiency of Traffic Flows in Networks*  
 (Beckmann-McGuire-Winsten Revisited)

February 4, 2010  
 Teodor Gabriel Crainic  
 University of Quebec at Montreal,  
 Interuniversity Research Centre on Enterprise  
 Networks, Logistics and Transportation (CIRRELT)  
*City Logistics*

February 18, 2010  
 Halit Üster  
 Visiting Eshbach Scholar  
 Northwestern University  
 Associate Professor of Industrial and Systems  
 Engineering  
 Texas A&M University  
*Strategic Design of a Relay Network for Truckload  
 Transportation*

March 4, 2010  
 Irina Dolinskaya  
 Assistant Professor of Industrial Engineering and  
 Management Sciences  
 Northwestern University  
*Optimal Path Finding for Direction, Location and Time  
 Dependent Costs with Application to Vessel Routing*

April 1, 2010  
 H. Oliver Gao  
 Assistant Professor of Civil and Environmental  
 Engineering  
 Cornell University  
*Transportation, Environment, and Energy Systems from  
 Transportation Emissions Control to Public Health - Are  
 We Doing the Right Thing, and Doing it Right?*



Irina Dolinskaya

April 8, 2010  
 Moshe Ben-Akiva  
 Professor of Civil and Environmental Engineering  
 Massachusetts Institute of Technology  
*Plans and Actions in a Model of Choice*

April 22, 2010  
 Bruno De Borger  
 Professor of Economics  
 University of Antwerp, Belgium  
*A Political Economy Model of Road Pricing: Why Road  
 Pricing is Not Implemented*

May 6, 2010  
 Samer Madanat  
 Professor of Civil and Environmental Engineering  
 University of California, Berkeley  
*Some Unintended Impacts of Green Logistics Policies in  
 Urban Areas*

# WILLIAM A. PATTERSON TRANSPORTATION LECTURE AND ENDOWMENT



## Annual William A. Patterson Transportation Lecture

In April 2009, Dr. Craig E. Philip, CEO of Ingram Marine Group, was the esteemed speaker at the 2010 William A. Patterson Lecture. Philip's talk focused on domestic marine transport, a significant but underappreciated and often invisible part of the freight network in the United States. Philip provided a historic overview of the U.S. inland waterway system, offering a critical and analytical perspective on how the industry benefits the broader transportation supply chain and the unique service it provides to many U.S. shippers. His company, Ingram Marine Group, is the largest U.S. barge company. It transports bulk products with a fleet of more than 100 towboats and 4,000 of the industry's 20,000 barges.

Philip has a longstanding relationship with the NU Transportation Center and has been a member of its Business Advisory Committee for over ten years. He received his PhD at MIT in the late '70s, and began his career in the rail industry, having worked for Conrail and the Southern Pacific Railroad before joining Ingram more than 20 years ago.



William A. Patterson on the  
April 21, 1947 cover of *TIME Magazine*

## William A. Patterson Transportation Endowment

The Annual Patterson Transportation Lecture Series is supported by the William A. Patterson Transportation Endowment which was established in 1978 as the intellectual focal point for transportation research and education at Northwestern. It is named in honor of the late William A. Patterson, former president and CEO of United Airlines, lifetime trustee of Northwestern University, and co-founder of the NU Transportation Center. Center Director, Hani Mahmassani, is the current William A. Patterson Distinguished Chair in Transportation and NUTC faculty member Karen Smilowitz is the Junior William A. Patterson Professor of Transportation.

# Transportation Research Board Conference and Reception

## About the Reception

Each year in mid-January, transportation professionals from across the country converge in Washington, D.C. to attend the annual Transportation Research Board (TRB) meetings. TRB meetings are a place to share ideas, showcase significant findings and breakthroughs, and explore new research directions. Northwestern faculty and students were well represented during the 2010 TRB meetings delivering papers, serving on committees, and organizing and chairing sessions.

NUTC once again hosted its Annual TRB Reception and Alumni Reunion during the 2010 TRB meetings. Over 400 guests came to network with old and new friends and colleagues. Many guests are alumni of the Center's programs and regard NUTC's reception and reunion as the must-attend event of the year.



Hani Mahmassani, Justin Zubrod, and Jane Lapin (from right)



Attendees at NUTC's annual TRB reception



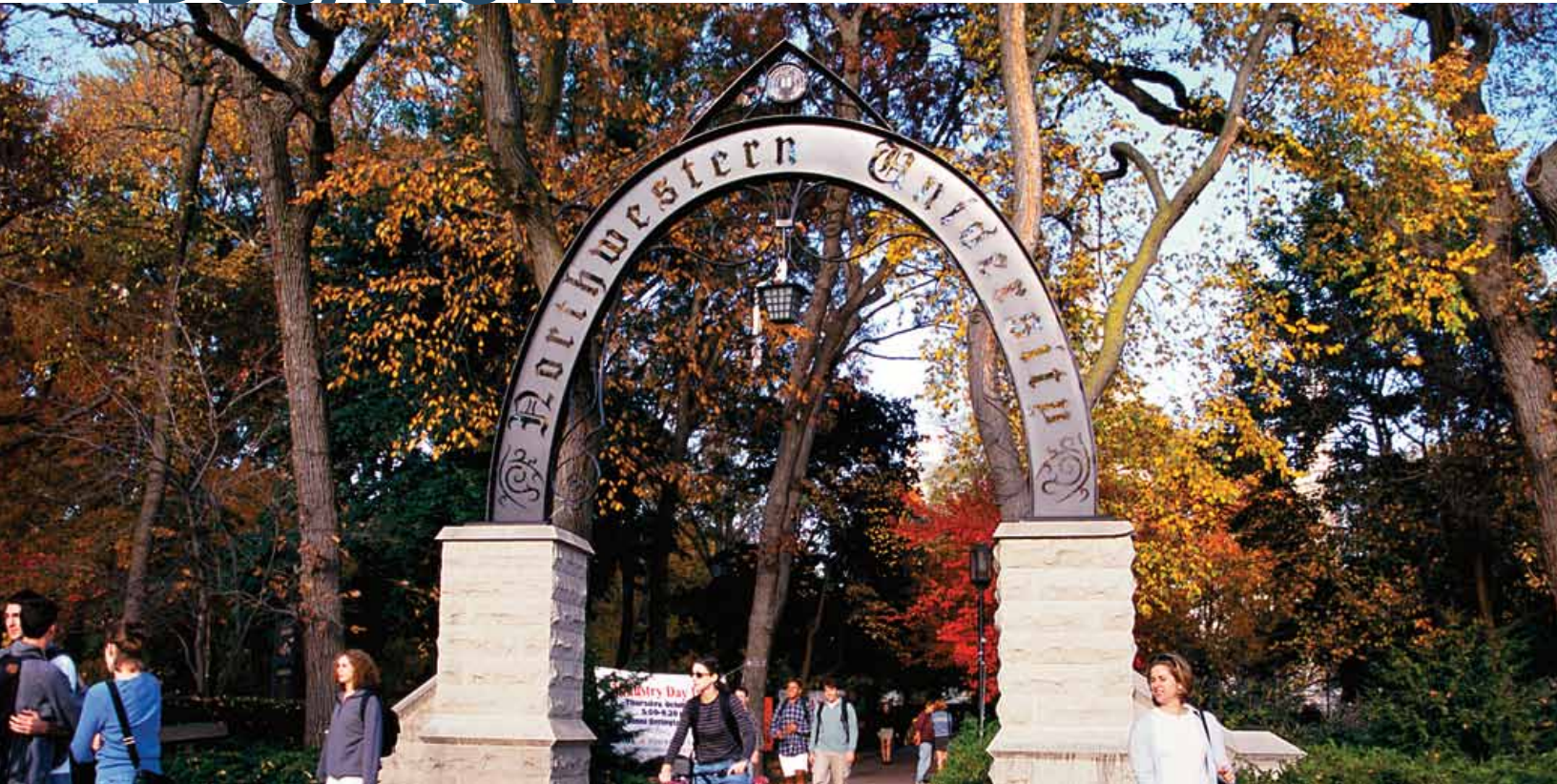
Chandra Bhat, Nick Vlahos, Brian Lee, and Patricia Mokhtarian



Current NUTC graduate students and friends



# EDUCATION



## Transportation Academic Programs

Northwestern University is recognized throughout the world as one of the premier institutions for transportation and logistics education and for the quality of its graduates. Northwestern's varied menu of interdisciplinary transportation programs at both the graduate and undergraduate levels prepare students for careers in diverse fields such as transportation operations, planning, engineering, and management in the private and public sectors, government service, consulting, and academia.

Transportation academic programs at Northwestern are specialized and thorough. Program structure balances highly technical and quantitative training in the engineering and mathematical fields with theories and applications drawn from the relevant disciplines of economics, management, finance, marketing, energy, and the social sciences. Each of these programs involves rigorous coursework, opportunities for involvement in research, and exposure to real-world learning experiences in the transportation industry.

### Undergraduate

- Interdisciplinary Minor in Transportation and Logistics

The minor is available to all Northwestern students, and its graduates benefit from an interdisciplinary approach to transportation and logistics education. Core courses come from the departments of Economics, Civil and Environmental Engineering, and Industrial Engineering and Management Sciences.

### MS/PhD

- MS and PhD in Transportation Systems Analysis and Planning
- MS and PhD in Industrial Engineering and Management Sciences
- MMM program — joint Master of Engineering Management and Masters of Business Administration

The Transportation Systems Analysis and Planning program included 25 students during the 2009-2010 academic year, with 55 students in the MMM Program. This year NUTC welcomed students from the United States, Republic of Korea, Iran, France, Germany, Switzerland, Turkey, and the People's Republic of China.

# Dissertation Year Fellowships

A primary goal of the Northwestern University Transportation Center is to promote academic excellence and research quality among its transportation students involved in graduate programs across campus. In support of this commitment, each year NUTC offers a number of Dissertation Year Fellowships to outstanding PhD candidates conducting thesis research on transportation, logistics, or supply-chain topics.

Dissertation Year Fellowships include full or partial funding to cover three quarters of tuition and a stipend for selected students during their final year of study.

## 2009-10 NUTC Dissertation Year Fellowship Recipients:

- Michael Huang, PhD Candidate, Industrial Engineering and Management Sciences  
Dissertation Topic: "Equity in Relief Routing"
- Marshall Lindsey, PhD Candidate, Chemical and Biological Engineering  
Dissertation Topic: "Energy Consumption and Greenhouse Gas Emissions Associated with Passenger Vehicle Use in Chicago"

Additionally, NUTC awarded a record number of Dissertation Year Fellowships for the 2010-11 academic year.

## 2010-11 NUTC Dissertation Year Fellowship Recipients:

- Hamed Alibabai, PhD Candidate, Civil and Environmental Engineering
- Elaine Croft McKenzie, PhD Candidate, Civil and Environmental Engineering
- Chan Seng Pun, PhD Candidate, Industrial Engineering and Management Sciences
- Xing Wu, PhD Candidate, Civil and Environmental Engineering
- Zitao Zhang, PhD Candidate, Civil and Environmental Engineering

# Student Awards

Laurence Audenaerd

- Awarded ISEN grant with Joe Schofer for dissertation research

David Baumgartner

- Awarded Eno Fellowship to attend 2009 Eno Transportation Foundation Leadership Development Conference

Elaine Croft McKenzie

- Awarded Fellowship in Leadership with the Northwestern Center for Leadership
- Received McCormick Dissertation Year Fellowship

Isabelle Ji

- Awarded Morris K. Udall Scholarship
- Murphy Scholar

Emily Kushto

- Presented paper at the Sixth Annual Inter-University Symposium on Infrastructure Management and won one of the top paper/presentation awards

Ömer Verbas

- Selected to receive 2009-10 ISEN Energy and Sustainability Cluster Fellowship

Zitao Zhang

- Received Institute of Transportation Engineers Scholarship Award and the Transportation Club International Annual Student Hooper Memorial Scholarship
- Received the American Society of Civil Engineers Graduate Scholarship in Transportation
- Selected as 2009-2010 Graduate Representative of the Advisory Board for ISEN



# COMMUNITY

The Northwestern University Transportation Center collaborates with dedicated scholars, professionals, and students from around the globe. Along with the world-class research and education happening at the Center, NUTC strives to foster a relevant and welcoming community for everyone in the NUTC family. By engaging those associated with NUTC by means of networking events, annual celebrations, clubs, and social networking, the NUTC community continues to thrive. NUTC regards the strength of its close-knit and friendly community as essential to the Center's longevity and success. Below are highlights from the 2009-10 year.

## Annual NUTC Picnic

Each year, the Northwestern University Transportation Center hosts a picnic to celebrate the year's accomplishments. The 2010 picnic, held June 4th, welcomed a large audience of students, researchers, alumni, and staff. Pictures from the picnic are below.



Sanghyung Ahn, Jiwon Kim, Lan Jiang, Hani Mahmassani, Omer Verbas, and Roger Chen



Diana Marek, Leon Moses, and Robert Gordon



Wilson Weizeng Zhang, Jian Feng Zheng, Arthur Zitao Zhang, and Yikai Chan



NUTC faculty members Irina Dolinskaya (back left) and Karen Smilowitz (front right)

## Lunar New Year

On March 1, 2010, thirty attendees welcomed the year of the Tiger with the third annual Lunar New Year Celebration at NUTC. NUTC's family of students, faculty, staff, and scholars came together to share a potluck dinner commemorating the new year as celebrated throughout much of Asia. The group enjoyed sharing culturally diverse dishes including traditional Chinese bao and moon cakes along with Korean gim-bahp, Iranian sabzeh pollo, Middle Eastern falafel, and classic chocolate cake for dessert.



## Social Media

### LinkedIn

With over 350 members, the NUTC LinkedIn Group is a dynamic professional networking medium to engage the NUTC community and other transportation professionals. Along with showcasing upcoming NUTC events of interest, the NUTC LinkedIn Group allows its members to connect with fellow members, announce available job positions, seek collaborators, as well as initiate and contribute to discussions regarding a range of transportation and logistics topics.



To join the NUTC LinkedIn Group, visit [transportation.northwestern.edu](http://transportation.northwestern.edu).

### Facebook

NUTC has two presences on Facebook, an NUTC Fan page and an NUTC Community Group page. Everyone has the option to “Like” the NUTC Fan page and receive important information on upcoming events and news of interest. The NUTC Community Group page is a special forum for close members of the NUTC community to keep in touch with one another. Unlike the NUTC Fan page, members of the Group page must be accepted.

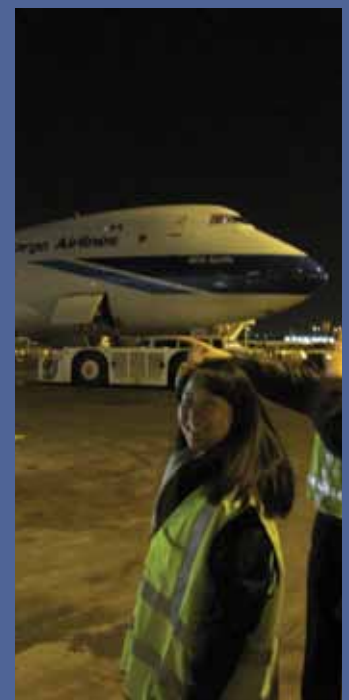


To join NUTC on Facebook, visit [transportation.northwestern.edu](http://transportation.northwestern.edu).

## Kellogg Transportation Club

In 2009-10 the Kellogg Transportation Club continued its work of engaging students in the airline, aerospace, railroad, ocean shipping and logistics (supply chain) industries. One of the club's events, organized by NUTC Business Advisory Committee member Shawn McWhorter, involved a special tour of Nippon Cargo Airlines' operations at O'Hare International Airport in Chicago.

The Kellogg Transportation club aims to raise student awareness and provide resources related to management opportunities with companies in these industries. Additionally, the club informs students about employment and recruiting opportunities and plans student events throughout the academic year.



# ORGANIZATION



Back row (left to right)  
Hani Mahmassani, Hillary A. Bean,  
Sarah Lowe (student), Bret Johnson  
Front row (left to right)  
Georgi Kostov (student),  
Rebecca Weaver-Gill, Diana Marek,  
Rachel L. Miller

