



Northwestern University Transportation Center

RESEARCH
OUTREACH
EDUCATION

2012 Progress Report



2012 Highlights

A leading interdisciplinary education and research institution, the Northwestern University Transportation Center (NUTC) serves industry, government and the public through a comprehensive research agenda, academic degree programs, executive education programs, and an array of outreach activities. Since its inception in 1954, the Center's mission has been to make substantive and enduring contributions to the advancement of transportation. The pursuit of the Center's mission is rooted in an interdisciplinary approach to transportation and logistics education and research. Its strength lies in the quality and productivity of its faculty, the focus on both scholarly and applied research, the Center's interactions with industry and public partners, and its continuous re-calibration to the forces generated as technology and society change.

NUTC exists to cultivate and share an 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.

Sponsored research projects active	27
Sponsored research proposals submitted	22
Dissertation Year Fellows supported	4
Students supported via research projects	33
Workshops, seminars conducted	27
Conferences, symposia, distinguished lectures organized	6
New members to the Business Advisory Committee (BAC)	7
Total BAC membership	81



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Northwestern University
Transportation Center



From the Director

“The transportation problem is solved.” What would that mean exactly? Getting to work and back home is now painless and friction-free, we enjoy unprecedented levels of affordable mobility, deliveries are made in record time and always on schedule, travel is again a joy and a source of pleasure, the carbon footprint of our mobility is negligible, highway crashes and rail-pedestrian accidents are essentially eliminated, and quality of life in our cities has never been higher and more ubiquitous.

An unlikely scenario, unfortunately, though it is not altogether far-fetched. But we know all too well that the reality is one of increasing congestion, decaying infrastructure, unreliable and unpredictable service times, and generally diminishing expectations for physical mobility, all the while ratcheting those up for our virtual mobility, or wireless-driven telemobility. The need for imaginative approaches to our transportation challenges continues to grow, and the Northwestern University Transportation Center is an increasingly important hub of activity, scholarship and industry-driven research and innovation for the transportation sector.

Several big themes continue to permeate our research activities—perhaps none as pervasively as the growing availability of data, new types of data, and more of it across most transportation systems. Data on system performance through growing deployment of fixed infrastructure-based sensors, fleet monitoring and management through vehicle-based sensors, individual experienced service levels through tracking devices, user satisfaction through a growing array of survey techniques, opinions and attitudes through social media interactions, vehicular and pedestrian data using flying drones, transit use patterns through automated fare payment systems, detailed transaction data for carriers and shippers, and of course the ubiquitous handset with increasing sensing functionality and two-way interactivity.

The NUTC research portfolio features several projects covering a range of applications, modal contexts, and industry segments. The main focus is on how to leverage the data to improve decision-making at various scales, and how to transform it into actionable knowledge, building the transportation science base and the advanced analytics such knowledge enables. Combining historical data with real-time streams from multiple sources provides the basis for estimation and prediction of the system state, and enables development and deployment of predictive management

strategies (traffic control, load assignment and routing decisions). Archiving huge volumes of sensor information and transactional data is creating huge data warehouses, which our students and researchers are mining to discover and uncover hidden gems of wisdom and knowledge to improve strategic thinking and policy decisions regarding transportation and mobility.



The stories and images featured in this Progress Report provide a glimpse into our research program, our diverse outreach and dissemination activities, and the unique community that is the NUTC. It conveys the dynamism of our faculty and student researchers, and the rich intellectual and professional environment that the Transportation Center at Northwestern provides for the study of transportation systems. There is never a dull moment at the NUTC, and no shortage of challenges to motivate and stimulate our researchers. Through its strong base of industry support and interaction, NUTC provides researchers and students opportunities for first-hand engagement in problem solving. Through the commitment and vision of our supporters, public and private, important advances in the state of the art are being charted at the NUTC, with direct bridges towards application in a real-world setting to correspondingly advance the state of the practice. It is our sincere hope that you experience this Progress Report in the same spirit of excitement in which the work and activities it describes have been accomplished.

A handwritten signature in black ink, appearing to read 'H. Mahmassani'.

Hani Mahmassani

*Director, Northwestern University Transportation Center
William A. Patterson Distinguished Chair in Transportation*

Collaboration & Outreach Highlights



Regional & National

NUTC co-organized the 5th Annual Lipinski Symposium on Transportation Policy: *High Speed Rail: Perspectives and Prospects.* (story p. 29)

Ian Savage organized and **NUTC** hosted the Symposium: *Transportation Deregulation and Safety: A Retrospective and Reflection after 25 Years.* (story p. 30)

Allan Mulally, President and CEO of Ford Motor Company, delivered the 2012 Patterson Lecture in Transportation: *The Ford Story.* (story p. 32)

NUTC was well represented in the technical program of the 91st Annual Meeting of the Transportation Research Board, with strong participation by faculty and students. (story p. 31)

NUTC hosted a White House Roundtable featuring NHTSA Administrator David Strickland. (story p. 30)

NUTC hosted workshops: *Improving the Customer Experience in Travel and Transportation Using Information Technology;* and *The Electrification of Transportation: A Look at the Road Ahead.* (story p. 34)

SYMPOSIA, CONFERENCES, & COMMITTEES



NUTC co-hosted, with Booz Allen Hamilton and the Chesapeake Crescent Initiative, a two-day multi-city exercise to identify potential infrastructure solutions. (story p. 36)

Google provided a *Google Research Award* to Karen Smilowitz's and Irina Dolinskaya's Humanitarian Logistics Initiative to utilize mapping technologies in developing dynamic disaster relief routing models. (story p. 20)

NUTC is part of a team led by SAIC, Inc. selected by U.S. FHWA to advise and operate a research program in connection with a new advanced Traffic Operations Laboratory at Turner-Fairbanks in Virginia.

RESEARCH COLLABORATION



Research, Analysis, Advising

- Chicago Metropolitan Agency for Planning
- Chicago Transit Authority
- Illinois DOT
- PACE Transit
- Chicago DOT
- FHWA, U.S. DOT

Based on **NUTC** research and analysis led by Hani Mahmassani and Joseph Schofer, the Chicago Transit Authority (CTA) devised and implemented a major plan to add over 50 bus and train routes, optimizing allocation of resources to improve service to its customers. (story p. 16)

NUTC and the FHWA conducted a Travel Behavior Workshop at Northwestern. Presentations were given by international experts from academia and practice. (story p. 30)

REGIONAL AND FEDERAL AGENCIES



Research Partners

- American Waterways Operators
- BNSF Railway
- The Boeing Company

- Booz Allen Hamilton, Inc.
- Delcan, Inc.
- Echo Global Logistics
- Ford Motor Company

- Phillips International
- Sabre Holdings
- SAIC, Inc.
- TomTom International BV

INDUSTRY RESEARCH



International

SYMPOSIUM, CONFERENCES, & COMMITTEES

Hani Mahmassani served on Committee to review all Civil Engineering research programs in the Netherlands.

Aaron Gellman serves on the Panama Canal Advisory Board.

NUTC faculty and affiliates presented papers, conducted workshops, and participated in conferences in:

- Beijing, China
- Beirut, Lebanon
- Berlin, Germany
- Chalkidiki, Greece
- Delft, The Netherlands
- Dubai, UAE
- Guangzhou, China
- Hong Kong, China
- Istanbul, Turkey
- Lausanne, Switzerland
- Oberwolfach, Germany
- Riyadh, Saudi Arabia
- Santiago, Chile
- Sydney, Australia
- Toronto, Canada
- Vilnius, Lithuania

NUTC organized and hosted the 2nd International Conference on Evacuation Modeling and Management (ICEM), with over 70 researchers from 10 countries attending. *(story p. 28)*

NUTC, through faculty affiliate Ian Savage, has been selected to host the International Transportation Economics Association (ITEA)'s 2013 Kuhmo Nectar Conference and Summer School.

NUTC was selected to host the 22nd International Symposium on Traffic and Transportation Theory (ISTTT) in 2017.

RESEARCH COLLABORATION

Hani Mahmassani has provided expert assistance to a development consortium in Indonesia, mapping out subjects for future training and research:

- Infrastructure Development
- Economic Development
- Transportation and Land Use
- Planning and Development
- Sustainable Design and Practices
- Communication and Public Policy

NUTC hosts and contributes faculty to Chalmers University of Technology, Sweden, for their Supply Chain Management professional education program.

Karen Smilowitz worked with Professor Martin Savelsbergh, University of Newcastle, Australia, to develop modeling and solution approaches to patient scheduling problems in community-based health care for chronic disease.

Supported by the Volkswagen Foundation, Dirk Brockmann and a team of researchers have developed new ways to look at complex transportation networks. *(story p. 23)*

GOVERNMENTS, AGENCIES

NUTC provided continuing technical assistance to the Kingdom of Saudi Arabia's Ministry of Transportation, as they develop a national Roads & Transportation Research Center.

Irina Dolinskaya and Karen Smilowitz, through the Humanitarian Logistics Initiative, have led pioneering logistics research and tool development efforts to aid international, national, regional and local agencies in disaster relief efforts in locations such as Haiti. *(story p. 20)*

CCITT

CENTER FOR THE COMMERCIALIZATION OF INNOVATIVE TRANSPORTATION TECHNOLOGY

The Center for the Commercialization of Innovative Transportation Technology (CCITT) is part of a nationwide University Transportation Center program operated and funded by the Research and Innovative Technology Administration of the US Department of Transportation. CCITT fosters the implementation of innovative technologies for all 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 translational “innovation gap” research projects that reduce technical risk barriers and enhance opportunities for technology adoption (commercialization) by industry and transportation agencies.

During the 2011-2012 academic year, CCITT awarded two research projects to Northwestern faculty. The projects included: a framework and proposed online tool for estimating emissions of freight transport operations from the Department of Civil and

Environmental Engineering; and a pilot study with the Chicago Transit Authority involving the development of a spatial software application to investigate transportation mobility boundaries in complex transportation networks from the Department of Engineering Sciences and Applied Mathematics. Faculty delivered final reports for Evaluation and Application of Super-Tough Steel for Use in Tank Cars Transporting Cryogenic Liquids, Strategic Gang Scheduling for Railroad Maintenance, and An Agent-Based Information System for Electric Vehicle Charging Infrastructure Deployment. These most recent projects have spurred further collaboration with Union Tank Car Company, BNSF Railroad, and electrical vehicle infrastructure providers. CCITT also provided partial financial support for two dissertation year graduate fellows, Laurence Audenaerd and Yang Liu.

Key numbers for program lifecycle (2006-12)

Projects funded – 15
 Faculty member principal investigators – 15
 Academic departments engaged – 6
 Students supported – 25
 CCITT funding committed – \$1,273,300

Transportation Library

The Transportation Library was founded in 1958 to support NUTC’s curricula and research programs. Containing close to 500,000 items, the Northwestern University Transportation Library 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 materials, 18th-21st century transportation companies’ annual

reports and its paper collection of environmental impact statements (EIS) is one of the most complete in the world.

The Transportation Library’s staff produces 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.

The Library’s collections are available to the general public Monday through Friday 8:30 p.m. – 5:00 p.m., and it provides reference assistance via email, telephone or in person.

Roberto Sarmiento,
 Transportation Library
 Department Head



Key numbers

Items in the library collection – 492,193
 Environmental Impact Statement (EIS) volumes in collection ~ 48,000
 Citations on our TRAN Article File database – 373,247
 Transportation Library volumes to Google for digitization: ~51,000

NUTC's 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 RITA of the US Department of Transportation. 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 on 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. Co-located with NUTC in Chambers Hall, NICO increasingly collaborates with NUTC in the interdisciplinary field of network science.



We continue to recognize that transportation issues are inherently multidisciplinary. Collaborative and innovative links across knowledge and research boundaries are essential. Areas of focus include:

- Rail and auto traffic corridors with their infrastructure needs, environmental impacts, and system behaviors
- Air and land transportation hub facilities and routes that can benefit from complex network analysis and insights into scheduling and resource allocation.

Institute for Sustainable Practices

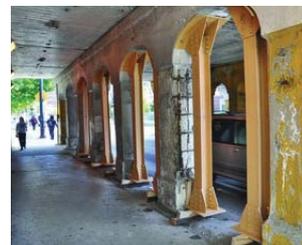
This partnership between Argonne National Laboratory and Northwestern facilitates joint research and educational initiatives to achieve sustainability in human and ecological systems. The Institute's scope encompasses energy and other natural resources, and its work includes development of tools for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



ITI Researchers continue to work on Remote Structural Integrity Monitoring of overpasses, bridges, and ramps.

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

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

Faculty Affiliates and Researchers

Elodie Adida

Assistant Professor of Mechanical and Industrial Engineering, University of Illinois at Chicago
 Mathematical modeling, optimization, game theory, supply chain management, disaster preparedness and operations research in health care

Hamed Alibabai

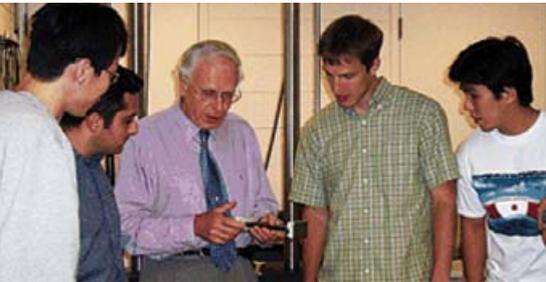
Post-Doctoral Research Fellow, Transportation Center
 Network flow modeling, simulation, system dynamics, theory, logistics, behavior modeling

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

**Zdenek Bazant**

McCormick Institute Professor and Walter P. Murphy Professor of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science
 Mechanics of materials and structures and structural safety, nanomechanics, and hygrothermal effects, and with applications to concrete, fiber composites, tough ceramics, rocks, soils, bone, snow and sea ice

**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

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

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

J. Edward Colgate

Allen and Johnnie Breed University Professor of Design, Mechanical Engineering; Co-Chair, Segal Design Institute, McCormick School of Engineering and Applied Science
 Human-machine interface, haptics, mechatronic systems

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

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**

Junior William A. Patterson Professor of Transportation; 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

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 Light-weight metallic materials (alloys, composites, foams and sandwiches) for energy-efficient transportation; high-temperature alloys for energy-efficient internal-combustion and jet engines

The interdisciplinary nature of transportation-related challenges and opportunities has led to a breadth and depth of NUTC affiliations and activities that is unmatched on any university campus. — HANI MAHMASSANI, DIRECTOR, NUTC

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, sustainability data analysis

**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

Andreas Frei

Visiting Scholar, The Transportation Center, McCormick School of Engineering and Applied Science Social networks and their implication on travel behavior; analysis of activities; modeling of transport behavior; changing behavior towards a more sustainable transport system

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

Faculty Affiliates and Researchers

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; 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](#)

Thomas N. Hubbard

John L. & Helen Kellogg Professor of Management and Strategy; Chair, Management and Strategy Department, 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](#); [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](#)

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](#)

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 and mechanical properties of grouted sands](#); [disposal of waste slurries](#); [problems involving soil-structure interaction](#); [engineering behavior of dredged materials](#); [dynamic response of soils](#)



Hani S. Mahmassani

Director, Northwestern University Transportation Center; William A. Patterson Distinguished Professor of Transportation, McCormick School of Engineering and Applied Science [Multimodal transportation systems analysis, planning and operations; dynamic network modeling and optimization; dynamics of user behavior and telematics; telecommunication-transportation interactions; and real-time operation of logistics and distribution systems.](#)

Suengjae Lee

Visiting Scholar, The Transportation Center; Professor in the Department of Transportation Engineering, the University of Seoul [Data modeling using big data, large scale activity based modeling, futuristic urban forms \(Compact.vs. Sprawl\) using integrated land use and transportation models](#)

Shinhae Lee

Visiting Scholar, The Transportation Center; Research Fellow at the Seoul Institute [Pedestrian oriented planning, efficient public transport operations, sustainable transport planning in terms of smart growth and transit oriented development](#)

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

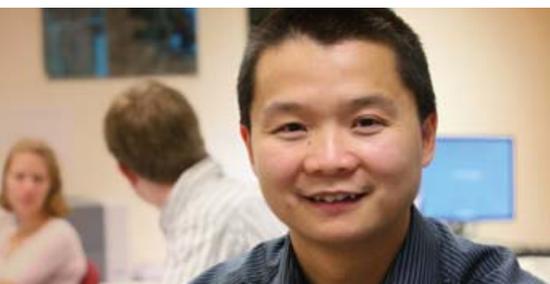
Professor Emeritus of Economics, Weinberg College of Arts and Sciences [Applied microeconomic analysis; logistics and transportation economics; economics of regulation safety and risk; urban and regional economics](#)

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

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 [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](#)

Alberto Salvo

Assistant Professor, Management and Strategy, Kellogg School of Management [Industrial organization, international trade, environmental economics, applied microeconomics, strategy](#)

Roberto Sarmiento

Library Department Head, Transportation Library, Northwestern University [Management issues for the digitization of transportation collections; analysis of transportation library's collection at the national level; the role of journal article indexing in a full text world](#)

Ian Savage

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



Faculty Affiliates and Researchers



Karen Smilowitz

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; humanitarian logistics

Richard Sobel

Visiting Scholar, Buffett Center for International and Comparative Studies
Political science, public opinion and policy; intersection of security and domestic politics, civil liberties, right to travel, and travel privacy, security and identification policies; housing and community development, and transportation articulation

Joseph A. Swanson

Visiting Scholar, Zell Center for Risk Research, 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



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

Jan A. Van Mieghem

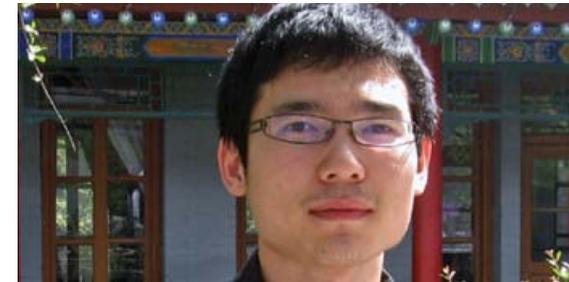
Harold L. Stuart Professor of Managerial Economics; Chair of Department of Managerial Economics & Decision Science; Professor of Operations Management, Kellogg School of Management
Operations management and strategy; supply-chain management and analysis; management and investment under uncertainty (e.g.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

Jun Xie

Visiting Scholar of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science, Transportation Engineering College, Tongji University
Transportation network analysis



New to NUTC



Jonathan Hall

Post-doctoral Research Fellow, Transportation Center, McCormick School of Engineering and Applied Science
Recipient of the Dan Searle Fellowship in Economics. Applied micro-economic theory; transportation economics; urban economics; and industrial organization



Michael Watson

Adjunct Professor, Department of Industrial Engineering and Management Sciences, McCormick School of Engineering and Applied Science
Supply Chain network design and facility location; analytics for the supply chain

Faculty Recognition

INVESTITURE OF NEW CHAIRS

Irina Dolinskaya

Junior William A. Patterson Professor in Transportation
McCormick School of Engineering and Applied Science

AWARDS AND APPOINTMENTS

Jan D. Achenbach

Awarded the 2012 Medal: American Society of Mechanical
Engineers (ASME)

Zdenek Bazant

Appointed Honorary Professor Southeast University, Nanjing, China
2012; Appointed Honorary Professor Xi'Yan Jiaotong University, Xi'Yan,
China 2012; Symposium in honor of Prof. Bazant, Annual ASCE
Engineering Mechanics Conference at the University of Notre Dame, Indiana

Fabian Bustamante

Awarded Second Prize in *Apps for Metro Chicago's (A4MC)*
Grand Challenge with app: *Trailblaze Chicago*

David Dunand

Named One of the 2012 Class of Fellows by The Minerals, Metals &
Materials Society

Paul Hirsch

Received the "Best Paper Award" from the Western Academy of
Management (with Franz Wohlgezogen)

Joel Horowitz

Awarded the Econometric Theory Multa Scripsit Award

Mark Ratner

Selected as the 2012 Willard Gibbs Medalist by the American
Chemical Society

Roberto A. Sarmiento

Appointed Chairman of TRB Library and Information Science for
Transportation Committee (ABG40);
Elected a Fellow of the Special Libraries Association (SLA)

Joseph Schofer

Named National Associate of the National Research Council of the
National Academies

Fred W. Turek

Named member of the Sleep Research Society's (SRS) Board of
Directors

ENDOWED AND KEYNOTE LECTURES

Hani Mahmassani

Keynote Lecture, LATSIS Symposium 2012 – 1st European Symposium
on Quantitative Methods in Transportation Systems; Lausanne,
Switzerland

Joseph Schofer

Presented the Melvin Webber Memorial Lecture at University of
California, Davis

NOTEWORTHY ACHIEVEMENTS

Zdenek Bazant

Elected Honorary Member, (ASME); presented the 2011
College of Engineering Distinguished Lecture at the University
of Miami, Corral Gables, FL; presented the 2012 School of
Engineering Endowed Lecture at the University of Akron, Ohio

Fabian Bustamante

Invited as visiting professor by the Computer Science
Department at the Universidad de Buenos Aires, Argentina

Irina Dolinskaya

Named to the 2011-2012 Northwestern Associated Student
Government Faculty and Administrator Honor Roll

Joel Horowitz

Member of Steering Committee for Workshop on Future
Directions for the National Science Foundation National
Patterns of Research and Development Programs, National
Research Council; Member of International Organizing
Committee for first conference of the International Society for
Nonparametric Statistics

Diego Klabjan

Launched McCormack School of Engineering and Applied
Science's Master of Science in Analytics

Hani S. Mahmassani

Chair of the 2nd International Conference on Evacuation
Modeling and Management

Member of Scientific Committees of 5th International
Symposium on Transportation Network Reliability (INSTR),
Hong Kong; 5th International Workshop on Freight
Transportation and Logistics (ODY SSEUS 2012), Greece.

Appointed to Editorial Board of new EURO Journal on
Transportation and Logistics.

Theresa J. McGuire

Appointed chair of a National Academies of Science/
Transportation Research Board study committee:
The Committee on Transportation Investments in Response
to Economic Downturns

Ian Savage

Chair of the Organizing Committee for the 2013 Summer
School and Annual Conference to be held at Northwestern,
International Transport Economics Association; Chair of
Local Arrangements Committee, Econometrics Society 2012
North American Summer Meeting; Co-Chair of the "Safety
Analysis and Policy" Special Interest Group of the 2013 World
Conference on Transport Research (WCTR)



Reinventing the User Experience in Transportation

In an age of anytime anywhere access to our virtual destinations, and ever greater expectations of effortless and near instantaneous communication, our everyday experience with physical mobility continues to deteriorate. From crumbling antiquated infrastructure to crippling congestion, long waiting lines to crowded planes and transit vehicles, to missed time windows for critical freight deliveries, the quality of the user experience is falling across the spectrum of transportation systems and services. 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 have become the center of community oases, succeeding at providing, paradoxically, personalization to a mass audience.

Drawing upon the lessons of highly successful consumer products and service concepts, reinventing the user experience calls 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 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 Massive Change Network (led by Bruce Mau

and Bisi Williams) in addressing the challenge of reinventing the public transit user's experience through a combination of physical design, service reconfiguration, and customer engagement.

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 providing 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. Key BAC industry partners include Teradata and Echo Global Logistics. Agency collaborators include the Chicago Transit Authority and PACE transit.

Humanitarian Logistics

The Humanitarian Logistics Initiative at Northwestern University, spearheaded by NUTC faculty affiliates Karen Smilowitz and Irina Dolinskaya, concerns itself with research that applies a broad range of engineering sciences and tools to solving the critical problems that arise in the chaotic arena of disaster relief distribution operations. Advances in geographic information systems (GIS) technologies, mobile communications platforms with social media features, optimization techniques, networking power, and the decision sciences are now being brought to bear on challenges such as:

- relief supply vehicle routing in uncertain, rapidly changing settings
- search and rescue that takes into account real-time information on access road networks and infrastructure conditions
- enhanced tools and methods for locating and setting up mobile health clinics in relief zones.



Emerging Challenges in transportation

The Initiative encompasses three interrelated fields:

- (1) humanitarian logistics involves the coordination of people, organizations, and materials to deliver goods and services to people in need;
- (2) evacuation logistics and management entails moving affected populations out of harm's way and providing for their needs during and after the process; and
- (3) non-profit logistics focuses on the operations of nonprofit organizations at local, regional and national levels

In all categories the research aims to provide the data necessary for reliable decision-making by integrating relief routing models with new streams of imagery, mapping, and crowd-sourced real-time data into tools usable by aid practitioners in real settings. In addition, understanding the psychological and sociological aspects of human response in these situations is essential.

Transportation Energy and Sustainability

In the United States, transportation accounts for approximately thirty percent of overall carbon emissions. The desire to reduce this contribution and decrease reliance on uncertain fuel supplies drives the recent surge in research related to transportation energy and sustainability. 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.

The areas addressed by NUTC faculty and researchers under this broad effort include the following:

- Vehicle electrification, and its infrastructure and economic implications
- Logistics aspects of non-conventional fuels and production techniques (e.g. fracturing)
- Green fleet management strategies, carbon accounting and life-cycle analysis
- Market adoption of new technologies and services
- Behavior change towards green practices, and the role of personal tracking devices and social media
- Urban transportation planning for walkability and non-motorized mode use.

Affiliated faculty members at Northwestern apply a variety of analytical (data mining and forecasting), decision-making, modeling, optimization and information technology skills to the above topics. NUTC faculty affiliates are experienced in both developing and applying numerous operational, economic, and financial models to solve diverse energy, environmental, economic, and policy problems. NUTC works closely with two synergistic programs on the Northwestern campus: the Initiative on Sustainability and Energy (ISEN) and the Center for Energy Efficient Transportation (CEET).

Research at NUTC is driven by major challenges facing the transportation industry and society. Mobility, safety, environment, energy, economic development, resilience, infrastructure renewal, and financial sustainability continue to be at the forefront of the policy agenda for transportation agencies. Competitiveness, globalization, collaboration, uncertainty, volatility and technological change are major drivers of strategic and operational decision-making for transportation enterprises.

The portfolio of research projects and activities at NUTC is continually evolving to anticipate, identify, and characterize significant challenges and problem areas faced by the transportation industry, in both private and public sectors, as well as at their interface. Faculty and student researchers work together with industry and agency partners at gathering information and 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 Transportation Center has identified eight emerging challenge areas:

- **Re-inventing the user experience in transportation**
- **Humanitarian logistics**
- **Transportation energy and sustainability: technology, economics, markets, behavior**
- Connected 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 targeted efforts both inside Northwestern as well as with our industry and agency partners. The top three in this list have gathered considerable momentum in the past couple of years, and are featured in this report.

CORE RESEARCH

Our 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 that can be utilized by industry, business, and government to support decision-making towards 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 12 pages present selected ongoing or recently completed projects in these areas.

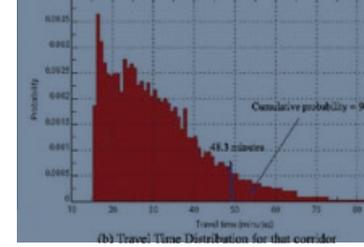
Chicago Transit Authority (CTA): Systemwide Approach to Service Design

Through a working relationship with the Northwestern University Transportation Center, an ongoing program of research and analysis is providing the CTA with a comprehensive assessment of service levels, using data collected from the entire transit system in connection with an optimal allocation model developed by the NUTC. With this information, the CTA has devised and implemented a major plan to restructure service, which affects over 50 bus and train routes, shifting resources from underutilized network services and relieving overcrowding on others. "NUTC researchers were brought in to take a fresh look at the problem," remarked Hani Mahmassani, NUTC Director. Northwestern's expertise provided the rigor, objectivity, clarity and analytics necessary to inform the Authority's decisions and actions that would affect services and riders in one of the nations largest metropolitan transit systems.

The NUTC research team, led by Mahmassani and Professor Joseph Schofer in collaboration with the CTA service planning and scheduling staff, developed a detailed model of bus service in the CTA service area. The model served as a basis for optimizing utilization of resources (e.g. fleet vehicles and operating budget) to provide bus service that benefits the largest number

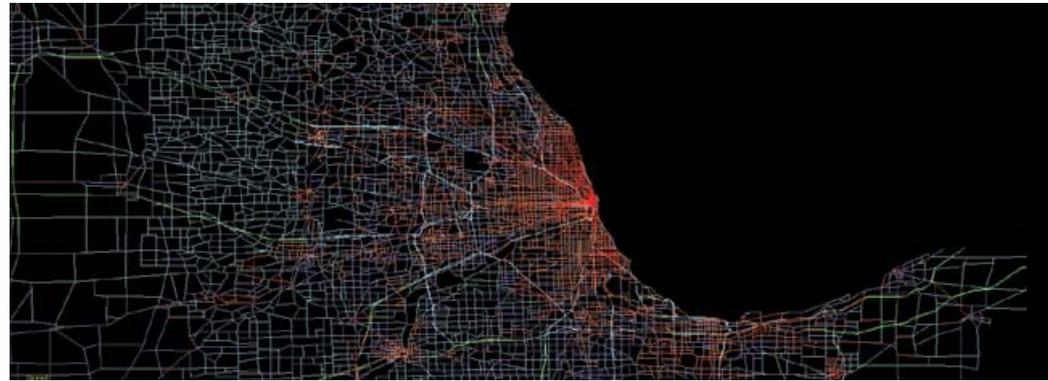


Photo: Chicago Tribune



“This route restructuring, based on a comprehensive review of the entire transit system, is long overdue and is the first system-wide, holistic review of CTA’s bus and rail service in 15 years,”

—Forrest Claypool, President, Chicago Transit Authority (CTA)



of riders with the best attainable service levels. Several model formulations were developed to enable consideration of trade-offs among multiple objectives in determining optimal bus headways for all bus route patterns and time periods.

The research team, which included graduate researchers Omer Verbas, Charlotte Frei, and Raymond Chan and post-doctoral fellow Hamed Babai, pushed beyond the boundaries of past studies and pursued a higher level of detail than typically considered in transit service design scenarios. Demand sensitivity (elasticity of ridership) based on a comprehensive analysis of historical ridership levels for the CTA network was determined at the route and stop level, recognizing temporal patterns in demand taken at 30-minute intervals. The analysis involved over 500,000 data points. By explicitly incorporating the concept of “service patterns” in conjunction with given routes, the platform also served as a basis for incremental changes to route service patterns.

The focus of the first phase of the study was directed at the fixed-route, fixed-service bus network. However, the basic network model provides a platform to evaluate the entire CTA service as an integrated system, optimizing overall service quality through better service integration and resource utilization across both bus and rail services. Ultimately, the work seeks to contribute to the improvement of the system’s user experience, while at the same time increasing efficiency through optimal resource utilization. ■

Reliable Routing in Transit Networks

Riders can have a less than ideal experience using public transit in metropolitan and rural areas due to a wide variance in transit headways. NUTC principal investigator Yu (Marco) Nie and his students are developing routing algorithms to incorporate reliability attributes of transit routes in planning tools and in rider information systems for trip planning purposes. The mathematical principles and methodologies that drive the tools will allow transit agencies to better evaluate the reliability of their bus systems and improve service to their ridership.





Reliable Routing in Transit Networks (continued)

Travel reliability is a critical dimension in the user experience of public transportation services. Prior to this project, Nie, his research assistants, and a collaborator at CTA surveyed commuters from the Chicago metropolitan area and found that travel reliability is the second most important factor that affects commuters' route choices, next only to travel times. Transit systems are affected by uncertainties of various sorts, ranging from extreme weather conditions and serious traffic accidents to unforeseeable mechanical failures and human errors, in addition to variability in demand patterns. While these uncertainties could adversely disrupt transit services, their overall impacts are rarely documented and understood in existing systems. As a result, neither transit operators nor transit users are able to make proactive decisions to ensure reliable travel. Ignoring the impacts of uncertainties often results in misallocation of limited resources in the transit system.

From the user point of view, the lack of reliability either encourages overly conservative risk-averse behavior or leads to uncomfortable, and sometimes disastrous, disruptions. Not surprisingly, almost half of the commuters who responded to the commuter survey described their transit service as "unreliable."

The researchers are developing enhanced routing algorithms that will help transit agencies measure and analyze the reliability performance of transit services and help travelers hedge against uncertainties in transit networks. In partnership with the (CTA) and bus tracking applications available from Google Inc., the goal of the project is to implement a prototype reliability-based transit route planning tool, test it on a real-world transit network, and evaluate the proposed methods and tools. ■

Shortest Path Tomography: A Tool for Optimizing Public Transit Networks

Dirk Brockmann is pursuing the challenge of creating effective ways of seeing heretofore hidden structures and relationships in networks: tools that will enable urban transit systems to improve their performance and increase their practical capacity to serve additional riders.

Shortest Path Tomography (SPaTo) and Transportation Networks

Brockmann's team, including graduate students Olivia Woolley-Meza and Isaac Velandó, are applying mathematical algorithms recently developed in Northwestern's engineering/math lab that are based on an emerging area of computer science known as network tomography—the visualization and analysis of a complex network's internal characteristics by means of analyzing external end point or node data. These tools enable extracting essential and salient features from available large scale network data.

New User Interface to Help Manage Transit Systems

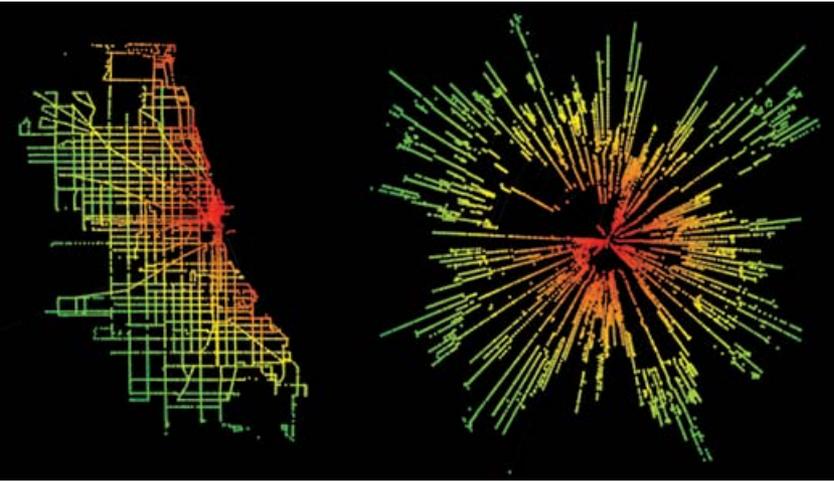
This CCITT-sponsored project is extending SPaTo technology to the urban transit system. The team is creating a user interface that bridges the gap between local and global network perspectives by providing a novel view of an entire transit network from a manager's or controller's specified perspective. Its capabilities will detect and visualize hidden structures in complex, multi-scale and time-dependent transit systems. Implicit transit-related geographic subdivisions and de facto boundaries—all affecting the flow of riders—will become visible and can then be addressed through modifying mode-specific or time-dependent parts of the complex network. The interface will make it possible to model changes within the system. The consequences of adding/removing service to specific locations or adjusting routes can be simulated and tested interactively without resetting or restarting the simulation.

Pilot Study with the CTA

A prototype version of the software is up and running in Brockmann's lab and has been applied to multi-scale, complex networks in various hypothetical settings. Work is underway to bring the interface and

CORE RESEARCH

IMPROVING TRAVEL NETWORK MODELS



Above left, a conventional geographic map of the Chicago Transit bus network. At right is a SPaTo representation showing the *effective distances* from the central downtown area.

coding to pilot study readiness—a sophisticated, scalable and platform-independent computational software application tailored to urban transportation and transit systems. The pilot study and application benchmark is being developed in collaboration with the Chicago Transportation Authority (CTA), where the rubber meets the road (or the steel meets the rails), in one of the United States' largest metropolitan areas. ■



Analysis of Network and Non-Network Impacts upon Traveler Choice: Improve Modeling Accuracy for Better Transportation Decision-Making

Developments in simulation-based network models have provided a good platform for integrating user choices in operational analysis tools, especially with regard to incorporating route choice and responses to traveler information in modeling traffic flows in highway networks.

However, the need for methods to evaluate the relative impact of a growing array of system management measures and policies, involving both network characteristics and non-network elements, calls for providing a richer behavioral basis than currently available in existing tools. The missing element in many cases tends to be in the representation of traveler choices in a network setting, and the influence of both network and non-network variables on these choices.

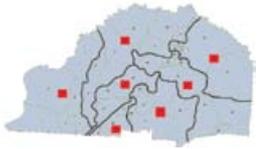
This study, conducted for FHWA under subcontract to SAIC, Inc. with Dr. Mahmassani as principal investigator, in collaboration with Emeritus Professor Frank Koppelman, addresses this important gap in modeling capability. The results aim to support a variety of initiatives that seek to improve traffic conditions and system safety and sustainability by targeting user choices before and during their travel. The main emphasis of this effort is on travelers' higher-level, predictive, strategic choices as these might be influenced by a range of variables that include experienced system performance (such as recurrent and non-recurrent congestion, and travel time reliability), environmental factors such as weather that affect both system performance as well as activity engagement opportunities, availability and accessibility to alternative modes, availability and cost of parking, bike lane treatments, quality of the walking environment reflected through sidewalk availability, as well as measures such as pricing, information supply, dynamic traffic management, and so on.

A thorough understanding of the determinants of travel choices and behavior, and an operational ability to model their dependence on key attributes of the transportation system, network performance, as well as non-network factors, will provide a foundation for designing effective interventions to improve system performance, and for evaluating different policies and options by predicting how users will respond to these measures. ■



Integral to the *Traveler Choice* research project was a workshop conducted at Northwestern on November 30, 2011. At the event, a panel of experts gathered to assess the state-of-the-art versus the state-of-the-practice in travel behavior research and modeling.

Integration of Real-time Mapping Technology in Disaster Relief Distribution



In one of the Humanitarian Logistics Initiative's previous projects: *Decision-Making Tools for Distribution Networks in Humanitarian Relief*, the research group developed a better process for assigning area zones to local search and rescue teams. Rather than employ the current standard of a rectangular grid map, the redrawn search zones take into account factors such as population density and road accessibility. The result is a set of mapped zones (above) that can facilitate a more fluid and optimized search and rescue operation.

Building on the results of their recent ground-breaking research in the emerging field of Humanitarian Logistics, Irina Dolinskaya, Karen Smilowitz, Dr. Jennifer Chan, and student researcher Teresa Chen have developed a set of test bed scenarios for the evaluation of relief routing strategies—paving the way toward improved distribution of relief supplies in humanitarian settings.



Vehicle routing in humanitarian logistics, such as disaster relief distribution, involves many challenges that distinguish these problems from those in commercial settings, given the time sensitive and resource constrained nature of relief activities. While operations research approaches can improve the effectiveness of relief routing,

these challenges must be addressed in routing models in order to realize the potential of the approaches. There have been many promising advances in the literature on relief routing, and aid organizations have been collaborating with academic researchers to increase the practicality of such models. Increases in the availability and use of information technology in the wake of disasters can further the effectiveness of routing models for aid distribution. Presently, challenges still remain to make routing models more applicable to humanitarian aid delivery and more tightly integrated with new streams of imagery, mapping, and crowd-sourced real-time data.

Facilitated through matching support provided as a result of a *Google Research Award*, NUTC affiliate researchers and their students have been developing dynamic routing models for the distribution of relief supplies in humanitarian settings. By improving these models, they can improve the effectiveness of humanitarian relief—using new mapping technologies and real-time information to mitigate the effects of chaotic and rapidly changing circumstances during humanitarian crisis and disasters and the significant amount of uncertainty that exists in these settings. The team developed a set of demonstration cases for the research community to better design and test their routing models and solution approaches. To facilitate wide implementation and potential commercialization of the tools, the research team will make these cases available online to practitioners and academicians, through a server dedicated to Humanitarian and Non-Profit Logistics at Northwestern University. ■



CORE RESEARCH

IMPROVING TRAVEL NETWORK MODELS

Undergraduate Student Research Gains Recognition

Search and Rescue Using Real Time Data

A team of McCormick School of Engineering senior students demonstrated the benefits of incorporating new forms of information into disaster relief logistical operations, gaining recognition and an invitation to present their work at the INFORMS (Institute for Operations Research and the Management Sciences) Annual Meeting in 2012.



When the 2010 Haiti earthquake struck, first search and rescue responders struggled with blocked roads and scarce information. At the same time, volunteers around the world, including hundreds from the Haitian Diaspora, gathered and organized information on changing

ground conditions. Some of this information came from relatively new sources—social media like Twitter, Facebook, blogs, and mobile phone calls. New sources and kinds of information brought new challenges.

Demonstration: Real-time Data Can Improve Search and Rescue

As a proof of concept, the student group created two models of post-disaster urban search and rescue (SAR) operations: one with real time data and one without. **The group applied a routing algorithm to both sets of data and found substantial improvements from incorporating real time data.** The real time model incorporated daily updates to this road network contributed by volunteers around the world. For the real time model, demand was predicted by filtering text messages sent to 4636 for actionable information on collapsed structures and trapped people. The non-real time model predicted demand using historical demand indicators such as building footprints.



Student team members: Alex Huang, Alex Ma, Sara Schmidt, Edwin Shi, Brandon Zhang, and Nancy Xu. Dr. Jennifer Chan instructed the students. They were advised by Irina S. Dolinskaya and Karen Smilowitz (not pictured).

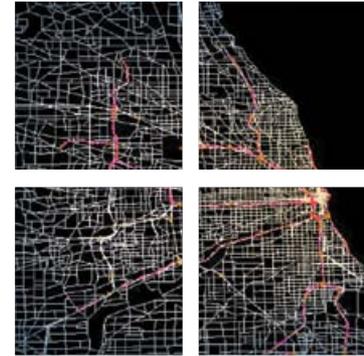
Routing and Traffic Assignment in Stochastic Networks

Travel time reliability exerts significant influence on travel decisions. Information about travel time reliability of particular portions of a transportation network can be utilized by a traveler to better arrange his/her travel according to the trip purpose and the traveler's individual risk preferences.

Supported by a NUTC Dissertation Year Fellowship, and advised by Professor Yu (Marco) Nie, doctoral researcher Xing Wu examined the problem of finding reliable a priori shortest paths (RASP) that ensure a specified probability of on-time arrival in a stochastic network.

In the traffic assignment model developed by Wu, travelers are assumed to choose paths to minimize the travel time budget that ensures their desired probability of on-time arrival, i.e., the percentile path travel time. Therefore, they drive the system to a percentile user equilibrium (UE) where no traveler can reduce their time budget by unilaterally changing routes. This work focused on developing and testing a heuristic algorithm for the percentile UE problem. The algorithm is based on a column generation scheme which is implemented by solving a RASP problem. Wu extended the RASP model to incorporate higher order stochastic dominance, which captures travelers' risk-taking behavior without requiring the knowledge of their specific utility functions. In particular, a general approach to modeling heterogeneous risk-taking behavior in route choice was proposed based on the theory of stochastic dominance (SD). This approach offers not only an interpretation of risk-taking behavior consistent with the SD theory for a variety of existing route choice models, but also a unified and computationally viable solution approach through SD-admissible path sets, which are usually small and can be generated without having to enumerate all paths.

This approach to the question of travel time reliability and traveler choice is useful for solving reliability-based traffic assignment problems. This, in turn, offers a base for reliability-sensitive planning decisions and network design. ■



Use of Mobile Data for Weather-Responsive Traffic Management Models

Dr. Mahmassani is one of two principal investigators on a team jointly led with Delcan, Inc. to undertake this project conducted for FHWA under a subcontract to SAIC, Inc.

In a recently completed FHWA-funded project, he and his team of researchers developed and tested a methodology for incorporating weather impacts in Traffic Estimation and Prediction Systems (TrEPS) (Mahmassani et al., 2009. *Incorporating Weather Impacts in Traffic Estimation and Prediction Systems*. Publication No. FHWA-JPO-09-065). The project addressed both supply and demand aspects of the traffic response to adverse weather, including user responses to various weather-specific interventions such as advisory information and control actions. The methodology was incorporated and tested in connection with the DYNASMART-P simulation-based DTA system, thereby providing a tool for modeling the effect of adverse weather on traffic system properties and performance, and for supporting the analysis and design of traffic management strategies targeted at such conditions. Accordingly, this decision support tool provides a basis for comprehensive benefit assessment of existing WRTM strategies and design of advanced control measures that recognize developments in both weather sensing/forecasting and traffic estimation/prediction.

A follow-on to the above project, an ongoing project is advancing the work towards actual implementation, through calibration, implementation and evaluation of weather-responsive traffic estimation and prediction systems, focusing on: (1) actual implementation and evaluation in the context of a regional planning and/or traffic operations agency to establish the model and calibrate it for application under a variety of local conditions and traffic patterns; and (2) development of weather-related traffic management and control measures, and interfacing their actual deployment and evaluation with the decision-support tools developed in this project.

In addition to their use as an essential input for the online implementation of the estimation and prediction system, traffic data are required for the off-line calibration of the network and related procedures. These include both demand-side quantities (e.g. origin-destination trip matrices) and supply-side relations (e.g. speed-density relations). Mobile data, obtained through GPS-assisted location information from smartphones and/or specialized devices, or other probe-equipped devices, have long held considerable promise as an infrastructure-independent source of traffic data as experienced by actual users, with generally good coverage of the entire network. With the rapid spread of smartphones, traffic uses for the data are gaining momentum.

The objective of this study is to examine and demonstrate the value and applications of mobile sources of data for WRTM with and without the presence of advisory and control strategies. ■

Modeling and Forecasting Toll Revenues

Three main strands motivate Dr. Mahmassani's present study conducted for FHWA under a subcontract to SAIC, Inc.: (1) the growing interest in different forms of pricing, alone or in conjunction with operational access management (e.g. value pricing), as a tool for improving operational performance of highway facilities and networks, as well as a potential source of much needed revenues to fund transportation needs; (2) the continuing convergence between planning and operational considerations, in terms of strategies and policies, as well as in terms of models and tools to support analysis, evaluation and planning/design; and 3) the growing availability of a new generation of methodologies and tools, that combine advanced travel demand/behavior models and traffic simulation capabilities within a network modeling (assignment) platform.

A handful of planning agencies are actively investing in an integrated set of activity-based demand models with a Dynamic Traffic Assignment (DTA) platform. Given the limitations of existing static assignment models, these agencies are motivated to move towards simulation-based DTA. Recent developments in DTA algorithms and tools capture the interaction between supply and demand in conjunction with realistic representation of both traffic dynamics and user behavior.

This research is addressing two key questions: (1) How can we advance the state of the practice to meet the needs of state DOT's and MPO's in evaluating the potential and impact of congestion pricing, combined with other operational interventions, and forecasting toll revenues and associated operational performance at the corridor, urban and regional levels? and (2) What potential improvements to the state of the art in DTA models and procedures are needed for these tools to better meet the above needs (HOT lanes, managed lane networks, priced dynamic shoulder lanes, among others)? The present work is documenting existing practice, demonstrating use of existing DTA tools and related advances in an actual application, extracting detailed application guidelines, and identifying potential improvement opportunities in these tools. ■



Finding the Backbone of Global Transportation Networks

Complex network theory has become one of the most successful frameworks for studying multiscale transportation networks and their dynamical processes.

Complex systems such as air travel routes, the internet, and the power grid generate complex behavior. A system's behavioral structure emerges locally, it is not designed or planned. In such complex systems, components of a network work together, interacting and influencing each other, driving the network's evolution.

NUTC research affiliate Dirk Brockmann and his team recently reported that different complex networks share very similar "backbones." Reducing a large-scale network to its core components—its backbone—and extracting essential components are critical for efficient network data management. These methods are often required to better identify universal principles of network design and how large scale networks respond to local network failures or anticipated attacks.

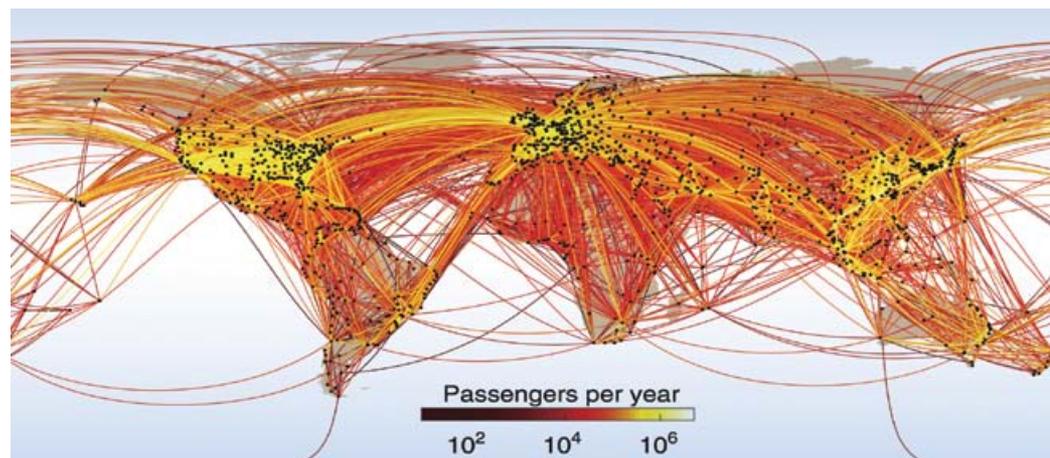
The team developed a method to identify a network's hidden core structure and showed that the skeletons possess some underlying and universal features. "The key to our approach was asking what network elements are important from each node's perspective," states Brockmann—a concept they refer to as "link salience." The new salience measure successfully classifies links into distinct groups in many transportation networks investigated with this novel technique: the global air transportation network, the global cargo ship network as well as the U.S. commuter network. Based on this classification the researchers introduced the high-salience skeleton (HSS) of a network, the collection of connections that exhibit unusually strong salience.

One of the findings—that the links in various different transportation networks generically fall in two classes—provides an important novel insight into the structure and design of large-scale transportation networks. Furthermore the technique offers new ways to investigate those networks' response to local and global failures and detect efficient ways to redesign them.

Dirk Brockmann was assisted by first author Daniel Grady, Post Doctoral Fellow, McCormick School of Engineering and Applied Science, and graduate student Christian Thiemann. Their paper titled *Robust Classification of Salient Links in Complex*

THE TEAM DEVELOPED A METHOD TO IDENTIFY A NETWORK'S HIDDEN CORE STRUCTURE

and showed that the skeletons possess some underlying and universal features.



Networks, was published in *Nature* and has received worldwide attention and discussion.

The research has been supported by The Volkswagen Foundation. Follow-up studies may be useful in managing complex air traffic routing and other transportation-related networks. ■

Above: global air traffic.

Transportation Energy and Sustainability

Determining the Optimal Locations for Electric Vehicle Charging Stations

Research conducted by Diego Klabjan has resulted in a Web-based information system, EVIDENT, that uses state-of-the-art data analytics for site selection of public charging stations. The system includes a Google maps-based display of demographics, traffic, social interactions, and other attributes; a spatial prediction of electric vehicles owners; estimates of their driving patterns; and an optimization-based selection of locations for charging stations considering the driving patterns, traffic, and installation costs.

The adoption of electric vehicles and the growth of this more eco-friendly segment of the car industry will depend in large measure on the availability of well-placed charging stations. EVIDENT removes the guess work from the location selection process. The system has already been used in select deployments around the country. ■



“We’re sitting on a huge amount of data. We need help evaluating it and looking for new ways to use that data to create algorithms and build better systems.”

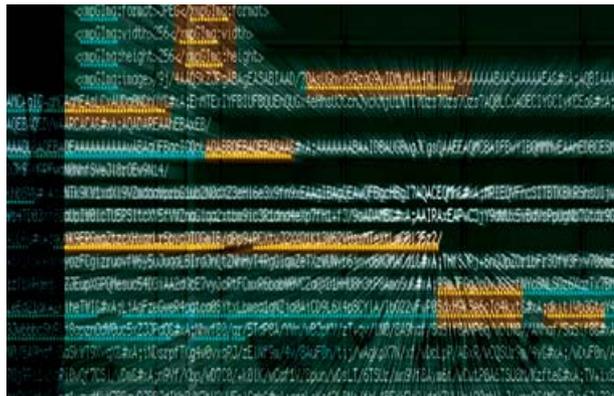
— Doug Waggoner, CEO, Echo Global Logistics

Big Data: Finding the Hidden Value in Large Volumes of Stored Information

A research team led by Professors Hani Mahmassani and Diego Klabjan is collaborating with Echo Global Logistics (Echo) to investigate and unlock the strategic value of large volumes of archived and near real-time transactional data available to the company. Echo provides technology-enabled business process service for companies seeking to outsource their shipping needs with Echo’s network of transportation carriers.

The researchers developed optimization and analytics-based techniques to better understand and predict the transactional behavior of shippers and carriers in response to pricing. The various tasks associated with this investigation included the design of data mining strategies, algorithms to estimate shipper /carrier behavior, optimization strategies for pricing, and scoring (or ranking) methodologies for decision-making.

Northwestern doctoral researchers Christopher Lindsey and Young-Woong Park, and post-doctoral fellows Hamed Babai and Andreas Frei interacted extensively with Echo information technology and business teams and gained direct insight into the challenges faced in industry settings. The study demonstrated the tremendous potential of Echo’s historical and real-time data for internal business process enhancement, as well as the potential for improving the value of their services to customers. ■



Estimating Emissions of Freight Transport Operations

Many companies strive to anticipate and meet compliance requirements for new environmental regulations. They recognize that measuring and managing their waste and emissions not only opens the doors to greater efficiencies, it casts a positive light on their organization’s reputation and products.

Pablo Durango-Cohen is principal investigator on this CCITT project that envisions an online platform to estimate truck emissions based on economic models of marginal emissions contributions from individual shipments across the supply chain. Durango-Cohen anticipates that this online tool will represent an improvement over existing methods and will pave the way for transport operators to address and embrace emissions-reduction efforts. Such efforts can take the form of redesigning warehousing and distribution networks or may include adjustments to equipment specification and resource allocation. The approach may be applied to other modes of freight transport as well.

Arriving at Meaningful Emissions Numbers

For corporations with extensive and high-volume distribution systems, emissions from transport operations constitutes a significant contributor to their environmental impact. In the ongoing effort to quantify and reduce shipping operations’ carbon footprint (and other pollutants), readily available data can be harnessed to provide reliable and meaningful numbers. This information, in turn, will support strategic shipping and supply-chain decisions that can positively

NUTC is committed to engaging industry, notably the companies represented on the Business Advisory Committee (BAC),

in relevant, innovative research. The opportunity to conduct such research is discovered through effective communication with industry partners—through proactive outreach, critical listening, innovative thinking, trust, and patient relationship building.

The Center facilitates technical “knowledge exchanges” with companies. We actively host these information and idea sharing forums and also travel to corporate locations to get a firsthand look at technical, operational, and management challenges.

affect emissions totals. Properly presented, these numbers will also facilitate consistent performance comparisons, year-to-year.

With research assistants Madison Fitzpatrick, and Yidan Luo, Durango-Cohen’s current transport emissions project is extending a research partnership begun four years ago with Philips—a corporation with worldwide product distribution in lighting, lifestyle (home electronics, personal devices), and health care equipment and supplies. The challenge is in making a rigorous processing platform to take advantage of imperfect but very useful data: Create a practical tool that sets up an attractive “least path of resistance” for businesses to follow toward more responsible operations. Research is moving the methodology forward and anticipating implementation.

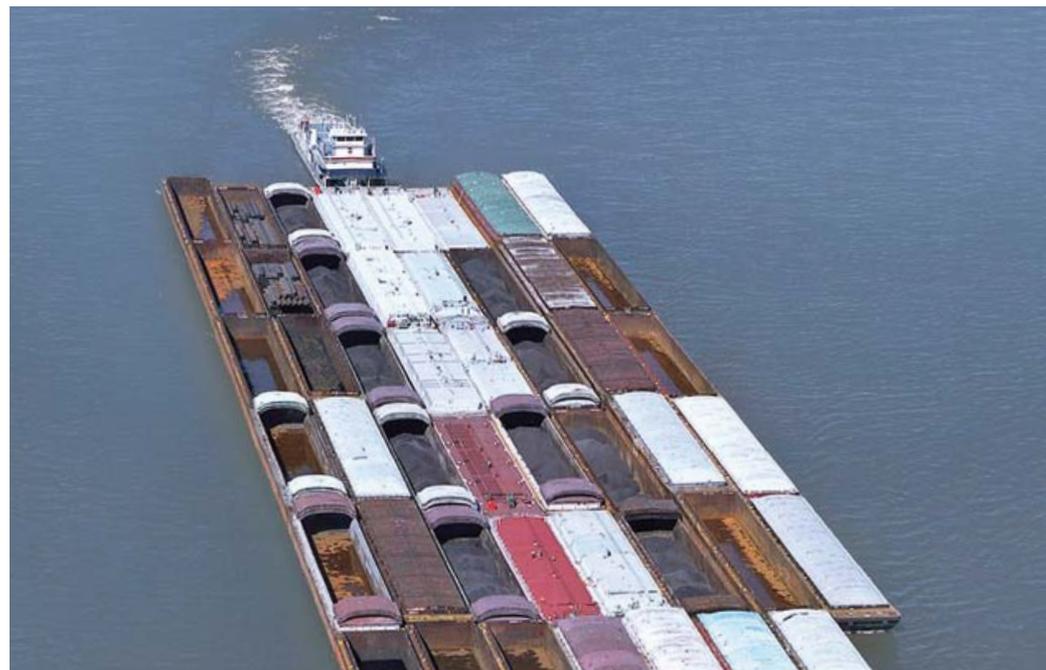
Online Implementation

This freight transport emissions project emphasizes practicality and ease of adoption. The protocols and paths for connecting to industry numbers, and the software and online implementation will utilize and be validated with data from the transportation operations of Philips. Durango-Cohen and his team expect this project to lead to additional incremental steps in support of reducing transportation’s environmental impact through low-cost, smart methods of inquiry and reporting that utilize existing data. ■



Gaining a Clearer Picture of Crewmembers’ Sleep Quality and Health

Funded by the towing vessel industry and the American Waterway Operators (AWO), this most recent Phase III of an ongoing research program is aimed at understanding the impact of the unique work schedule in this industry on sleep, alertness and health. The ultimate goal is to identify modifiable risk factors in order to develop strategies to reduce fatigue and the resulting risks it poses; and to improve the health of crewmembers operating vessels around the clock. Fatigue as a result of short sleep is a concern in the maritime industry. The predominant schedule in the United States tow boat industry includes



Gaining a Clearer Picture of Crewmembers' Sleep Quality and Health (continued)

2 x 6 hour work and 2 x 6 hour rest periods/day (6:6:6:6). This schedule results in several factors that could influence sleep/fatigue including night work and limited rest intervals.

NUTC research affiliates Fred Turek and Kathryn Reid designed and conducted a large-scale survey of sleep quality and general health among wheelhouse towing vessel crewmembers on American waterways. A major finding from the present study was that when on duty, crews on the Captain's (work between 6am-12pm; 6pm-12am) or Pilot's (work between 12am-6am; 12-6pm) watch reported similar time in bed (TIB) and sleep duration. A second major finding was that there were no differences in reported sleep duration for crews when at home or on the vessel. Indeed, we found that crews spent significantly more TIB when on duty than when at home, indicating that the 6:6:6:6 square watch schedule is allowing crews sufficient TIB. A third major finding was that the crewmembers reported much longer sleep duration based on survey data when compared to our objective (actigraphy) data (from onboard studies in Phases I and II).

Sleep disorders such as sleep apnea impact the ability to sleep that in turn negatively impact waking function and health. Based on the sleep apnea risk questionnaire, 41% of the crewmembers were at a high risk for sleep apnea, compared to 32% of similarly-aged males in the general population. Importantly, the body mass index (BMI), a health indicator for risk of cardiometabolic disease and sleep apnea, was in the obese range for a high percentage of crewmembers (47.9%) while the level of morbid obesity (BMI>40) was nearly double that of the normal population (10.1% vs. 5.7%). Given the high percentage of crewmembers at high risk for sleep apnea, which can affect health and alertness outcomes, consideration should be given to the findings of this study so that screening and risk mitigation strategies can be implemented. The next steps in this program will involve developing a fatigue prevention and risk management plan/program for consideration by the AWO for possible implementation. ■



“ALSO DISCOVERED WAS THAT

the consideration of customers' buy-up behavior helps airlines modify their booking limits to generate more revenue from passengers.”



Optimizing the Demand/Capacity Challenge for Airlines

In the passenger airline industry, revenue management means guiding a resource-constrained network toward maximizing revenue. The underlying optimization takes demand and capacity forecasts and creates insights that can be used to make a control policy. Airlines can use the control policy to sell their seats to the most profitable passengers at the right time. This optimization problem has been an interesting topic to both practitioners and researchers for decades. The optimization challenge is driven by the dynamic nature of the airline business, the perishability of seats (no resale value after departure), and the size of the flight networks. Therefore, the entire industry is on a quest for simple and efficient heuristics.

To address this challenge, NU researchers explored an optimization problem and its solution methodology to capture demand dependency and to efficiently obtain nested-booking-limits. They found that nested-booking-limits allow airlines to improve their revenue by selling low-fare seats to high-fare passengers, whose allocation has already been depleted. Also discovered was that the consideration of customers buy-up behavior helps airlines modify their booking limits to generate more revenue from passengers.

Advised by Diego Klabjan, Bill Pun (Northwestern University Transportation Center PhD Dissertation Year Fellow) was the principal investigator on this project. The data he used was provided by Sabre Holdings, a leading airline solutions vendor. ■

Haptic Interface for Vehicular Touch Screens

Touch screens, so familiar now as the interface to smart phones and tablets, are increasingly showing up on the instrument panels of automobiles. This trend raises concerns that drivers will make more and lengthier glances away from the road in order to complete even simple tasks, such as adjusting temperature or selecting a radio station. One potential way to mitigate this form of distraction is to provide haptic (tactile) feedback, enabling drivers to complete tasks more easily without looking at the screen.

Collaborating with Ford Motor Company

To investigate the efficacy of this approach, J. Edward Colgate and Michael Peshkin, both professors of Mechanical Engineering, partnered with Ford Motor Company in a recent study.

Colgate and Peshkin have developed a number of novel technologies for providing haptic feedback on a touch screen, and Ford has one of the most advanced driving simulators (the VIRTTEX) in existence today. Graduate student Joe Mullenbach has



Ford's VIRTTEX driving simulator

brought these two things together. Working with Colgate and Peshkin, he built a device known as a TPaD, then integrated it into a Ford Edge vehicle in the simulator and ran experiments with 25 volunteer drivers. Mullenbach tested those drivers on two types of tasks: a simple button

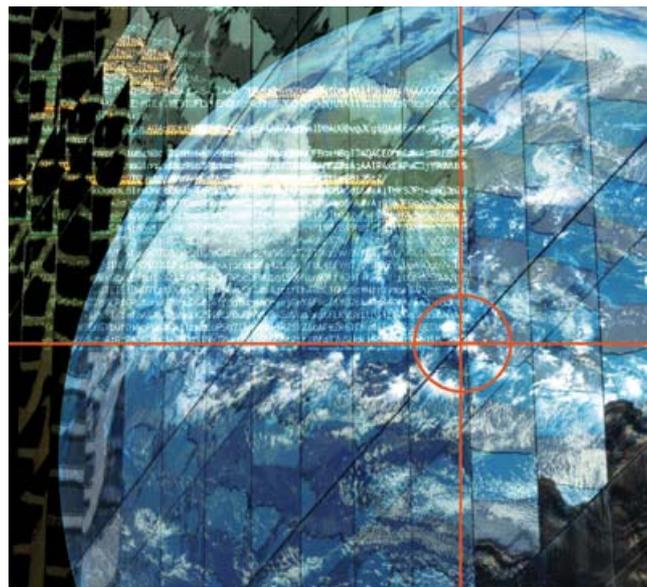
acquisition, and a more complex level adjustment. Drivers consistently performed better with haptics, spending less time looking away from the road and completing the tasks just as easily as with vision alone. Moreover, drivers had an overall preference for the combination of visual and haptic cues.

Mullenbach is now working with Colgate and Peshkin to develop an even more advanced haptic touchscreen that the team expects will further improve the technology. ■

Logistics Market Assessment of New Positioning and Tracking Technology

The Northwestern University Transportation Center led a study for Business Advisory Committee member, Boeing, on the potential product integration and market opportunities in the transportation and logistics sector for a novel precision positioning and tracking technology. Over twenty business applications were investigated and assessed for the technology, which leverages the positioning capabilities of a low earth orbit satellite constellation in conjunction with dedicated geo-navigation systems, GPS and Glonass.

The study involved subject matter experts covering agriculture, construction, fleet management, geographic information systems, investment banking, mining, package delivery, healthcare, ports, supply chain, rail, third party logistics, and trucking. The study findings revealed growing competition and consolidation among the location-based service providers serving the transportation, logistics, and supply chain industries. NUTC Associate Director Bret Johnson led the study, which involved several graduate and undergraduate student researchers from the Kellogg School and McCormick. ■



OUTREACH • EVENTS

ICEM 2012: NUTC Hosts 2nd International Conference on Evacuation Modeling and Management

Conferences, Symposia

White House Roundtable
 Transportation Research
 Board Annual Meeting
 William A. Paterson Lecture
 Leon N. Moses Lecture
 Industry Workshops
 NUTC Seminars
 Sandhouse Gang
 Icarus Society

The Second International Conference on Evacuation Modeling and Management (ICEM) brought 70-plus participants from 10 countries representing over 40 institutions to the Evanston, Illinois, campus of Northwestern University on August 12-15, 2012. ICEM 2012 was sponsored by the Northwestern University Transportation Center (NUTC) and its U.S. DOT funded institute—the Center for the Commercialization of Innovative Transportation Technology (CCITT).

In his role as Chair of the three-day event, NUTC Director Hani Mahmassani provided opening remarks to the assembled researchers and students, stressing the cross-disciplinary nature of the work and noting the unique venue the Conference provides in terms of the following:

- Focused on the methodological cross-disciplinary challenges of developing and applying models of evacuation processes and decision-oriented analytics
- Includes all aspects of modeling and management of evacuations: flow physics, behavior, specific hazard requirements, strategy optimization
- Multi-hazard perspective: seeking commonality across different types of causes, yet recognizing unique characteristics and time frames of each
- Cross-disciplinary: hazard domain experts (fire, flood, etc.), traffic flow, architecture, transportation systems, modeling, simulation, visualization
- Equal emphasis on vehicular traffic and pedestrian crowd flow
- International in scope and participation
- Features advanced tool development as well as applications
- Small size gathering encourages Informal discussions and exchanges.



Conference Chair and NUTC Director Hani Mahmassani provided opening remarks to the ICEM 2012 participants.

Mahmassani reminded the attendees that ICEM 2012 would be carrying forward the mission of the first ICEM gathering held at Delft University of Technology, The Netherlands, in 2009, to stimulate, formalize, and share new research projects that advance scientific insights leading to improved emergency response evacuation planning and implementation.

Linking Theory, Data, and On-the-Ground Response

The ICEM Conferences are narrowing the gap between researchers' emerging tools for hypothetical event traffic simulation (modeling and analysis) and administrators' actual planning and emergency management.

This year's Conference presentations approached evacuation modeling—predicting the behaviors of transportation systems and individuals—from several perspectives. Many researchers employed new methods for real-world event data collection and visualization, while others provided insights and tools originating in game theory, psychology, traffic physics, simulation modeling, and optimization strategies. Researchers are examining and modeling how human beings and systems behave in emergency environments ranging from skyscraper fires to hurricane landfalls to flooding and earthquakes.

Keynote Presentations

Serge Hoogendoorn, Professor of Civil Engineering and Geosciences at Delft University of Technology (DUT), described innovative methods of traffic data collection and outlined behavioral insights and models that have been achieved in DUT's prototype lab. Professor



Karen Smilowitz, NUTC faculty affiliate, delivered a compelling introduction to the field of humanitarian logistics.

The ICEM Mindset for a Continuing Mission

Throughout the Conference (and in conferences to come)

the role of sophisticated data collection, analysis, and event modeling was grounded in an understanding that lives can be saved and outcomes improved as a result of the advancement of these models of evacuation processes and decision-oriented analytics. ■

ICEM 2012
2nd International Conference on
Evacuation Modeling and Management

FIFTH ANNUAL WILLIAM O. LIPINSKI SYMPOSIUM ON TRANSPORTATION POLICY

High Speed Rail: Perspectives and Prospects

With the High Speed Rail (HSR) theme, the 5th annual William O. Lipinski Symposium on Transportation Policy brought together supporters and skeptics to consider the challenges and opportunities of HSR. U.S. Transportation Secretary Ray LaHood began the day with a strong advocacy statement: "Very soon, you're going to be riding on a train from Chicago to St. Louis that's going to be a state of the art train on state of the art tracks... This will get cars off the road, get people out of congestion and from one point to another in an efficient, cost-effective way."



Four Panel Discussions Fill the Day's Agenda:

- The first provided reasons for optimism, and contrasting views
- The second focused on the challenge of forecasting market demand
- A third panel addressed the major questions of financing
- The fourth and closing panel in the form of a Q & A session was moderated by ITI Director and NUTC affiliate Joseph Schofer.

At the luncheon, Former Congressional Representative William O. Lipinski presented the David F. Schulz Award for Outstanding Public Service in Transportation and Infrastructure to U.S. Senator Richard J. Durbin, citing his efforts to secure resources for major transportation projects in Illinois. ■



Fifty-eight of the seventy-plus participants in ICEM 2012 gather on Northwestern University's lakefront grounds for a commemorative photo. Researchers and students from 10 countries representing over 40 institutions attended.

NUTC/FHWA WORKSHOP

Travel Behavior Research and Modeling



NUTC, in collaboration with the Federal Highway Administration (FHWA), conducted a workshop that gathered a panel of 30 national and international experts from academia and professional practice to assess the state of the art in travel behavior research and modeling, and where it stands relative to the current state of the practice.

Organized and chaired by Hani Mahmassani with the participation of Emeritus Professor Frank Koppelman, in collaboration with Dr. David Yang of FHWA, the workshop took place on November 30 and 31, 2012, on the Northwestern Campus. It consisted of a series of commissioned presentations addressing methodological as well as substantive questions, followed by a series of breakout groups tasked with identifying and prioritizing gaps in travel behavior analysis. A final session focused on identifying and prioritizing research topics over the short, medium and long runs.

The workshop was motivated by the need to better understand and incorporate traveler behavior in analysis tools and models used to support programs using information and communication technologies to manage transportation systems through both

demand and supply-side operational interventions, such as Intelligent Transportation Systems (ITS), Active Traffic Management (ATM) and Active Travel Demand Management (ATDM). The influence of measures targeting environmentally sustainable behaviors is also of interest.

Attendees included Dr. Joe Peters (FHWA), Dr. Kermit Wies (CMAP), and Professors Elisabetta Cherchi (TU-Denmark), Cinzia Cirillo (Maryland), Kevin Krizek (Colorado-Boulder), Ram Pendyala (Arizona State U) and Joan Walker (UC-Berkeley). NUTC post-doctoral researcher Andreas Frei and doctoral researcher Charlotte Frei played key roles in coordinating the conference and summarizing its recommendations. ■



Conferences, Symposia White House Roundtable Transportation Research Board Annual Meeting

William A. Paterson Lecture
Leon N. Moses Lecture
Industry Workshops
NUTC Seminars
Sandhouse Gang
Icarus Society

WHITE HOUSE ROUNDTABLE: NHTSA Administrator David Strickland Connects on a Range of Topics



NUTC and its DOT-funded institute, CCITT, in conjunction with The White House and the U.S. Department of Transportation, hosted a White House Roundtable on March 30, 2012, featuring Northwestern alumnus, The Honorable David L. Strickland, Administrator of the National Highway Traffic Safety Administration (NHTSA).

NUTC faculty affiliate Ian Savage facilitated the discussion with Administrator Strickland involving over twenty professionals, faculty, and students, including guests from Coca Cola, the Illinois Tollway, Chicago DOT, the National Safety Council, Illinois Operation Lifesaver, AAA Chicago Motor Club, the City of Evanston, and Cambridge Systematics. The dialogue covered topics such as the current state of efforts to reduce distracted driving, rail crossing safety, driver/pedestrian safety, and transforming data into actions.

A day earlier, on March 29, Administrator Strickland delivered a seminar addressing the topic: *Safety Without Borders: Raising the Bar on Traffic Safety Across the Globe Through Data, Research, and Collaboration.* ■

SYMPOSIUM Transportation Deregulation and Safety: A Retrospective & Reflection after 25 Years

Held on May 3, 2012, and jointly organized and sponsored by NUTC and the Chicago Chapter of the Transportation Research Forum, the Symposium participants surveyed transportation regulation and safety concerns and statistics of the last quarter century.

Presenters developed fresh assessments of the impact of transportation deregulation on safety and industry dynamics beginning with late 1970s deregulation legislation. Through the lens of the landmark 1987 NUTC conference: *Transportation Deregulation and Safety*, the Symposium attendees analyzed the recent data and noted that by almost all measures safety performance has continued to improve in the motor carrier, rail, and air transportation sectors. Deregulation accomplished



many of its stated goals, yet vigilance is still required amidst constant market and technological evolutionary changes. ■

The Transportation Research Board (TRB) 91st Annual Meeting

More than twenty-five NUTC faculty members and students shared research findings at the Transportation Research Board (TRB) Annual Meeting in Washington, D.C., January 22-26, 2012. The 2012 theme was *Transportation: Putting Innovation and People to Work* and the conference drew more than 11,000 transportation professionals from around the globe.

NUTC had a strong presence at the 2012 TRB Meeting. NUTC faculty affiliates, researchers, and students organized and chaired sessions, led panel discussions, conducted workshops, presented papers, and gave poster presentations on a variety of transportation-related research. Presentation topics included network modeling, driver behavior, data and information innovations for researchers, airline economics, planning methods and models, infrastructure systems and operations, and traffic management. NUTC faculty and research affiliates presenting at TRB were David Boyce, Kay Geary, Frank Koppelman, Hani Mahmassani, Marco Nie, Roberto Sarmiento, Joseph Schofer, and Surendra Shah. NUTC students presenting at TRB were Laurence Audenaerd, Hamed Babai, Charlotte Frei, Tian Hou, Lan Jiang, Jiwon Kim, Meead Saberi, Alireza Talebpour, Omer Verbas, Alireza Talebpour, Xing Wu, and Ali Zockale.

NUTC also hosted its annual TRB Reception and Alumni Reunion on Sunday evening. The popular event attracted more than 400 guests and was one of the largest reception events at TRB. NUTC's guests were members of NUTC's expansive network of transportation professionals representing industry, academia, and government.



31st Annual William A. Patterson Lecture

MULALLY ACKNOWLEDGED THAT electrification is “the next frontier” and that the auto industry sits at the epicenter of numerous national and global issues.



2010 Nobel Laureate in Economics, Dale Mortensen, (at left) with Northwestern University President Morton Schapiro, in the audience at the 2012 William A. Patterson Lecture.

Ford CEO Alan Mulally Delivers the 2012 Patterson Transportation Lecture

On April 18, 2012, Alan Mulally, President and Chief Executive Officer of Ford Motor Company, delivered the 31st Annual Patterson Transportation Lecture to a standing-room-only audience of students, faculty, alumni, transportation professionals, and members of the public.

In his talk, *The Ford Story*, Mulally chronicled Ford's 21st-century fall and rise—highlighting Ford's dismal state in 2006 and its “relentless implementation” of key objectives leading to its resurgence as an automotive design/manufacturing powerhouse.

Ford under Mulally leadership has:

- streamlined collaboration and communication to breed innovation and accountability
- divested itself of brands such as Jaguar and Volvo, creating a single-minded focus on Ford and Lincoln
- committed to establishing a complete set of best-in-class vehicles
- accelerated new vehicle development while simultaneously matching production to demand.

Notwithstanding the fact that Ford has now reached greater market share and profits, Mulally acknowledged that electrification is “the next frontier” and that the industry sits at the epicenter of numerous national and global issues, including corporate responsibility, environmental sustainability, economic development and energy independence. ■



Patterson Transportation Endowment

The Annual Patterson Transportation Lecture Series is supported by the William A. Patterson Transportation Endowment, 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 NUTC. Hani Mahmassani is the current William A. Patterson Distinguished Professor of Transportation and Irina Dolinskaya is the Junior William A. Patterson Professor of Transportation.

Inaugural Leon N. Moses Distinguished Lecture



Robert Gordon, Renowned Northwestern University Economics Professor, Delivers First Moses Lecture

The first Leon N. Moses lecture, delivered on October 25, 2011, struck a note that is still reverberating in academic and economic planning circles. As an acknowledged expert on inflation, unemployment, and productivity growth, professor Gordon's lecture laid out a provocative questioning of the usual assumption that economic growth is a steady process that will continue forever.

Rapid progress in economic growth made over the last 250 years, according to Gordon, should be attributed to the first, second, and third industrial revolutions: (1) steam and railroads from 1750 to 1830; (2) electricity, the internal combustion engine, running water, indoor toilets, communications, entertainment, chemicals, and petroleum from 1870 to 1900; and (3) computers, the web, mobile phones and wireless devices from 1960 to the present. Gordon suspects that the technological advances that fueled productivity growth during the last 50 years will have a more limited role in future growth than most would anticipate.

Innovation and growth in the U.S. now must face stiff headwinds—as Gordon calls them—including demographic trends such as an aging workforce, gaps in the education system, rising income inequality, globalization, declining energy/environment resources, and consumer and government debt. He acknowledges that it is very difficult to forecast if or when the next great impetus to gains in productivity might occur.

Professor Gordon's 2012 paper, *Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds*, has received a great deal of attention and been widely cited in U.S. and international publications and discussions. In it, he consolidates much of his thinking on the subject. He credits his lectures over the past year as having provided the impetus and rigorous discussions necessary to bring his observations into focus. ■



Above: Professor Emeritus Leon N. Moses attends the inaugural lecture named in his honor. During his long career, Moses made significant contributions to the field of transportation economics. Included in his many appointments at Northwestern, he served as Chair of the Economics Department. He held several positions at the Transportation Center, among them Director of Research and Director of Education. From 1976 until 1980 he served as NUTC's Director. Under his leadership the Center gained national prominence for its several conferences exploring the prospect of transportation deregulation.



Professor Robert Gordon came to Northwestern in 1973 after teaching at Harvard and the University of Chicago. He is a Fellow of the Econometrics Society, a Research Associate of the National Bureau of Economic Research, a Research Fellow of the Centre for Economic Policy Research (London) and the Observatoire Français des Conjonctures Economiques (Paris), and an economic adviser to the Congressional Budget Office and the Bureau of Economic Analysis. Gordon is author of *Macroeconomics*, eleventh edition, and several other foundational books in economics.



INDUSTRY WORKSHOP

Improving the Customer Experience in Travel and Transportation Using Information Technology

Reinventing the user experience in transportation was the subject of the October 25, 2011, Northwestern University Transportation Center (NUTC) workshop. In two panel discussions the event explored the current state of, and research challenges associated with, emerging technologies. What roles does information technology (IT) have in advancing customer care and improving the experience for: (1) travelers, and (2) users of freight and logistics services.

Held in conjunction with the Fall Business Advisory Committee meeting, the event was co-hosted by NUTC and Teradata Corporation. In his opening remarks, event co-chair Peeter Kivestu of Teradata stated, "(although) meaningful progress in the customer experience increasingly depends on IT, finding the sweet spot for leveraging IT is not something that is easy to discover." Kivestu asked the following:

- Does the customer see the picture differently than you?
- Does the competitor see the customer better than you?
- What is customer behavior during pre-planning, travel, and post trip?
- Given all this data, where is the best place to apply customer experience management?

The Way Forward for IT and the Customer Experience

Much potential exists for IT to improve the user experience, noted the traveler panel participants (Dick Alexander, Veolia Transportation; Perry Cantarutti, Delta Airlines; and Kivestu). Technology will be a powerful tool in aligning customer and provider expectations. It was noted that social media is becoming useful in allowing agents to simultaneously serve multiple customers. Travelers can now



"tweet" their concerns and requests to rebook rather than endure long phone calls.

Enhanced customer traveler experience through IT requires answers to questions such as: How much data is needed to make a difference? How safe is that data? Will people share private information? What level of participation is required to reduce uncertainty?

From the freight panel, the presenters (David Adams, GTNexus; Dr. Mark Cooper, FedEx Services; and Gary Smith, Con-way Freight) shared insights regarding how businesses are benefiting from new information models, continually improving service quality indices, and using customer information for business decisions.

New approaches and tools include cloud storing of data, one-to-many and many-to-one ways of communicating as in social media platforms, and crowd sourcing in order to improve data quality. IT tools must help reveal and address true customer expectations.

In closing the workshop, NUTC Director and event co-chair Hani Mahmassani charged all participants to look beyond only meeting expectations to the delivery of new and satisfying experiences for passengers and users of transportation services. During the traveler panel, for example, he asked Alexander whether any post trip surveys were being used to ask about experience, or whether there is any information about what customers are doing, and if so, how is that data being used? His vision, and NUTC's goal, is to understand the existing reality, design a better experience, and provide it in real time. ■

INDUSTRY WORKSHOP

The Electrification of Transportation: A Look at the Road Ahead

With ever growing concerns regarding the need for diversification of our country's energy resources and the recent emergence of consumer and fleet electrical vehicles (EV), this NUTC workshop explored opportunities and challenges facing the implementation of electric vehicles, the current state of the EV market, factors impacting the user experience and user adoption, and transport electrification in the context of other energy choices.

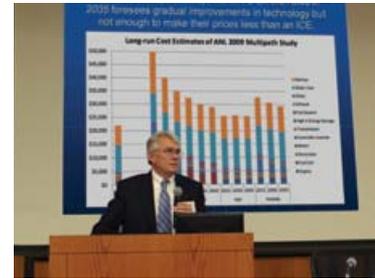
The April 18, 2012, NUTC workshop consisted of two panel discussions, the first: *Infrastructure, Policy and Regulatory Hurdles*, and the second: *EV User Demand, Impacts and Constraints*. From the educational, public, and private sectors, panelists included: Dr. Kimberly Gray, *Moderator*, Professor of Civil and Environmental Engineering, McCormick School of Engineering; Ted Bohn, Senior Power Electronics Engineer, Center for Transportation Research, Argonne National Laboratory; Dan Gabel, Manager, EV and Technology, Commonwealth Edison; Kate Tomford, Chief Sustainability Policy Advisor, Illinois Energy Office, DCEO; Chair, Illinois EV Advisory Council; Bryan Wagner, Senior Environmental Planner, Illinois Tollway; Joshua Milberg, *Moderator*, Regional Vice President, Midwest Operations, Willdan Energy Solutions; Dr. Jing Dong, Center for Transportation Analysis, Oak Ridge National Laboratory (Dr. Dong received her PhD from Northwestern and is a former

NUTC post-doctoral fellow); Ms. Sharon Feigon, CEO, iGo Car Sharing; David Goodridge, Vice President - Sales, 350Green; Terry L. Komlos, Manager, Zero Emission Mobility Corporate Planning, Nissan North America

Panelists provided insights on:

- developing public codes and standards for electric vehicles (EVs)
- justification for public funding for charging stations
- transportation agency support
- electric vehicles and the smart grid
- forecasts for, and barriers to EV adoption
- the consumer experience in charging their EVs
- electric vehicles—input from leading car-share provider 350Green, Inc.

Dr. David Greene, Oak Ridge National Laboratory Senior Fellow, wrapped up the full-day event with the feature presentation: *Why Electrify? A New Paradigm for Transportation's Energy Transition*. He offered comprehensive observations derived from the last 100-plus years of transportation technologies, fuel types, and shifts in impact and efficiency. Greene then provided reasonable projections and caveats based on the oncoming constraints and trends that are driving global advances toward reduced-emissions ground transportation solutions. ■



MEGACOMMUNITY SIMULATION

NUTC Co-hosts a Strategic Simulation to Re-imagine Infrastructure

Transportation Center faculty and staff, including Director and Professor Hani Mahmassani, Professor Joseph Schofer and Associate Director Bret Johnson, collaborated with Business Advisory Committee member Fred Messina's Booz Allen Hamilton (BAH) team and the Chesapeake Crescent Initiative to design, develop and host a two-day "wargame" exercise to identify potential infrastructure solutions to reduce congestion and support the efficient intra- and inter-regional flow of goods and people in the United States. The July 23-24 *MegaCommunity Simulation to Re-Imagine Infrastructure* brought together business, government, academia, and transportation leaders who simultaneously met as working groups in Chicago, Orlando and Washington, D.C.

NUTC worked with BAH to recruit "players" for the Great Lakes Megaregion, as well as provide assistance for the Florida Megaregion. In addition to teams

representing federal and financial decision makers recruited by BAH, the working groups at each location were organized in four categories: freight, carriers (passengers), public infrastructure owners, and customers (businesses, military, passengers). The working groups independently brainstormed innovative infrastructure concepts, and then shared input via virtual AV connections as a single mega-community through an iterative process. The Great Lakes Megaregion portion of the event hosted participants from Illinois, Indiana, Michigan and Wisconsin, including several NUTC BAC members: Mike Burton (C&K Trucking), Craig Philip (Ingram Barge), and Paul Nowicki (BNSF). Also attending: NUTC graduate students Charlotte Frei, Christopher Lindsey, Raymond Chan, and post-doctoral fellow Andeas Frei.



NUTC Seminar Series Events

07/27/2012

Between GPS-based self-tracking and the diary: What is next for travel behavior studies? Kay W. Axhausen, Professor, Institute for Transport Planning & Systems (IVT), Swiss Federal Institute of Technology, Zurich, Switzerland

05/24/2012

The Panama Canal as Precursor; Aaron J. Gellman, Professor of Transportation, NUTC, Adjunct Professor of Management & Strategy, Kellogg School of Management

05/10/2012

The Competitive Effect of Multi-Market Contact; Guy Arie, PhD in Management & Strategy, Kellogg School of Management, 2011-2012 NUTC Dissertation Year Fellow

04/26/2012

Leveraging the Mobile Cloud for Travel Demand; Joan Walker, Assistant Professor, Civil & Environmental Engineering and Center for Global Metropolitan Studies, UC-Berkeley

04/12/2012

Urban Travel Forecasting: A 50 Year Retrospective; David Boyce, Adjunct Professor, Department of Civil and Environmental Engineering, Northwestern University

04/05/2012

A Priority System for Multi-Modal Traffic Signal Control; Larry Head, Associate Professor & Department Head, Systems & Industrial Engineering, University of Arizona

03/29/2012

Safety Without Borders: Raising the Bar on Traffic Safety Across the Globe Through Data, Research, and Collaboration; David L. Strickland, Administrator, National Highway Traffic Safety Administration (NHTSA), U.S. DOT

03/01/2012

Traffic Congestion in Networks, and Alleviating It with Public Transportation and Pricing Carlos F. Daganzo, Robert Horonjeff Professor of Civil Engineering, UC-Berkeley

02/02/2012

Vulnerability and Adaptation Options of European Transport Systems Towards Weather Extremes; Dr. Claus Doll, Freunhofer-Institute for Systems and Innovation Research, ISI

01/12/2012

A Trade-Space Analysis of Surface Alternatives for Short-Haul Passenger Air Travel; Laurence Audenaerd, Senior Engineer, Center for Advanced Aviation System Development, The MITRE Corporation, NUTC 2011 Dissertation Year Fellow

01/05/2012

Proactive Transmission Planning in Electricity Networks; Enzo E. Sauma, Associate Professor of Industrial and Systems Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile

12/01/2011

Effectiveness and Equity of Future Transportation Financing Options; Zhang Lei, Assistant Professor, Department of Civil and Environmental Engineering, University of Maryland

11/11/2011

NY Commuter Railroad's Response to Hurricane Irene; Howard Permut, President of Metro-North Railroad (MTA), New York

11/10/2011

Ranking of Information in Intelligent Transportation Systems; Ouri Wolfson, Professor of Computer Science, University of Illinois at Chicago (UIC)

11/01/2011

Towards a 21st Century Postal Service; John C. Panzar, Louis W. Menk Professor, Emeritus, Department of Economics, Northwestern University

10/26/2011

Safety Technology, Fuel Economy, and Individual Mobility; David L. Strickland, NHTSA, U.S. DOT

10/20/2011

Anticipating Disaster: Planning for Emergency Logistics Needs; Mark Turnquist, Professor of Civil & Environmental Engineering, Cornell University



The Icarus Society

provides a forum for the discussion and dissemination of national and international issues impacting the aviation industry in order to share knowledge about all things relevant to aviation with the widest possible audience. The Society promotes in-depth dialogue about airlines, aircraft manufacturing, aviation services, technology, government oversight, and significant elements of business aviation. **In addition to co-sponsoring seminars and events described elsewhere in this report, the Icarus Society was responsible for two important speaker and seminar events:**

03/08/2012

Designing NextGen Advanced Runway Operations to Exploit the Uncertainty of Meteorological Conditions; (Joint Icarus Society Meeting and Transportation Center Seminar) Laurence Audenaerd, Senior Engineer, Center for Advanced Aviation System Development, The MITRE Corporation, NUTC 2011 Dissertation Year Fellow

5/17/12

Economics of Airline Industry Consolidation
Hubert Horan, Aviation Expert and Independent Airline Consultant



Conferences, Symposia
White House Roundtable
Transportation Research Board Annual Meeting
William A. Paterson Lecture
Leon N. Moses Lecture
Industry Workshops
NUTC Seminars
Sandhouse Gang
Icarus Society

The Hagestad Sandhouse Gang

is a railroad-oriented discussion group hosted by NUTC. 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.

9/27/2012

The Great Railroad Revolution: The History of Trains in America. Presentation and Book Signing; Christian Wolmar, Transportation Journalist and Author

8/21/2012

Panel Discussion: Chicago Regional Freight Planning: A 2012 Perspective; Norman West, NEPA Principal Reviewer OECA, Region 5, U.S. EPA, Tom Murtha, Senior Planner, Chicago Metropolitan Agency for Planning, Libby Ogard, Transportation, Trucking, Railroad Consultant and Contractor

7/26/2012

The Arkansas and Missouri: 25 Years of Railroad in the Ozarks
J. Reilly McCarren, Chairman of the Board, Arkansas Missouri Railroad

6/14/2012

Forrest Gump of Railroad - 7 carriers and 27 years into my Railroad Odyssey; David Arganbright, Vice President - Government Affairs, RailAmerica, Inc.

5/03/2012

Transportation Deregulation & Safety: A Retrospective and Reflection after 25 Years. Conference (Co-sponsored by Icarus Society)

4/03/2012

Personal Perspective on the Last 15 Years of the Golden Empire
Mr. Andrew Fox, President, Chicago South Shore & South Bend Railroad

3/20/2012

Iowa Pacific Holdings, LLC – Newest Full Member of the AAR
Ed Ellis, President, Iowa Pacific Holdings

2/23/2012

Changing the Face of Logistics; (Joint Sandhouse Gang Meeting & NUTC Seminar) Mr. Michael M. Mullen, Vice Chairman, CenterPoint Properties

12/07/2011

Sandhouse Gang Luncheon Meeting: Transportation Trends and Investment Implications; Chris Ceraso, Director & Senior Equity Research Analyst, Credit Suisse, NY

11/01/2011

Iowa Interstate's Resurrection of the Rock; Dennis Miller, President, Iowa Interstate Railroad, Ltd

10/06/2011

Requiem for a Railroad: The Collapse of the Rock Island Joint Sandhouse Gang Meeting and Seminar; Gregory Schneider, Professor of History, Emporia State University, Emporia, Kansas

9/20/2011

Recent Railroad Research at Northwestern; (Joint Sandhouse Gang Meeting & NUTC Seminar) Ian Savage, Associate Chair, Department of Economics; Distinguished Senior Lecturer, Weinberg College of Arts and Sciences, David Kosnik, Research Engineer, ITI



Sandhouse Gang Steering Committee member Norman Carlson (at left) and Dennis Ciborowski, Director, FBM International Ltd. (right) share a lighter moment with British author and presenter, Christian Wolmar.

Executive Education

Academic Programs
Dissertation Year Fellowships
Student Awards



NUTC Executive Education Programs

Freight Transportation and Logistics: Delivering Results in a Volatile Environment

Faced with economic uncertainty, freight operators and their customers work in volatile business landscapes with shifting opportunities and expectations. To address these challenges, the Northwestern University Transportation Center conducted a customized three-day program, May 14-16, 2012, for transportation and logistics executives.

The Program faculty provided deep context for decisions on pricing, service, access, mode selection, and contractual arrangements. Success strategies for transportation buyers and sellers were explored.

Subject matter covered:

- Global freight marketplace size, scope, and complexity
- Forces driving change in transportation and logistics
- Trends in supply chain, logistics, and global third party logistics
- How customers buy freight in a volatile market
- The cost structure of freight transportation services
- The business arenas of domestic vs international freight
- Using data to manage freight and logistics decisions
- The role of freight intermediaries
- Global sourcing, including near-sourcing
- Carrier strategies for leadership, differentiation, and growth.



EDUCATION

The Northwestern University Transportation Center (NUTC) offers rigorous, non-degree executive program courses for transportation and logistics professionals, as it has done 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. These programs provide industry participants with the skills to excel in the complex business realm of global transportation and logistics. All NUTC Executive Programs are taught by leading authorities in the field.

The faculty included: Daniel Avramovich, Chairman, CEO and President, Pacer International, Inc.; Farrukh Bezar, Partner, Clarendon Group; Rick Blasgen, President, CEO, Council of Supply Chain Management Professionals (CSCMP); Lee Clair, Partner, Norbridge; Bill Driegert, Chief Innovation Officer, Coyote Logistics, Inc.; Aaron Gellman, Professor of Transportation, Northwestern University Transportation Center; Professor of Management & Strategy, Kellogg School of Management; Hani Mahmassani, William A. Patterson Distinguished Professor of Transportation and Professor of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science; Director, Northwestern University Transportation Center; Shawn McWhorter, President - Americas Region, Nippon Cargo Airlines, Inc.; Steven Rothberg, Partner, Mercator International, LLC; Ian Savage, Associate Chair of Economics and Distinguished Senior Lecturer, Weinberg College of Arts and Sciences; Joel Sitak, President and CEO, BirdDog Solutions; Jan Van Mieghem, Harold L. Stuart Professor of Managerial Economics, Professor of Operations Management, Kellogg School of Management; Doug Waggoner, CEO, Echo Global Logistics; Justin Zubrod, Managing Partner, Justin Zubrod & Co., LLC. ■



Pricing Highway Infrastructure

In September 2012, NUTC presented a three-day program for private and public sector professionals focusing on the principles and methods of pricing highway infrastructure. The course took into account that the funding of highways is at a crossroads. In this environment, opportunities exist for raising funds to establish and/or sustain infrastructure while providing a return on investment to both public and private investors. The key question of how to set prices received the full spectrum of consideration including systems behaviors, human factors, and public policy.



Faculty for the program were: Hani Mahmassani, William A. Patterson Distinguished Professor of Transportation and Professor of Civil and Environmental Engineering, McCormick School of Engineering and Applied Science; Director, The Transportation Center, Northwestern University; Ian Savage, Associate Chair of Economics and Distinguished Senior Lecturer, Weinberg College of Arts and Sciences, Northwestern University; and Joseph L. Schofer, Associate Dean, McCormick School of Engineering and Applied Science; Professor of Civil and Environmental Engineering; Director, Northwestern University Infrastructure Technology Institute. ■

EDUCATION

Executive Education

Academic Programs

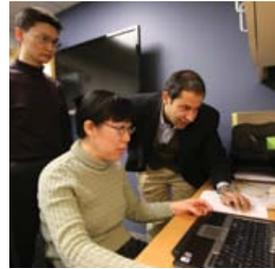
Dissertation Year Fellowships

Student Awards

Academic Programs in Transportation and Logistics

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 level 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. The 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. Students involved in the program 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

MS in Analytics, McCormick School of Engineering & Applied Science (NEW)



CCITT STUDENT OF THE YEAR

Luis de la Torre, PhD

Candidate in Industrial Engineering and Management Sciences, McCormick School of Engineering, receives the CCITT Student of the Year Award at the Council of University Transportation

Centers annual banquet held in Washington, D.C. on Jan. 21, 2012.

Speaking at the event and presenting the awards to transportation center students was Gregory D. Winfree, Deputy Administrator of the Research and Innovative Technology Administration, U.S. Department of Transportation. ■

Dissertation Year Fellowships

A primary goal of the Northwestern University Transportation Center is to promote academic excellence and quality research 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.

2012-13 NUTC Dissertation Year Fellowship Recipients

Yikai Chen

PhD Candidate in Civil & Environmental Engineering
Dissertation Topic: *Statistical Health-Monitoring for Transportation Infrastructure*; Faculty Advisor: Pablo Durango-Cohen

Luis de la Torre

PhD Candidate in Industrial Engineering & Management Science
Dissertation Topic: *Models and Algorithms for Coordination in Humanitarian Logistics*; Faculty Advisors: Irina Dolinskaya and Karen Smilowitz

Jiwon Kim

PhD Candidate in Civil & Environmental Engineering
Dissertation Topic: *Reliability in Traffic Simulation Models*
Faculty Advisor: Hani Mahmassani

Tim Sweda

PhD Candidate in Industrial Engineering & Management Science
Dissertation Topic: *Decision Making for Electric Vehicles*
Faculty Advisor: Diego Klabjan

2011-12 NUTC Dissertation Year Fellowship Recipients

Laurence Audenaerd

PhD Candidate in Civil & Environmental Engineering
Dissertation Topic: *Measuring the Sustainability of Intercity Travel*
Faculty Advisor: Joseph L. Schofer

Guy Arie

PhD Candidate in Management and Strategy,
Kellogg School of Management
Dissertation Topic: *Multi-Market Contact in the Airline Industry*
Faculty Advisor: Jeroen Swinkles

Yang Liu

PhD Candidate in Civil & Environmental Engineering
Dissertation Topic: *Welfare Effects of Congestion Pricing on Travelers with Different Value of Time*
Faculty Advisor: Yu (Marco) Nie

Student Awards, 2011-12

Yikai Chen, PhD Candidate in Civil and Environmental Engineering

Paper Selected as One of Five Best: "Multivariate Statistical Process Control for Structural Health Monitoring"
8th Annual Inter-University Symposium on Infrastructure Management (AISIM8), 2012

Charlotte Anne Frei, PhD Candidate in Transportation

Systems Analysis and Planning
Eisenhower Transportation Fellowship, 2012–2013

Madison Fitzpatrick, PhD Candidate in Transportation

- Eno Leadership Development Fellowship, 2012
- NSF Fellowship: "Reach for the Stars: Computational Models for Teaching and Learning in Physics, Astronomy and Computer Science"

Yue Geng, PhD Candidate in Industrial Engineering

CII (Containerization & Intermodal Institute) Scholarship, 2012

Ali Zockaie Kheiraie, PhD Candidate in Civil and Environmental Engineering

Graduate Student Participation Grant to attend 8th National Aviation System Planning Symposium, 2012

Ramón L Torres, PhD Candidate in Civil and Environmental Engineering

NSF Fellowship: "Reach for the Stars: Computational Models for Teaching and Learning in Physics, Astronomy and Computer Science"

Alex Huang,

Alex Yue Ma,

Sara L Schmidt,

Nancy Xu,

Brandon Zhang

*Team of McCormick School of Engineering Seniors
Awarded Honorable Mention,*

2012 INFORMS Undergraduate Operations Research Prize Competition; Project: "Integration of Real Time Data in Urban Search and Rescue"





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 consists of industry executives from a wide variety of firms and organizations involved in providing, procuring and/or supporting transportation, logistics, and supply chain operations. Membership includes senior-level executives from shipper and carrier firms, freight-forwarders,

equipment and technology suppliers, trade associations, financial organizations, and management 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.





Fall 2011 Meeting October 25-26, 2011

Unequaled by any academic transportation advisory board in the country, the BAC has long been a major force behind the Transportation Center's success.

It is structured through four 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 BAC meets twice yearly on the Evanston campus to foster an exchange of ideas among its 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 opportunities for more informal networking and exchange.

The Fall BAC meeting began with a Tuesday afternoon workshop formatted as two panel discussions addressing the topic: *Improving the Customer Experience in Travel and Transportation Using Information Technology*. (See article on page 34) NUTC Director Hani Mahmassani exhorted industry leaders to use data and analytics to "design a better experience" for travelers and freight customers.

Tuesday evening, Robert J. Gordon, Northwestern's Stanley G. Harris Professor in the Social Sciences, delivered the Inaugural Leon N. Moses Distinguished Lecture. (See article on page 33)

Wednesday's BAC meeting agenda featured a call to order and opening comments by BAC Chair Justin Zubrod followed by a welcome from McCormick School of Engineering and Applied Science Dean, Julio Ottino.

Professor Mahmassani then provided his *State of the Center* report to the BAC members. He highlighted a number of initiatives and programs sponsored by the Center over the 2010-2011 academic year including key international and national partnerships and strategic outreach events focused on public policy issues. He also reported on the Center's increased research activity, noting that there were 22 research projects underway at the Center during 2011. Another high point of the year was the addition of a number of new companies and members to the BAC and new affiliated faculty to the Center's research team.

Five presentations offered in-depth analyses and perspectives:

Sourcing: On-Shoring, Near-Shoring & Managing Disruptions Risks in the Supply-Chain; Sunil Chopra, IBM Professor of Operations Management and Information Systems, Kellogg School of Management

The State of Manufacturing in the United States in the Context of Global Manufacturing; Atlee Valentine Pope, President, Blue Canyon Partners; and Discussant: Mike Mullen, Chairman & Co-Founder, CenterPoint Properties

Research Update – Industrial Market Drivers Study; Hani Mahmassani

Comments on Transportation and Logistics at Kellogg; Sally Blount, Dean of the Kellogg School of Management

Oil and Transportation:

Fuel Price Management in a Volatile Environment; Jon Efken, Bank of America Global Commodities

Implications of Crude Oil Price to Supply Chain Network Decisions; Michael Watson, PhD, IBM ILOG Supply Chain Applications

The meeting adjourned to a luncheon with NUTC students. ■



Spring 2012 Meeting, April 18-19, 2012

An industry workshop marked the start of the Spring BAC meeting on Wednesday, with two panel discussions exploring the timely subject: *The Electrification of Transportation: A Look at the Road Ahead*. (See article on page 35) Regulations, technologies, infrastructure, and user experience considerations were presented, along with a comprehensive response to the question: “Why electrify?”

That evening, Alan Mulally, President and Chief Executive Officer of Ford Motor Company, delivered the 31st Annual Patterson Transportation Lecture: The Ford Story. (See article on page 32)

Thursday began with McCormick School of Engineering and Applied Science Dean, Julio Ottino, welcoming participants and briefly laying out McCormick’s strategic vision: *The Great Intersection*.

This was followed by NUTC Director Hani Mahmassani’s *State of the Center* report to the BAC members. He highlighted new BAC memberships, NUTC fiscal health, faculty recognition, a number of outreach activities related to public policy and research, executive education workshops, and international projects and visiting scholars. Mahmassani stressed that students were at the core of the Center’s mission, noting that there were twenty-seven students supported via NUTC’s research projects and three via dissertation year fellowships.

New BAC members were introduced after which the gathering focused on a panel discussion and several presentations.

Panel Discussion: Contemporary Issues in Transportation Safety

Panel Moderator, Ian Savage, Associate Chair, Economics Department, was well-qualified to provide introductory remarks, having planned the major conference: *Transportation Deregulation and Safety: A Retrospective and Reflection after 25 Years*. (See article on page 30)

Panel presentations included:

Overview of Issues Impacting Health and Safety within the Transportation Sector: Focus on Fatigue, Hours of Service and Rest;

Kathryn Reid, Research Assistant Professor, Northwestern Department of Neurology

Safety Issues within the Aviation Industry; James Rankin, President, Air Wisconsin Airlines

Safety Issues Impacting Ground Transportation; Steven Ricci, Division Manager, Human Resources, UPS

Edward Colgate, Professor of Mechanical Engineering, Northwestern University, gave a faculty research update on interactive touch screens—focusing on improved operating conditions.

2010 Nobel Laureate in Economics, Dale Mortensen, Northwestern University Professor of Economics, offered insights in his presentation: *Unemployment... During and After the Great Recession*. He explained and documented: (1) “The Flows Approach” to unemployment analysis—that the labor market can be analyzed as a dynamic flow; (2) the role and determination of job openings; and (3) the Great Recession and what may come next. After Mortensen’s



talk, BAC members were then given an opportunity to comment on labor issues facing the transportation industry.

[2010 Nobel Laureate Dale Mortensen, Northwestern University Professor of Economics, spoke to the BAC members on April 19, 2012.](#)

In a final presentation before adjournment, Reggie Dupré, Chief Executive Officer of Dupré Logistics, LLC, offered—by way of his company’s examples—several strategies to overcome labor shortages.

The Spring BAC Meeting ended with an introduction of NUTC students and a wrap-up luncheon. ■



New Members

Leadership Level



Mr. Jim Compton
Executive Vice President,
Chief Revenue Officer,
United Airlines



Mr. Alfred Messina
Vice President,
Booz Allen Hamilton



Mr. Jeff Silver
CEO,
Coyote Logistics

Sustaining Level



Mr. William A. Cook
Director - Logistics
and Customs,
Chrysler Group LLC



Ms. Jean Regan
Chief Executive
Officer, Chairman of
the Board, TranzAct
Technologies, Inc.



Mr. Mark Scudder
President, Scudder
Law Firm, P.C., L.L.O.



Mr. Tom Wells
President and CEO,
TTX Company

Continuing Members

Sustaining Level



Dr. Allen Adler
VP, Enterprise Tech-
nology, Strategy
Engineering Opera-
tions & Technology,
The Boeing Company



Mr. Tom Anderson
Senior Vice
President,
Services and
Customer Support,
Airbus



Mr. Daniel W.
Avramovich
Chairman & CEO,
Pacer
International, Inc.



Mr. Farrukh A. Bezar
Partner,
Clarendon
Consulting Group



Mr. Andrew Boyle
Executive Vice
President & CFO,
Boyle Transportation



Mr. Neil Collins
Senior Client Partner
Global Sector Leader,
Logistics & Transporta-
tion Services, Korn/
Ferry International



Mr. Frederick S.
Cromer
Senior VP,
International Lease
Finance Corporation



Mr. Keith W. Dierkx
Global Industry
Leader, Rail; and
Director of the
IBM Global Rail
Innovation Center



Ms. Ann M. Drake
Chairman & Chief
Executive Officer,
DSC Logistics



Mr. Reggie Dupré
CEO,
Dupré Logistics, LLC

Continuing Members

Leadership Level



Mr. Alberto Aleman Zubieta
Administrator &
CEO, Panama Canal
Authority (ACP)



Ms. Susan Bee
Managing Partner,
Teradata



Mr. Doug Cook
VP, International
Planning &
Engineering
FedEx Express



Mr. Keith Creel
Chief Operating
Officer, Executive VP,
Canadian National
Railway



Mr. Charles R. Eisele
Senior VP Strategic
Planning &
Administration,
Union Pacific
Corporation



Mr. Edward Jenkins
Assistant VP,
E-Business &
Marketing,
CSX Transportation



Dr. Robert E.
Martínez
VP, Business
Development,
Norfolk Southern
Corporation



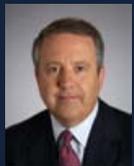
Mr. Paul E. Nowicki
Assistant VP,
Government &
Public Policy,
BNSF Railway
Company



Mr. Lester M. Passa
VP, Strategic
Planning,
CSX Corporation



Mr. Will Ris
Senior VP,
Government Affairs,
American
Airlines, Inc.



Mr. Matthew K. Rose
Chairman & CEO,
BNSF Railway Co.



Mr. Gene Seroka
President,
Americas,
APL Limited



Mr. Burt Wallace
President,
Corporate
Transportation,
UPS

BAC



Mr. Michael Broaders
VP, Regional Field
Operations
Product Supply,
Coca-Cola
Refreshments



Mr. Edward A.
Burkhardt
Founder, President,
Rail World, Inc.



Mr. Michael Burton
President, CEO,
C&K Holdings
Aquisition, LLC



Mr. Perry A. Cantarutti
Senior VP Europe,
Middle East
and Africa,
Delta Air Lines, Inc.



Mr. Lee A. Clair
Partner,
Norbridge, Inc.



Mr. Edmund J. Feeley
Managing Director,
Littlejohn & Co., LLC



Mr. Andrew Fox
President,
Chicago South
Shore & South Bend
Railroad



Mr. Eli Gross
Managing Director,
Morgan Stanley



Mr. James L. Hamilton
Managing Director,
Transportation
Investment Banking,
J.P. Morgan & Co.



Mr. Robert W. Hart
VP and Managing
Director, Surface
Transportation,
Fifth Third Bank

Continuing Members

Sustaining Level



Mr. John Hellman
President, CEO,
Genesee &
Wyoming, Inc.



Mr. Steven Holic
Supply Manager,
Senior Director
General Purchasing,
Philips Electronics



Mr. Reginald L. Jones
Managing Partner,
Greenbriar Equity
Group



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President, CEO,
Canal Barge
Company, Inc.



Mr. Benjamin J. McLean
Senior VP, CIO,
Ruan Transportation
Management Systems



Dr. Craig E. Philip
CEO,
Ingram Barge
Company



Mr. Clifford
Porzenheim
Senior VP,
Strategic Growth,
GATX Corporation



Mr. James P. Rankin
President, CEO,
Air Wisconsin
Airlines Corporation



Ms. Kathleen L. Ross
Senior VP,
Senior Client
Manager,
Bank of America
Merrill Lynch



Mr. Steven Rothberg
Founding Partner,
Mercator
International, LLC

Association Level



Mr. Rick D. Blasgen
President, CEO,
Council of Supply
Chain Management
Professionals
(CSCMP)



Mr. Bruce Carlton
President & CEO,
National Industrial
Transportation
League (NITL)



Gov. Bill Graves
President, CEO,
American Trucking
Associations (ATA)



Mr. Edward
Hamberger
President, CEO,
Association of
American Railroads
(AAR)



Mr. Joshua L. Schank
President & CEO,
Eno Transportation
Foundation, Inc.

Individual Level



Mr. Phil Bakes
President,
Snapper Creek
Equity
Management, LLC



Mr. L. Price
Blackford
Senior Advisor,
Sagent Advisors,
Inc.



Mr. John Bowe
Principal,
American Maritime
Group, LLC



Ms. Vicki Bretthauer
Independent
Consultant



Mr. James H.
Burnley IV, Esq.
Partner,
Venable, LLP



Mr. Eugene F.
McCormick
Partner,
McCormick
Jahncke Group



Ms. Linda J. Morgan
Partner,
Nossaman, LLP



Mr. Dennis P.
Neumann
Chairman,
BNY Capital
Funding, LLC



Mr. David J. Rohal
Vice President,
Patriot Rail
Corporation



Mr. James A. Runde
Special Advisor,
Investment Banking
Division,
Morgan Stanley

BUSINESS ADVISORY COMMITTEE



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President,
Americas Region,
Nippon Cargo
Airlines, Inc.



Mr. D. Stephen
Menzies
Group President,
Trinity Rail,
Trinity Industries, Inc.



Mr. Michael M. Mullen
Vice Chairman,
Co-Founder,
CenterPoint
Properties



Mr. Dennis Nash
President, CEO,
Kenan Advantage
Group, Inc.



Mr. Aurelio Pérez
Alonso
Assoc. Director, CFO,
Grupo ADO
S.A. De C. V.



Mr. Gilles Roucolle
Partner, Global
Transportation
Practice,
Oliver Wyman



Mr. John M. Smith
Chairman of
the Board,
CRST International



Mr. Dan Spellman
President & COO
Americas and Asia,
Caterpillar Logistics
Services LLC



Mr. Jeff A. Starecheski
VP Logistics Services,
Sears Holding
Corporation



Mr. Douglas R.
Waggoner
CEO,
Echo Global
Logistics

BAC



Mr. Norman Carlson
Chairman,
Carlson Consulting
International, LLC



Mr. Brendan P.
Hickman
Managing Partner,
Transportation
Management Group



Mr. Adam Inselbuch
Managing Director,
South Street
Ventures, LLC



Mr. Tim Krauskopf
Founder,
Round Lake Freight



Mr. Charles B.
Lounsbury
Former Senior
Vice President,
Ryder System, Inc.



Mr. David I. Scott
Principal,
David Scott
Consulting, LLC



Mr. Andy Sze
Founder,
Fastraxx Group,
LLC



Mr. Justin Zubrod Sr.
Managing Partner,
Justin Zubrod & Co., LLC
*Chair, Business Advisory
Committee*

Community

New Academic Year Welcome Dinner

In September 2011 NUTC hosted a Mexican “fiesta” dinner to welcome students to the starting academic year. New transportation students were introduced and networked with NUTC ongoing students and faculty.



SOCIAL MEDIA



The NUTC LinkedIn group, with over 300 members, is a dynamic medium to engage the NUTC community. Along with showcasing upcoming NUTC events of interest, the NUTC LinkedIn Group members engage in transportation and logistics discussions.

To join, visit transportation.northwestern.edu.



Facebook NUTC has two forums: an NUTC Fan page, which everyone can “Like” in order to receive information on upcoming events and news of interest; and the NUTC Community Group page which is a special member-only forum for those closely tied to the NUTC community.

To join, visit transportation.northwestern.edu.

End of the Year Picnic

Each year, the Transportation Center hosts an annual get-together in June to celebrate the end of another successful academic year. This traditional event brings together the NUTC ‘family’ of students, faculty, alumni, colleagues and friends for a relaxed BBQ on the back lawn of the TC.



Kellogg Transportation Club

The Transportation Club aims to raise student awareness and interest in management opportunities within the transportation industry for MBA students. Throughout the year, the Transportation Club sponsors a variety of events, including presentations by industry managers from airline, aerospace, rail, ocean shipping and logistics companies as well as field trips to local transportation operations. During the 2011-12 academic year, Club members visited O’Hare Airport to view firsthand the multi-million dollar O’Hare Expansion Project. Another field trip, hosted by BAC member, Shawn McWhorter, President of the Americas Region of Nippon Cargo Airlines, gave the students an up-close experience with cargo management operations.



Conference Reception Dinner

NUTC graduate student researchers socialize with international thought-leaders and presenters at an evening outdoor reception dinner on Northwestern's lakefront facilities to initiate the ICEM 2012 Conference.



Boat Cruise & Banquet

Students and researchers from ten countries enjoy an elegant dinner and lively conversation during the third evening of the ICEM 2012 Conference.





Hani Mahmassani
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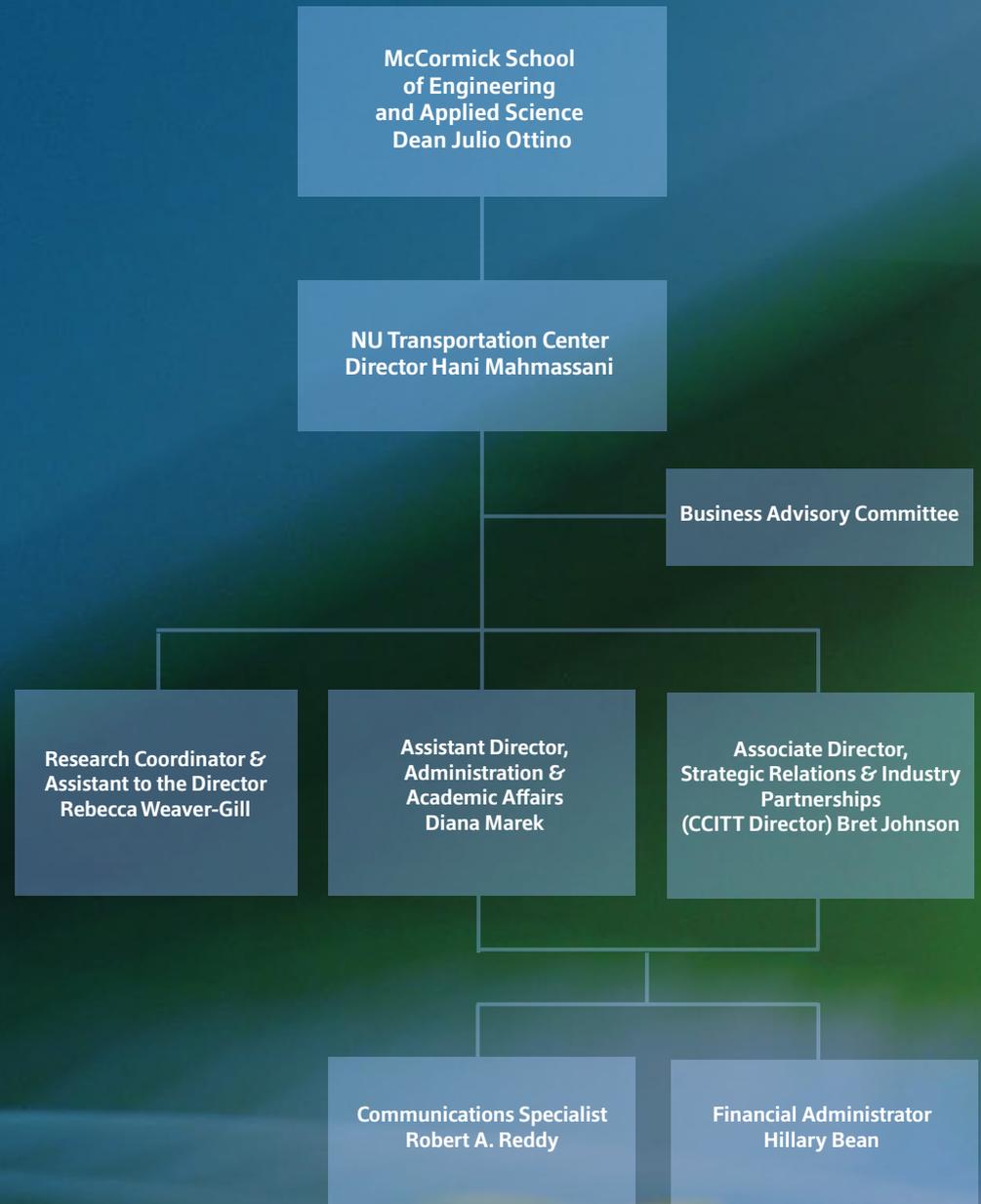


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