



Northwestern University

TRANSPORTATION CENTER

ADVANCING THE MOVEMENT OF

FREIGHT

PEOPLE

ENERGY

AND

INFORMATION

2015 Progress Report



Photo: © Halley Tsai / Grimshaw

**A CONTINUING MISSION** As we look toward the years ahead, the Transportation Center recognizes that its mission—while retaining the essential features of transportation research, outreach, and education—requires that the focus shift as technologies, markets, and societal issues evolve.

This report reflects that transformative change in the transportation domain, and in the initiatives and collaborations that we pursue as a hub for generating, disseminating, and implementing new knowledge.



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Photo at left: Fulton Center transit hub and retail complex, New York

## Director's Message

Our progress report is an opportunity for us at the Transportation Center to take stock of the many accomplishments of our faculty and students over the past year. It is also a striking reminder of how much this year is different from the previous year, and the one before it. The transportation domain is experiencing transformative change—driven by a range of new technologies and service innovations that cut a broad swath through the sector. Autonomous vehicles, connected travelers, unmanned aerial vehicles (aka drones), the Internet of Things (IoT), smart cities, are ushering in new visions for urban personal mobility and last-mile delivery in supply chain logistics. Technology giants such as Google, Apple and Amazon, along with tech-driven transportation companies such as Uber, have become regular players in the transportation domain, and their influence is being felt across the spectrum of transportation policy decisions and market choices. Amazon, the online retailing pioneer of the dotcom era, has reached dizzying heights of vertical integration, from owning interaction with its customers to owning a vast logistics asset base for last mile delivery.

At the same time, the crumbling state of the nation's physical infrastructure continues to further deteriorate, in terms of both physical and operational conditions, for all modes of transportation. Urban rail transit systems in the nation's major cities are succumbing to peak demand overloads and to many years of deferred maintenance. Public transport, in its dominant present form of buses running along fixed routes on fixed schedules may become even less viable with the growth of on-demand alternatives. Political dysfunction precludes coherent national and regional strategies for freight and person mobility. On the bright side, certain progressive cities have been aggressively promoting environmentally sustainable forms of mobility, such as bicycling and walking, through a combination of urban design and repurposing of the public right



of way. Yet the transportation system is complex, and must meet sometimes competing objectives; tinkering at the margin will not address the fundamental imbalances that exist between the needs of people and firms for accessibility and system fluidity on one hand, and the continuous erosion of the transportation system to meet growing mobility expectations for people and goods.

Extreme volatility of demand and prices in global markets, and uncertainty about sustaining growth rates in major economies around the world have created more challenging conditions for planning inventories and associated supply chains. Uncertainty in oil and commodity prices, exacerbated by geopolitical considerations, is directly impacting all industry sectors. Wait and see approaches are shortening lead times for producers and retailers, raising logistics costs. Disruptions due to natural disasters are occurring at higher frequency, placing greater emphasis on the need for resilience in our transportation and logistics systems.

We at the Transportation Center love challenges! It is indeed an exciting time to be in the transportation business, judging by the number and types of new entrants. With its more than 60-year history, the Transportation Center can place these transformations in a proper perspective, and facilitate the kinds of exchanges

from which new concepts and ideas emerge, and advance to where they can affect positive impact on the flow of people and goods, along with the information flows that have become an integral component of both virtual and physical movement. Through systematic fundamental and application-driven research, the Transportation Center is focused on developing and applying principles and methods that help anticipate how new technologies will perform, and how to best deploy resources to ensure their effectiveness.

The Transportation Center's unique model of industry-engagement through its impressive Business Advisory Council (BAC) (see p. 46), along with active research programs addressing methodological, engineering, management and policy aspects of transportation issues faced by agencies (see p. 32), keep our faculty and student researchers at the cutting edge and beyond of the developments that matter in the transportation domain. The 2015 Progress Report highlights the kind of research underway by faculty and students in conjunction with our industry partners and agency sponsors. We are especially proud of *Mobility 2050: A Vision for Transportation Infrastructure*, a document resulting from an interdisciplinary study by the Transportation Center (see p. 38) in collaboration with our industry partners.

We hope you enjoy looking through this Progress Report and reading about the year in the life of our vibrant community as much as we enjoyed the accomplishments, successes, and events of our diverse and rich community of transportation scholars and professionals.



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

## Highlights By the Numbers



Assistant Director Diana Marek and Associate Director Bret Johnson welcome alumnus Robert Peskin of AECOM to a special NUTC 60th Anniversary reception held in Washington DC.

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**34** Graduate Students Enrolled in  
Transportation Degree Programs

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**13** Research Projects with  
Graduate Students Involved

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**2** Dissertation Year Fellows  
2015–2016

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**15** Students Enrolled in  
Transportation & Logistics  
Minor Program

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**10** NUTC Proposals in Review

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**9** NUTC Research Projects Funded

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**9** New Business Advisory Council  
(BAC) Companies

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**11** New BAC Members

---

**61** Years of NUTC Transportation &  
Logistics Research Support

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# Collaboration and Connections

## Regional & National

### Symposia, Conferences, & Committees

NUTC hosted the 7th William O. Lipinski Symposium on Transportation Policy & Strategy: Paths to Economic Competitiveness: Advancing Supply Chain Performance in the Chicago Hub (see p.58).

Douglas Parker, Chairman and CEO of American Airlines, delivered the 2015 Patterson Lecture in Transportation: American Airlines: Building an Airline for the Future (see p. 56).

Jan Brueckner, Professor of Economics, University of California, Irvine presented the 3rd Leon N. Moses Distinguished Lecture in Transportation Lecture: Convenient Flight Connections vs. Airport Congestion: Modeling the “Rolling Hub” (see p. 57).

Karen Smilowitz of Northwestern Engineering and Mike Hewitt of Loyola University Chicago were elected officers in the 2015 Transportation Science and Logistics (TSL) Society.

Ian Savage and BAC member Craig Philip were appointed to a Transportation Research Board special committee, the Committee for Study of Domestic Transportation of Petroleum, Natural Gas, and Ethanol.

Robert J. Gordon published a book, *The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War*.

David Boyce with Huw C. W. L. Williams published a book, *Forecasting Urban Travel: Past, Present and Future*.

### Research Engagements

Marco Nie and Amanda Stathopoulos are leading a NSF Partnerships for Innovation: Building Innovation Capacity research project on crowd-sourced urban package delivery in collaboration with the Kellogg School of Management and the University of Illinois at Chicago.

NUTC faculty and students gave more than 30 presentations at the 94th Annual Meeting of the Transportation Research Board. (see p. 67)

The LINCS (Leveraging, Integrating, Networking, Coordinating Supplies) national supply chain management education consortium, of which NUTC is a member, launched 8 supply chain certificate training programs. (see p. 37)

Bret Johnson was named co-chair of the Academic Advisory Council for the LINCS consortium.

### Governments and Agencies

NUTC initiated a technical assistance project with the Chicago Department of Transportation for Red Light Camera Enforcement: Best Practices and Program Road Map (see p. 25).

Hani Mahmassani has partnered with Leidos on three projects for Federal Highway Administration and USDOT: Active Transportation and Demand Management (ATDM) Analytical Methods for Urban Streets; Integrated Modeling for Road Condition Prediction; and Tools for Tactical Decision Making/Advancing Methods for Predicting Performance (see pp. 26–28).

NUTC’s Sandhouse Rail Group, in collaboration with DePaul University’s Chaddick Institute, co-hosted the presentation of Amtrak’s Chicago Gateway Blue Ribbon Panel final report (see p. 64).

Joseph Schofer serves on the Freight Committee and Bret Johnson serves on the Economic Development Committee of the Chicagoland Metropolitan Agency for Planning (CMAP).

NUTC provided technical assistance to the US Secret Service and law enforcement agencies on crowd dynamics and management in connection with Pope Francis’ visit to Philadelphia.

### Industry Engagement

NUTC completed a research study on Grain and Soybean Industry Dynamics and Rail Service in partnership with BNSF Railway (see p. 36).

NUTC produced a report, *Mobility 2050: A Vision for Transportation Infrastructure*, in partnership with the American Association of Equipment Manufacturers (see p. 37).

Karen Smilowitz led a NSF Grant Opportunity for Academic Liaison with Industry (GOALI) project on Improving Medical Preparedness, Public Safety and Security at Mass Events (see p. 30).

NUTC hosted industry workshops: Unmanned Aerial Vehicles: Applications and Emergent Technologies; and The Internet of Things in Transportation and Logistics (see pp. 61–62).

NUTC sponsored the 2015 Rail Summit in Chicago, and organized a session, *Freight Markets: Practices and Prospects for Trading Capacity in Truck Brokerage and Rail Auction Markets*.



## International

### International Symposia



Noshir Contractor delivered keynote addresses at:

- IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining
- NetSci Computational Social Science Conference

Hani Mahmassani delivered keynote addresses at:

- 3rd International Conference on Evacuation Modeling and Management, Tainan, Taiwan.
- 18th EURO Working Group on Transportation (EWGT 2015), Delft, The Netherlands.
- 2nd Interdisciplinary Conference on Production, Logistics and Traffic in Dortmund, Germany.
- 11th International Conference of The International Institute for Infrastructure Resilience and Reconstruction, Seoul, South Korea.



NUTC faculty affiliates and students presented papers, conducted workshops and executive courses, gave talks, and participated in conferences in:

- Beijing, Harbin and Xi'an, China
- Delft, Groningen and Tilberg, The Netherlands
- Dortmund, Germany
- Hong Kong
- Jeddah, Kingdom of Saudi Arabia
- Kobe and Kyoto, Japan
- La Rochelle, Lyon and Paris, France
- Pretoria, South Africa
- Seoul and Incheon, South Korea
- Tainan and Taipei, Taiwan
- Toronto, Ontario, Canada
- Singapore
- Southampton and Windsor, United Kingdom
- Vienna, Austria
- Zaragoza, Spain



The NUTC will host the 22nd International Symposium on Traffic and Transportation Theory (ISTTT) in 2017.

### International Research Collaboration

NUTC partnered with Sejel Technologies Inc. (Jeddah, KSA) in the development and application of crowd simulation and optimization tools to assist the Kingdom of Saudi Arabia's Ministry of Hajj in the management of large-scale pilgrim movements in Makkah.

The Kellogg Center for Research in Technology & Innovation and NUTC conducted a joint workshop with researchers at Åbo Akademi University in Finland on Information and Incentive Failures in Business Ecosystems, as part of a collaborative study of the market potential of new technologies on bulk shipping in the Baltic Sea (see p. 33).

NUTC continued its partnership with the University of Chile through the International Time Use Observatory.

Kimberly Gray served on the Science Advisory Committee for the Center for Sustainable Urban Development at Pontificia Universidad Catolica de Chile.

Karen Smilowitz collaborated with Last Mile Health in Liberia and advised an undergraduate Northwestern researcher to help solve routing problems for community health care workers.

Marco Nie is an adjunct professor in the School of Transportation and Logistics at Southwest Jiaotong University (Sichuan, China).

### International Governments and Industry

NUTC continued its advisory role in the development of a national Roads and Transportation Research Center for the Kingdom of Saudi Arabia's Ministry of Transportation, in collaboration with SETS, Inc.

Hani Mahmassani was an invited participant in an international OECD Roundtable in Paris, France on Quantifying the Socio-Economic Benefits of Transport: Travel Time Variability and Wider Economic Benefits.

# Synergistic Institutes and Centers

The Transportation Center aims to educate and promote awareness of transportation-related research by way of programming and building relationships with institutes and centers aligned in the ongoing effort to enhance transportation-related knowledge among students and faculty alike. The activities they generate are open to the campus and larger transportation communities, contributing to a rich intellectual and professional experience in virtually all aspects of transportation systems.

## Center for the Commercialization of Innovative Transportation Technology (CCITT)

CCITT is a research center operated by NUTC that specializes in the technology transfer of transportation research at Northwestern. The Center was established in 2005 as part of the The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The Center develops and co-hosts NUTC's Industry Technical Workshop series, which in 2015 included: "Unmanned Aerial Vehicles: Applications and Emergent Technologies" and "The Internet of Things in Transportation and Logistics" (see p. 62).

Building on the original mission to foster the commercialization or implementation of innovative technologies for multiple modes of

surface transportation, CCITT seeks to remain at the forefront of innovative methods to translate research outcomes to transportation practitioners in the public and private sectors.

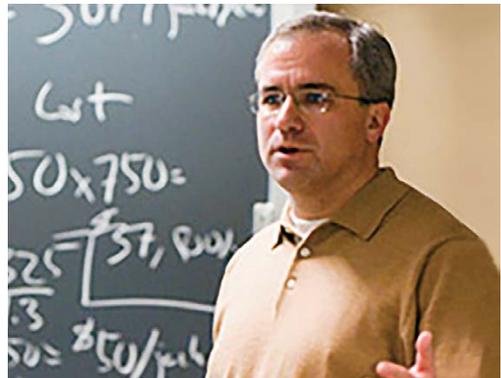
CCITT director Bret Johnson is a member the Transportation Research Board's Technology Transfer Committee (ABG30).



Left to right: CCITT Director Bret Johnson, Joe Burns, Michael Drobac, Sean McCann, Hani Mahmassani.

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

COSCM was established in 2004 to organize the Kellogg School's research and pedagogical activities in these essential subject areas. The Kellogg School's Operations and Supply Chain Management programs, led by nine accomplished faculty members, are historically ranked among the nation's best.



Center for Operations & Supply Chain Management Director Martin Lariviere.

## Institute for Sustainability and Energy (ISEN)

ISEN was established in 2008 as an umbrella organization whose unique mission is to advance global energy and sustainability solutions through transformational research, interdisciplinary education, and public engagement. 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 was founded in 2004 with the goals of uncovering fundamental principles governing complex systems in science, technology, and human behavior and applying these principles to solve societally relevant problems through the analysis, design, and control of complex systems. Based on the belief that breakthroughs in complex systems require collaboration across boundaries of traditional domains, NICO brings together faculty in business, engineering, education,

medicine, natural sciences, and social sciences. Cross-disciplinary collaborations break down barriers due to disciplinary knowledge silos and domain-specific terminology, accelerating the development of the new science of complex systems.



## Infrastructure Technology Institute (ITI)

ITI's goal 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.



# The Transportation Library

The Transportation Library houses valuable research, provides public service programming, and hosts special events that support and celebrate Northwestern University's transportation research community, and beyond. Founded in 1958, the Library supports the Center's curricula and research programs. With a catalog containing over 926,000 books, journals, indexed articles, and more, the Transportation Library at Northwestern boasts one of the largest transportation-focused collections in the world.

## 2015 Developments

In late January 2015, the Northwestern University Transportation Library debuted NUtranlit, a more powerful discovery to replace the Transportation Article database (TRANweb). In order to provide Center researchers with better services, the Library developed a new search interface to allow targeted searching of all available collections; specific collections (NUtranlit, EIS collection); as well as, all of NU Library collections.

In February, Transportation Library Director Roberto Sarmiento presented a lecture titled, *The Transportation Library: A True Hidden Treasure* at Northwestern on behalf of an Alumnae Continuing Education Class led by Kevin Leonard, University Archivist.

In May, Sarmiento co-authored a report as chair of the TRB Committee on Library and Information Science for Transportation (LIST) titled, *Literature Searches and Literature Reviews for Transportation Research Projects: How to Search, Where to Search and How to Put it All Together*. As indicated by report: "This e-circular is the result of a 2-year collaborative effort by more than 50 individuals. The publication is aimed at all transportation researchers, including university investigators, graduate students, consultants, and practitioners at state and federal transportation agencies.

The e-circular also will be useful to sponsors of research when conducting initial literature searches and evaluating literature reviews to determine the quality of the products received."

In October, the Library partnered with the Transportation Center to host a special symposium and book launch event around the recently released *Forecasting Urban Travel: Past, Present and Future*, which was co-authored by Transportation Center Adjunct Professor, David Boyce (see p. 63).

Library Assistant Joe Ellison was elected treasurer to the Special Libraries Association Transportation Division. Public Services Librarian Rachel Cole joined the library, bringing with her a background in academic, special, and corporate libraries.



Graduate students in the Transportation Library



Left to right: Transportation Library Director Roberto Sarmiento, Public Services Librarian Rachel Cole, Library Assistant Joe Ellison

**TRANSPORTATION LIBRARY** materials and files are available on all transportation modalities including but not limited to, air, rail, highway, pipeline, water, urban transport, and logistics. More specifically, the Library hosts a sizable collection of law enforcement materials, transportation company annual reports dating back through the 19th century, and one of the nation's most comprehensive collection of printed US environmental impact statements (EIS).

The Transportation Library is open to the general public. For research assistance, please contact Library staff via email, telephone or stopping by during the scheduled hours of operation listed at right.

The Library and Information Science for Transportation (LIST) committee serves as a forum for transportation librarians and the transportation research community on developments in information science and

their applicability to transportation. The LIST committee is in the Research and Education (ABG00) Section of the Transportation Research Board (TRB).

Northwestern University Transportation Library  
 1970 Campus Drive | Evanston, IL 60208-2300  
[trans@northwestern.edu](mailto:trans@northwestern.edu) | [tiny.cc/NUTCLibrary](http://tiny.cc/NUTCLibrary)  
 HOURS: 8:30 AM – 5:00 PM



Northwestern University Transportation Library

## In Memoriam

# Aaron J. Gellman (1931–2016)

Professor Aaron J. Gellman, age 85, passed away on January 11, 2016. Professor Gellman was an intellectual powerhouse and a visionary with deep appreciation of the interplay of technology, economics and policy in the transportation industry. In demand by policy makers, government, industry and the media for his wide-ranging expertise, Gellman had more than 50 years of experience as an economist, strategist, consultant and academic in the transportation industry. His research focused on transportation economics, innovation, regulation and policy.

50+

YEARS OF  
SERVICE IN  
TRANSPORTATION

### Transportation Center Director

Gellman served as Director of the Transportation Center from 1992 to August 2000. He used his contacts from the business world to advance both the Center's academics and research agenda. Under his leadership, the Center initiated a "Building for the Future" campaign to raise funds for a new headquarters building to be built in the heart of the Evanston campus. Chambers Hall, the current home of the Center, was inaugurated and occupied in 1999. Gellman remained an intellectual cornerstone for the Center, sharing his deep knowledge, insight and wisdom freely with colleagues, students and industry partners. He is missed not only by his colleagues at Northwestern, but also by his many friends and professional associates in the wider transportation community who valued his expertise and enthusiasm.

### Professor in the Kellogg School of Management and McCormick School of Engineering

In addition to serving as Center Director, Gellman held faculty appointments in the Kellogg School of Management as a professor of management and in the McCormick School of Engineering as a professor of industrial engineering and management sciences.

"Aaron had an insatiable appetite for knowledge, about transportation, of course, but also about art, music, the economy, technology, business—the world," said long-time

colleague Joseph Schofer, Associate Dean for Faculty Affairs at the McCormick School of Engineering and Applied Science and professor of civil and environmental engineering. "And he was driven to share that knowledge with everyone around him—students, friends, colleagues, policymakers, the public. When Aaron spoke, people listened."

### Service to Government Agencies

Gellman served on numerous government panels and committees. These included, most recently, the advisory board to the Panama Canal Authority; the National Aeronautics and Space Administration (NASA) Aerospace Technology Advisory Committee; and the Federal Aviation Administration (FAA) Research, Engineering and Development Subcommittee on Safety and Air Traffic Services. He also was a long-time member of the Board of Advisors to the Eno Center for Transportation.

In 2015, Gellman was awarded the Wilbur S. Smith Friend of Eno Award. Former Secretary of Transportation Norman Mineta delivered the award presentation speech.

In 2014 Gellman received the Francis X. McKelvey Award from the TRB Aviation Group and in 1995, received the Salzberg Honorary Medallion for Outstanding Achievement in the Field of Transportation. In 2011, the Transportation Center held a symposium, The Future of Aviation, in Gellman's honor.

## Aaron J. Gellman, Former NUTC Director, Aviation Expert and Transportation Scholar



### Earlier Career

Prior to coming to Northwestern, Gellman was an adjunct professor of systems and regional science at the University of Pennsylvania for 24 years. He founded and served as president of Gellman Research Associates, Inc., a transportation consulting firm.

Gellman earned a PhD in economics from the Massachusetts Institute of Technology, an MBA from the University of Chicago and a BA in economics from the University of Virginia.

# Faculty Affiliates and Researchers

## Jan D. Achenbach (Mc)

Walter P. Murphy and Distinguished McCormick School Professor Emeritus of Civil and Environmental Engineering, Engineering Sciences and Applied Mathematics, and Mechanical Engineering *Airworthiness assurance of aircraft structures; ultrasonic methods in quantitative nondestructive evaluation; fracture mechanics*

## Zdeněk Bažant (Mc)

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

## Henry Binford (WC)

Associate Professor, History and Urban Affairs *Evolution of subcommunities within cities; redevelopment of cities; history of transportation relating to growth of cities*

## David E. Boyce (Mc)

Adjunct Professor, Civil and Environmental Engineering *Urban travel and location forecasting models; transportation network analysis and modeling; history of urban travel forecasting methods*

## Ronald R. Braeutigam (Mc)

Associate Provost, Undergraduate Education; Harvey Kapnick Professor of Business Institutions; Professor of Economics *Applied microeconomic theory and industrial organization; regulatory economics*

## Fabián E. Bustamante (Mc)

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

## Clarke L. Caywood (MJ)

Professor of Integrated Marketing Communications *Marketing and communications; crisis management and communications; humanitarian logistics, stakeholder relationship management; political and deceptive messages and advertising; China management education and training*

## Wei Chen (Mc)

Wilson-Cook Professor in Engineering Design; Professor of Mechanical Engineering *Multidisciplinary design optimization; design under uncertainty; simulation-based design; design theory and methodology*

## Sunil Chopra (KM)

IBM Distinguished Professor of Operations Management and Information Systems, Department of Managerial Economics & Decision Sciences *Supply chain management and operations; design of communication and distribution networks; supply chain risk*

## J. Edward Colgate (Mc)

Allen K. and Johnnie Breed Senior Professor in Design; Professor, Mechanical Engineering; Director, Master of Science in Engineering Design & Innovation Program; Research Council Member, Segal Design Institute *Human/machine interface; haptics; mechatronic systems*

## James G. Conley (KM, Mc)

Clinical Professor of Technology, Department of Managerial Economics and Decision Sciences, Clinical Professor of Mechanical Engineering (by courtesy) *Product design and development technologies; intellectual property strategies; intellectual capital; innovation management*

## Noshir Contractor (KM, Mc, CM)

Jane S. & William J. White Professor of Behavioral Sciences; Professor of Industrial Engineering and Management Science; Professor of Communications Studies *Social and knowledge networks; statistical and computational methods; organizational theory*

## David Corr (Mc)

Clinical Associate Professor of Civil and Environmental Engineering *Structural engineering and mechanics; structural sensing and diagnostics; failure analysis and forensic engineering; performance of civil engineering materials; stochastic methods and structural reliability*

# Affiliations

**FM** Feinberg School of Medicine

**KM** Kellogg School of Management

**Mc** McCormick School of Engineering and Applied Science

**MJ** Medill School of Journalism, Media, and Marketing Communications

**LB** Northwestern University Library

**CM** School of Communications

**LW** School of Law

**WC** Weinberg College of Arts and Sciences

**LU** Loyola University Chicago

**UI** University of Iceland / Chalmers University

## Anne Coughlan (KM)

John L. & Helen Kellogg Professor of Marketing  
*Distribution channel management and design; pricing strategy; reverse channels for product returns; competitive strategy*

## Gianluca Cusatis (Mc)

Associate Professor of Civil and Environmental Engineering  
*Mechanics of infrastructure materials and constitutive modeling of concrete and cementitious composites*

## David A. Dana (LW)

Kirkland & Ellis Professor of Law  
*Environmental and land use law, regulation, and policy, particularly methods of allocating carbon credits; regulation and technological change in the automobile industry; eminent domain reform and urban sprawl*

## Irina S. Dolinskaya (Mc)

Assistant Professor, Industrial Engineering and Management Sciences  
*Transportation science and logistics; adaptive modeling and solutions; humanitarian logistics; optimal vessel performance; electric vehicle routing*

## Charles H. Dowding (Mc)

Associate Chair and Professor of Civil and Environmental Engineering  
*Construction vibrations; structural health monitoring; subsurface exploration decisions*

## David Dunand (Mc)

James N. and Margie M. Krebs Professor of Materials Science and Engineering; Co-Director, Initiative for Sustainability and Energy at Northwestern  
*Lightweight metallic materials for energy-efficient transportation; high-temperature alloys for energy-efficient internal-combustion and jet engines*

## Pablo Durango-Cohen (Mc)

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

## Steven Franconeri (WC)

Assistant Professor, Cognitive Psychology  
*Visual cognition; guidance, capture, and tracking of visual attention and awareness; effective visual design*

## Robert J. Gordon (WC)

Stanley G. Harris Professor in the Social Sciences  
*Macroeconomic theory; monetary theory; airline economics; airline management; airline history; airline customer experience*

## Kimberly A. Gray (Mc)

Professor of Civil and Environmental Engineering  
*Urban sustainability; brownfield and urban redevelopment; environmental impacts of transportation on ecological and human health; energy-efficient technology*

## Brian Hanson (WC)

Director of Programs, Research, and Operations, Buffett Center of International and Comparative Studies; Lecturer, Political Science  
*International political economy; globalization; international trade; changing roles of the state in world politics*

## Mike Hewitt (LU)

Assistant Professor of Information Systems and Operations Management, Quinlan School of Business  
*Quantitative models for decision-making; solutions for transportation and supply chain management domains, particularly in freight transportation and home delivery*

## Paul M. Hirsch (KM)

James L. Allen Distinguished Professor of Strategy & Organizations; Chair, Management and Organizations Department  
*Organizational change; human resources and mass media*

# Faculty, Researchers (continued)

## **Joel Horowitz (WC)**

Charles and Emma Morrison Professor of Market Economics *Econometrics; travel demand modeling; urban transportation; air quality*

## **Thomas N. Hubbard (KM)**

Elinor and H. Wendell Hobbs Professor of Management; Senior Associate Dean, Strategic Initiatives *Industrial organization; trucking industry; economics of strategy; applied econometrics; economics of technology*

## **John C. Hudson (WC)**

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

## **Albert Hunter (WC)**

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

## **Arthur P. Hurter (Mc)**

Professor Emeritus of Industrial Engineering and Management Sciences *Logistics; applied microeconomic analysis; routing and risk analysis; facility locations; plant and equipment investment and replacement*

## **Seyed M.R. Irvani (Mc)**

Professor of Industrial Engineering and Management Sciences *Stochastic modeling and analysis; production and logistics; optimization of queuing systems; manufacturing and supply chain management; white collar work and service operations systems; analysis of integrated production and maintenance policies*

## **Breton Johnson (Mc)**

Associate Director, NUTC; Director, Center for the Commercialization of Innovative Transportation Technology *Technology transfer and commercialization; technology-based economic development; space and technology innovation policy; homeland security*

## **Richard Joseph (WC)**

John Evans Professor of International History and Politics; Faculty Affiliate, Buffett Center of International and Comparative Studies *Growth, governance, and sustainable development; comparative democratization; African politics; HIV prevention strategies; energy, environment, and transportation*

## **William L. Kath (Mc, KM)**

Professor of Engineering Sciences & Applied Mathematics, Center for Photonic Computer and Communication; Professor of Neurobiology and Physiology *Computational neuroscience; fiber optics; wave propagation; nonlinear dynamics; complex systems*

## **Leon M. Keer (Mc)**

Walter P. Murphy Emeritus Professor of Civil and Environmental Engineering and Mechanical Engineering *Engineering mechanics; tribology*

## **Diego Klabjan (Mc)**

Professor of Industrial Engineering and Management Sciences; Director, Master of Science in Analytics Program *Business intelligence and analytics in air transportation, logistics, rail, retail, and supply chain management*

## **Frank S. Koppelman (Mc)**

Professor Emeritus of Civil and Environmental Engineering *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 (Mc)**

Stanley Pepper Professor of Civil and Environmental Engineering; Director, Master of Project Management Program *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 (Mc, KM)**

William A. Patterson Distinguished Chair in Transportation; Professor of Civil and Environmental Engineering; Director, NUTC; Professor, Managerial Economics and Decision Sciences *Dynamic traffic system management; network modeling and optimization; dynamics of user behavior and telematics; intermodal freight and logistics*

**Therese McGuire (KM)**

ConAgra Foods Research Professorship in Strategic Management; Director, Guthrie Center for Real Estate Research & Real Estate Program *State and local public finance; fiscal decentralization; property tax limitations; education finance; regional economic developments*

**David Morton (Mc)**

Professor of Industrial Engineering and Management Sciences *Stochastic optimization and its application to energy, security, and health problems*

**Barry L. Nelson (Mc)**

Walter P. Murphy Professor of Industrial Engineering and Management Sciences *Computer simulation of dynamic stochastic systems; design and analysis of simulation experiments*

**Yu (Marco) Nie (Mc)**

Associate Professor of Civil and Environmental Engineering *Network optimization; traffic flow theory; traffic simulation*

**Maciek Nowak (LU)**

Associate Professor of Information Systems & Operations Management, Quinlin School of Business; Director, Master of Science in Supply Chain Management Program *Vehicle routing and tracking; supply-chain management; operations management and research; logistics and data analysis; quantitative methods; heuristic search*

**John C. Panzar (WC)**

Louis W. Menk Professor Emeritus of Economics *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 (MJ, FM, KM)**

Professor of Integrated Marketing Communications; Professor of Psychiatry and Behavioral Sciences; Affiliated Professor of Marketing *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*

**Mark A. Ratner (Mc)**

Professor of Chemistry; Co-Director, Institute 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 (FM)**

Research Associate Professor, Neurology *Impact of sleep loss and circadian disruption on human performance; health and safety with emphasis on the impact of shiftwork*

**Roberto Sarmiento (LB)**

Head, Transportation Library *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 (WC)**

Associate Chair, Department of Economics; Professor of Instruction *Transportation safety; transportation economics; urban transit*

**Joseph L. Schofer (Mc)**

Associate Dean, Faculty Affairs; Professor of Civil and Environmental Engineering *Transportation policy analysis and planning; uses of data and information in decision making; issues and factors in investment decisions; traveler behavior and market research*

**Karen Smilowitz (Mc)**

Charles Deering McCormick Professor of Teaching Excellence Professor, Industrial Engineering and Management Sciences *Design and operations of logistics networks; vehicle routing and scheduling; supply chain management; applications in commercial and non-profit settings*

**Richard Sobel (WC)**

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*

**Amanda Stathopoulos (Mc)**

William A. Patterson Junior Professorship Chair; Assistant Professor, Civil & Environmental Engineering *Transportation choice modeling and forecasting*

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NUTC AFFILIATED  
FACULTY AND  
RESEARCHERS

# Faculty, Researchers (continued)

## **Gunnar Stefánsson (UI)**

Professor, Industrial Engineering, Mechanical Engineering, and Computer Science; Associate Professor, Technology Management and Economics *Logistics and transportation management; collaboration management; information and communication systems; management of technology and economics*

## **Fred W. Turek (WC)**

Charles E. and Emma H. Morrison Professor of Biology, Department of Neurobiology & Physiology; Director, Center for Sleep and Circadian Biology *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*

## **Jan A. Van Mieghem (KM)**

Harold L. Stuart Distinguished Professor of Managerial Economics; Professor of Operations Management, Department of Managerial Economics & Decision Science *Operations management and strategy; supply chain management and analysis; management and investment under uncertainty*

## **Ismail Ömer Verbas (Mc)**

Post-Doctoral Research Fellow, NUTC *Transportation network modeling; multi-modal assignment and simulation; transit network design; transit scheduling; time-dependent origin-destination estimation; energy and sustainability; emergency evacuation*

## **Michael Watson (Mc)**

Adjunct Professor, Department of Industrial Engineering and Management Sciences, Master of Engineering Management Program, and Master of Science in Analytics Program *Supply chain network design; facility location; analytics*

## New Faculty Affiliates and Researchers



## **Gad Allon (KM)**

Professor of Managerial Economics and Decision Sciences *Service operations management, social networks*



## **Ying Chen (Mc)**

Research Assistant Professor, Transportation Center *Machine learning and data mining, travel demand and behavior modeling; large-scale transportation network modeling and analysis; traffic flow theory and characteristics; agent-based modeling*



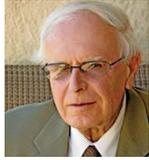
## **Mohanbir S. Sawhney (KM)**

McCormick Foundation Chair of Technology: Clinical Professor of Marketing; Director, Center for Research in Technology & Innovation *Business innovation, digital and social media marketing, network-centric innovation, growth and scaling strategies*

## Recognition for Faculty and Researchers

**18**  
FACULTY AND  
RESEARCHERS  
RECOGNIZED  
IN 2015

**Zdeněk P. Bažant** Elected to the Royal Society of London in 2015 (as one of 10 foreign members, and the only engineer) from a pool of approximately 700 candidates. The Royal Academy, founded in 1660, recognizes the world's



most distinguished scientists, drawn from all areas of science, engineering, and medicine and promotes and supports excellence in science and encourages the development and use of science for the benefit of humanity.

The American Society of Civil Engineers (ASCE) Board of Direction approved at the January 2015 meeting a new Zdeněk P. Bažant Medal for Failure & Damage Prevention. The award will recognize individuals for significant contributions to the engineering science of failure and damage prevention. The Engineering Mechanics Institute of the ASCE will administer the newly established Society Award.

**Fabian Bustamante** Published an Op-Ed article, as an NU Public Voices Fellow, supporting faster internet access as a basic human right. The article appeared on the *Forbes* website in January 2015. Northwestern



is partnering with The OpEd Project, a social venture founded to increase the range of voices and quality of ideas we hear in the world. The program provides NU scholars across disciplines with the resources, support and skills to dramatically increase their visibility and influence as thought leaders in academia and the world at large.

**Clarke Caywood** Honored by the DeTao Institute in Shanghai People's Republic of China (PRC) with the title of DeTao Master. This title is both an academic and professional designation for leaders who teach and speak at the Institute and in PRC government programs. DeTao is expanding education in PRC.



**Wei Chen** Presented with the Design Automation Award by the American Society of Mechanical Engineers (ASME), Design Engineering Division in August 2015. This is the highest achievement award in design automation.



Delivered the conference Keynote Address at the First International Conference on Quantification of Uncertainty in Engineering, Sciences and Technology (QUEST), in Beijing, China. The title of Chen's speech was, "Reduction of Epistemic University in Multifidelity Multidisciplinary Design Optimization."

Elected as member of the Executive Committee of the International Society of Structural and Multidisciplinary Optimization (ISSMO) in 2015.

Appointed Member of the Editorial Board, Design Science (2015 – present); Associated Editor, SIAM/ASA Journal of Uncertainty Quantification (JUQ) (2015 – present); and Department Editor, IIE Transactions (Department on Design Engineering and Product Realization (October 2014 – present).

**J. Edward Colgate** Named Fellow of the National Academy of Inventors (NAI). This high professional distinction was awarded to Colgate and his fellow NU researcher, Michael A. Peshkin, for their work on human-machine interface and robotics. Together they founded several spinoff companies.



NAI Fellows are nominated by their peers for outstanding contributions to innovation in areas such as patents and licensing, discovery and technology, impact on society and support and enhancement of innovation.

Northwestern startup company Tanvas, co-created by Professors Ed Colgate and Michael Peshkin, was one of 24 award recipients at the 14th Annual Chicago Innovation Awards. These awards go to the most innovative new products or services brought to market or to public service in the Chicago region. Tanvas has a patented technology that allows users to feel textures on their flat, glass touchscreens.

Inducted into the Chicago Area Entrepreneurship Hall of Fame Class of 2015. The honor recognizes leaders who have made lasting social and commercial contributions to the Chicago community through their startup enterprises.

# Recognition (continued)

**Noshir Contractor** Honored with the title of International Communication Association (ICA) Fellow on May 23, 2015. The award was presented at the International Communication Association (ICA) Annual Conference.



Elected to receive the National Communication Association Distinguished Scholar Award by a group of his peers. The Award recognized a lifetime of scholarly achievement in the study of human communication.

**Irina Dolinskaya** Awarded the Cole-Higgins Award for Excellence in Advising in 2015 by the McCormick School of Engineering.



**Breton L. Johnson** Named Co-Chair of the Academic Advisory Council for LINCS (Leveraging, Integrating, Networking, Coordinating Supplies) Supply Chain Management Consortium.



## Kimberly Gray Named Chair of the Department of Civil and Environmental Engineering



Kimberly Gray, professor of civil and environmental engineering, was named chair of the Department of Civil and Environmental Engineering in the McCormick School of Engineering and Applied Science, effective August 1, 2015. Gray succeeds chair Jianmin Qu.

With a courtesy appointment in the Department of Chemical and Biological Engineering, Gray is an expert in environmental catalysis and physicochemical processes in natural and engineered environmental systems. She specifically focuses on energy and urban sustainability applications. Along with collaborators from around the world, Gray explores the design of ecologically inspired, sustainable cities that can withstand the consequences of climate change.

Gray has served as co-director of Northwestern's Global and Ecological Health Engineering Program since 2009 and formerly directed the Weinberg College of Arts and Sciences Environmental Science, Engineering, and Policy Program from 2003 to 2010. Committed to improving environmental policy, Gray is a member of Northwestern's Institute for Policy Research and works closely with the Chicago Legal Clinic to provide the technical expertise

needed to solve environmental problems for low-income, urban communities. She also previously served as a senior science fellow at the Environmental Law and Policy Center.

Gray received her bachelor's in biochemistry from Northwestern, masters in civil engineering from the University of Miami, and PhD in geography and environmental engineering from Johns Hopkins University. Before returning to Northwestern in 1995, she served as an associate professor at the University of Notre Dame. Gray has authored more than 100 scientific papers and lectures widely on energy, climate, and environmental issues. She has also received numerous awards, including being named an Aldo Leopold Leadership Fellowship by Stanford University, Presidential Young Investigator by the National Science Foundation, Distinguished Scientist by Trinity University in San Antonio, Texas, and Sigma Xi Distinguished Lecturer.

Gray has also received several teaching awards, including the McCormick Excellence Award in Research, Teaching, and Citizenship and being named member of the Northwestern Faculty Honor Roll two years in a row.

**Richard Joseph** Received the Lifetime Social Justice Award from Dartmouth College.



Presented the keynote address at the inaugural conference of the Ibadan School of

Government and Public Policy in Nigeria: “State, Governance, and Democratic Development in Africa: The Nigerian Challenge.”

**Director Hani Mahmassani** Selected to deliver the Thomas B. Deen Distinguished Lectureship, Transportation Research Board of the National Academies of Engineering and the Sciences; the lectureship recognizes the career contributions and achievements of an individual in one of the areas covered by the Board’s Technical Activities Division.



Delivered the Melvin Webber Memorial Lecture, “Progress Report: Leveraging the Data Deluge Into System Intelligence,” University of California Transportation Center Annual Conference, University of California-Santa Barbara, February 2015.

Keynote speaker at the Third International Conference on Evacuation Modeling and Management (ICEM 2015), Tainan, Taiwan, May 2015. Keynote speaker at the International Institute for Infrastructure Resilience and Reconstruction (I3R2) Seoul, Korea, August 2015.

**Barry Nelson** Awarded the INFORMS Simulation Society 2015 Outstanding Publication Award with PhD Alum, Wei Xie, at the Winter Simulation Conference held in December 2015 for the following two papers:



“Quantifying Input Uncertainty via Simulations Confidence Intervals” and “A Bayesian Framework for Quantifying Uncertainty in Stochastic Simulation.”

**Kaylan Raman** Received the Dorothy Ann and Clarence L. Ver Steeg Distinguished Research Fellowship from Medill School of Journalism.



**Kathryn Reid** Published TRB’s National Cooperative Freight Research Program (NCFRP) Report 36: *Enhancing Sleep Efficiency on Vessels in the Tug/Towboat/Barge Industry*.



**Reid (continued)** Appointed to the Board of Directors of the Sleep Research Society in June 2015.

Appointed to the Governing Council of the World Sleep Society in January 2015.

Presented “Managing Fatigue: Challenges for the Future” at the International Conference of Applied Human Factors and Ergonomics, in Las Vegas in July 2015.

Presented “Enhancing Sleep Efficiency on Vessels in the Tug/Towboat/Barge Industry” at the American Waterway Operators Fall Convention in St. Louis in October 2015.

**Ian Savage** Awarded the Herbert O. Whitten Service Award by the Transportation Research Forum (TRF) in March 2015. The Award is presented to a member of TRF whose contributions to TRF have played an important role in the organization’s history.



Promoted to Professor of Instruction by the Weinberg College of Arts and Sciences.

Appointed along with NUTC Business Advisory Council member Craig Philip, to a Transportation Research Board special committee, the Committee for Study of Domestic Transportation of Petroleum, Natural Gas, and Ethanol.

**Karen Smilowitz** Received the 2015 Charles Deering McCormick Professor of Teaching Excellence Award from Northwestern University. The Award recognizes outstanding dedication to undergraduate education. It has a three-year term and includes a cash award of \$10,000 to the recipient and \$3000 award to the recipient’s home department.



Elected an officer of the Transportation Science and Logistics (TSL) Society in the 2015 elections, along with NUTC Affiliate Faculty member Mike Hewitt of Loyola University Chicago.

**Amanda Stathopoulos** Appointed the William A. Patterson Junior Professorship Chair for 3-year term (2015–2018).



Appointed to the National Academies Transportation Research Board (TRB) committee on Transportation Demand Forecasting for a 3-year term starting in 2015.

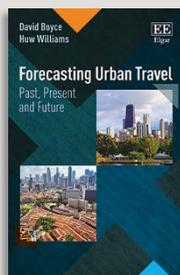
Appointed co-chair of a TRB sub committee on “Emerging Methods and Developments in Urban Activity and Travel Analysis” for a 3-year term, starting in 2015.

# Faculty Books and Podcasts Published in 2015

## David Boyce

*Forecasting Urban Travel: Past, Present & Future*

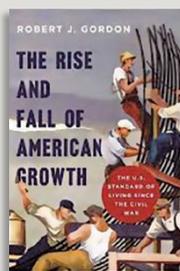
Co-authored by David Boyce, Professor Emeritus of Transportation at the University of Illinois at Chicago and Adjunct Professor of Civil & Environmental Engineering at Northwestern, and Huw Williams, Emeritus Professor of the School of Planning and Geography at the University of Cardiff, Wales, UK—the book chronicles the evolution of travel forecasting and policy analysis in the US and UK from its beginnings in the 1950s until today, mapping its changing scope and approaches in different eras (see p. 63).



## Robert S. Gordon

*The Rise & Fall of American Growth: The US Standard of Living Since the Civil War*

In his latest book, Gordon challenges the view that economic growth can or will continue unabated, and he demonstrates that the life-altering scale of innovations between 1870 and 1970 can't be repeated. He contends that the nation's productivity growth, which has already slowed to a crawl, will be further held back by the vexing headwinds of rising inequality, stagnating education, an aging population, and the rising debt of college students and the federal government. Included in Gordon's book are two chapters focused on the evolution of American transportation from 1870 to the present. The book received favorable reviews from the *Economist*, *New York Times* and the *Wall Street Journal*.



## Joseph Schofer

*The Infrastructure Show*, Northwestern-sponsored Podcast Hosted by Professor Joseph Schofer

Since 2009, McCormick's Associate Dean and Professor of Civil & Environmental Engineering, Joseph Schofer, has hosted this regular podcast production. On the podcast, Schofer interviews experts on the many aspects of civil infrastructure systems in an effort to inform listeners about US infrastructure.

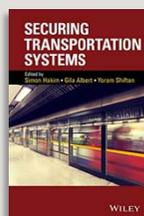


Schofer recently interviewed Paul James, Senior Vice President with Lendlease US Construction in Chicago, about the tradeoffs in design and materials selection in the construction of tall concrete and steel buildings. The interview was the third of a series in which Professor Schofer explores the use of advanced concretes in mega structures. Earlier in the year, Schofer interviewed Joseph Burns, managing Principal of Thornton Tomasetti and CEE External Advisory Board member, about designing tall building made with concrete. He also talked with NU Emeritus Professor Surendra Shah on the same topic. Shah described advances in the science of concrete that have led to materials with super high strength or rheology (viscosity) that allows the materials to be pumped to great heights.

To date, *The Infrastructure Show* has featured over 70 interviews during which Schofer discusses the functionality of infrastructure, new developments, reported problems and policies relating to the topic. To listen to episodes, visit: [theinfrastructureshow.com](http://theinfrastructureshow.com).

## Amanda Stathopoulos

Chapter 5 in: *Securing Transportation Systems*, edited by Simon Hakim, Gila Albert, Yoram Shifan



Authored portions of Chapter 5: "Travelers' Perceptions of Security for Long Distance Travel: An Exploratory Italian Study." Other contributing authors: E. Valeri, E. Marcucci, V. Gatta, A. Nuzzolo, A. Comi.

# Emerging Challenges in Transportation

Transportation Center research is driven by the major challenges facing the transportation industry and society. Mobility, safety, environmental sustainability, energy, economic development, resilience, infrastructure renewal, and financial viability are at the forefront of transportation agencies' policy agendas. Competitiveness, globalization, collaboration, uncertainty, volatility and technological change are major drivers of strategic and operational decision-making for transportation enterprises.

**5**  
RESEARCH  
THEMES  
IDENTIFIED

## Strategic Research

The Center's portfolio of research projects and activities is continually evolving to anticipate, identify, characterize, and develop solutions for significant issues faced by the transportation industry, in both private and public sectors. Faculty and student researchers work together with industry and agency partners to gather information and devise methodologies to analyze these problems, formulate strategies, design solutions, and work towards implementation and evaluation.

The Center engages its faculty and industry partners in identifying strategic research areas with significant societal and/or industry impact, and spanning the interests of several faculty members. Building on the core strengths of its faculty researchers, enhanced through collaboration with other research centers and entities, the Center had identified three main emerging areas of strategic significance:

- Reinventing the User Experience in Transportation
- Humanitarian Logistics and Disaster Response
- Transportation Energy and Sustainability

In addition, as part of its 60th Anniversary activities, the following five themes were identified as particularly timely targets of TC faculty expertise and interest:

- 1 **Autonomous vehicles—including system impacts for people and goods.**
- 2 **Smart Sustainable Cities—including connected systems, sustainability, and the role of the Internet of Things**
- 3 **Same day delivery and last mile logistics , including role of drones, collaborative logistics**
- 4 **“Sharing economy”—personal and freight mobility, markets**
- 5 **Transaction data—leveraging “Big Data” in all modes of transportation.**

These themes share the following characteristics: (1) impact on society and/or industry; (2) significant opportunity driver, particularly technological developments; (3) fundamental and methodological challenges; (4) cross-disciplinary; and (5) strategic dimension. Four of these are highlighted here, with several specific projects described in the research section (see p. 24).

## Smart Sustainable Cities

Imagine the city as one big connected computing cluster, where myriad transactions (corresponding to financial, information, energy, material, people, and vehicle flows) are sensed in real-time, where virtually all machines and people are interconnected, can provide status information passively, and can receive personalized information and instructions through various media. The city's vital infrastructure



Autonomous vehicle interior

## Emerging Challenges in Transportation (continued)

systems would be always on, always aware of the demands on their different components, and would accordingly adjust allocation of resources to meet and anticipate spatial and temporal patterns of demand. Entities would transact seamlessly in that environment, matching customers to retail, recreational and other opportunities. In this environment, the user's urban experience would be paramount, while enabling sustainably optimized operation of vital infrastructures. Coupled with innovations in physical and process design intended to achieve zero-net carbon impact in virtuous



cycles of material and fluid flows, cities can learn and adapt towards achieving the dual goals of environmental and economic sustainability.

The vision of smart cities as the logical outgrowth of connectivity in an Internet of Things is not only the target of marketing efforts by virtually all major information technology providers, but increasingly an opportunity that is capturing the attention of public and private stakeholders in metropolitan areas. Additional opportunities arise from two key developments in automotive technology: electrification, and autonomous vehicles. Both could thrive in a smart city environment, the ultimate smart grid for wirelessly-charging circulating vehicles, while autonomous vehicles of all types could fundamentally alter the economics of many forms of person and freight mobility.

Bringing the vision to light, in whatever form it might eventually take, raises critical challenges—technological, methodological, operational, organizational, and institutional, among others. Research at the Transportation Center already informs several facets of the problem, such as use of real-time sensor and probe data for predictive system management and control, development of simulation and optimization tools to optimize real-time

operational aspects of transportation and logistics systems, understanding of individual perceptions, preferences and usage patterns with regard to smartphones and other personal wireless devices. However, considerable fundamental and applied research and development is required to enable the vision and its promise. Through a series of industry workshops, the Center has brought together leading industry participants, along with NUTC faculty, in delineating some of the challenges and opportunities in the evolving vision of the smart city. Another workshop has addressed connectivity through the Internet of Things and concrete applications in the transportation industries in an urban context. The Center is actively engaged in building partnerships with industry and public agency partners to develop comprehensive approaches to address the system-level aspects of these developments.

### Humanitarian Logistics and Disaster Response

The Humanitarian Logistics Initiative at Northwestern University, launched in 2011 by NUTC faculty Karen Smilowitz and Irina Dolinskaya to address critical problems that arise in the chaotic arena of disaster relief distribution operations, has considerably expanded its scope to include the logistics of mass events. 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; and enhanced tools and methods for locating and setting up mobile health clinics in relief zones.

The Initiative encompasses four 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; (3) logistics of organized mass events, such as marathons and other sports/cultural manifestations, celebratory events such as presidential inaugurations and visits by dignitaries, and religious manifestations such as pilgrimage in Makkah, entails complex scheduling and routing of people and resources to ensure safe and successful operations; and (4) nonprofit logistics focuses on the operations of nonprofit organizations at local, regional and national levels.

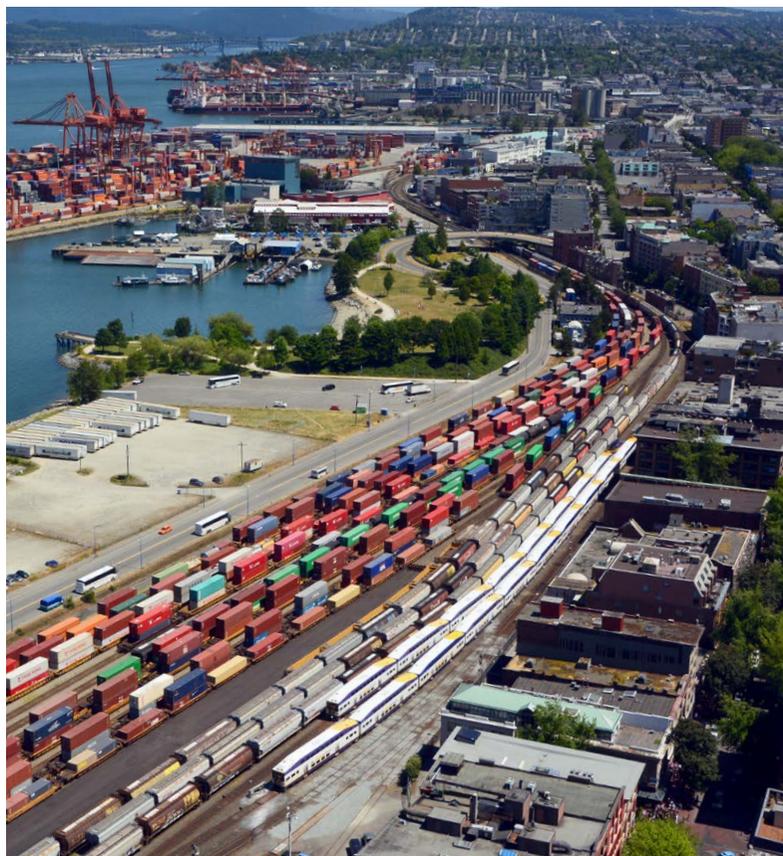
In all categories the research aims to provide the data necessary for reliable decision-making by integrating relief routing models with new streams of imagery, mapping, and crowd-sourced real-time data into tools usable by aid practitioners in real settings. In addition, the research seeks to understand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

## Same Day Delivery and Last Mile Logistics

Freight and logistics are core topic areas at the Transportation Center. The renewed emphasis identified in this area is on the growing intersection between the logistics of e-fulfillment and urban deliveries in connection with online and omnichannel retailing, and developments in last-mile technologies and service concepts. Key areas addressed include:

- Role of unmanned aerial vehicles (drones) in last-mile delivery, and in shortening delivery times from fulfillment center to customer locations.
- Logistics network design for emerging service concepts and customer requirements.
- Role and competitiveness of emerging on-demand delivery options through crowd-sourced and shared-economy concepts.

This effort ties together several research strands at the Center, including the smart cities initiative as well as the role of transaction



data for real-time fleet management and order fulfillment. It is also part of a larger effort at examining freight mobility and intermodal hubs in the context of global supply chains, which also targets:

- Assuring reliability, resilience and consumer responsiveness of freight and logistics networks;
- Meeting capacity needs and alleviating congestion at critical urban hubs to eliminate bottlenecks through judicious combination of technological innovation, infrastructure investment, and policy initiatives;
- Defining models for public-private partnering in infrastructure development, financing, and operation to achieve national objectives regarding multimodal freight corridors; and
- Developing knowledge bases, data and tools to support freight planning, policy development and investment decisions at statewide and metropolitan levels within a national competitiveness framework.



**7** CORE  
RESEARCH  
AREAS

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

## Core Research

The Transportation Center's primary objective is to discover new insights, concepts and tools to be utilized by industry, business and government as decision-making support. The ultimate end goal of the Center's research agenda is to assist these sectors in a move toward more efficient, and responsive, transportation systems and services. The Center's core research topics were created to compliment and support all efforts to achieve this end goal.

### Beyond Snapshots: Does Automated Photo Enforcement Make our Streets Safer?

**PROJECT TITLE:** *Red Light Camera Enforcement – Performance Assessment and Best Practices*

**SPONSOR:** Chicago Department of Transportation

**NUTC PI:** Hani Mahmassani and Joseph Schofer

The City of Chicago has one of the oldest and largest automated red light camera enforcement systems in the country. As such, it offers an opportunity to examine the long-term effectiveness of the system, at the specific locations where the cameras are deployed as well as overall on city streets and arterials.

The objective of this project is to perform a comprehensive assessment of the system's performance, review existing practices, and benchmark them against national best practices. Using available safety data as well as detailed violation data, NUTC will conduct rigorous analyses to assess the performance of the existing RCL enforcement practices, and seek understanding of the various underlying human factors aspects that determine the effectiveness and impact of these programs. This will form the basis for improvement recommendations aimed at enhancing the transparency and performance of these systems. The recommendations will range from the engineering side, to the enforcement practices, and to public policy in the realm of road safety and intersection enforcement. The study will produce a set of best practices in camera enforcement, recommendations for further reforms to the Chicago program, and a road map to delivery on those recommendations. This project is intended to ensure the City is getting the most out of the system

it has and for continual improvement of the program, with particular attention towards where best to locate cameras and ongoing monitoring of the system.

The guidelines will help cities determine the value of automated enforcement systems for their own networks, and make intelligent choices regarding selection of specific deployment locations.



## How Competitive Would 'Uberizing' Last Mile Delivery Be on Cost and Reliability?

**PROJECT TITLE:** *Smart CROwdsourced Urban Delivery (CROUD) System*

**SPONSOR:** National Science Foundation

**NUTC PI:** Yu (Marco) Nie, James Schummer, Amanda Stathopoulos

The rise of e-commerce is rapidly changing the landscape of retail business. By 2017, online sales will account for more than 10% of the \$4.5 trillion industry, according to a 2014 US Census Bureau report. To stay competitive in this growing market, retailers are under enormous pressure to quickly deliver the goods to their consumers at low prices. Large asset-based carriers (e.g., UPS and FedEx) are not particularly cost-efficient for express local deliveries in urban areas, essentially because their distribution networks are designed to transport through hubs rather than directly between customers and retailers. A promising solution, enabled by recent advances in wireless communication and mobile computing, is crowdsourcing technology that has been successfully applied in passenger transport, such as Uber and Lyft.

The overarching goal of this project is to develop and evaluate a CROwdsourced Urban Delivery (CROUD) system. The project spans several scientific disciplines.

First, the researchers will develop pricing mechanisms that focus on matching consumers with couriers under varying market conditions. Second, the project will help understand and predict behaviors and choices of humans in a CROUD system. And third, the researchers will develop smartphone-based motion detection methods to track and interpret the activities of couriers. And fourth, computational tools will be created to facilitate collaborative delivery among couriers, and to optimize routing plans based on real-time information.

This project features researchers from the Department of Civil and Environmental Engineering and the Department of Managerial Economics and Decision Science at Northwestern, as well as the Center for Supply Chain and Logistics Management, which is affiliated with University of Illinois at Chicago.



## Predictive Analytics in Connected Vehicle Systems can Reduce Congestion and Improve Travel Time Reliability, Especially in Bad Weather

**PROJECT TITLE:** *Analysis, Modeling, and Simulation (AMS) Testbed Development and Evaluation to Support Dynamic Mobility Applications (DMA) and Active Transportation and Demand Management (ATDM) Programs*

**SPONSOR:** FHWA

**NUTC PI:** Hani Mahmassani, in collaboration with Booz Allen Hamilton

Intelligent Transportation Systems (ITS 2.0) have morphed into connected vehicle systems powered by the Internet of Things (IoT). The US DOT initiated connected vehicle research to evaluate the merit of applications that leverage connected vehicles, connected travelers, and ITS infrastructure to enhance current operational practices and transform future surface transportation systems management. According to the US DOT, "Connected vehicles refer

to the ability of vehicles of all types to communicate wirelessly with other vehicles and roadway equipment, such as traffic signals, to support a range of safety, mobility and environmental applications of interest to the public and private sectors. The concept also extends to pedestrians, motorcycles, cyclists and transit users carrying compatible devices, which could make these vulnerable users more visible to surrounding traffic."

### The objectives of the DMA Program include:

- Applications exploiting frequently collected and rapidly disseminated multi-source data drawn from connected travelers (including pedestrians with special needs), vehicles and infrastructure;
- Applications showing potential to improve the nature, accuracy, precision and/or speed of dynamic decision making by both system managers and system users;
- Innovative forms of wireless connectivity linking travelers, vehicles and infrastructure supporting these new mobility applications; and

- Demonstrate applications predicted to improve the capability of the transportation system to provide safe, reliable, and secure movement of goods and people.

Simultaneously, The Federal Highway Administration (FHWA) Office of Operations initiated the ATDM Program to seek active, integrated and performance based solutions to improve safety, maximize system productivity, and enhance individual mobility in multi-modal surface transportation systems. ATDM is the dynamic management, control, and influence of travel demand and traffic flow in multimodal transportation systems and facilities in real-time to achieve operational objectives, such as preventing or delaying breakdown conditions, improving safety, promoting sustainable travel modes, reducing emissions, or maximizing system efficiency. Under an ATDM approach, the transportation system is continuously monitored. Using historical and real-time data, predictions of traffic conditions are generated and actions performed in real-time to achieve or maintain system performance. The ultimate vision of ATDM is to dynamically manage across travelers' entire trip chain.

Both DMA and ATDM Programs have similar goals. The DMA Program focuses on exploiting new forms of data from wirelessly connected vehicles, travelers, and the infrastructure to enable transformative

mobility applications. The ATDM Program focuses on accelerating the pace of dynamic control within transportation systems management through operational practices that incorporate predictive and active responses to changing operational conditions. Both are required to realize the potential of connected vehicle systems to improve traffic conditions, reduce congestion, and enhance environmental sustainability.

Research and development to ensure successful deployment of these programs require dedicated Analysis, Modeling and Simulation (AMS) capabilities. AMS testbeds are virtual computer-based environments, in a laboratory setting. To this end, the DMA and ATDM Programs have jointly sponsored the planning of multiple AMS Testbeds to evaluate and demonstrate the system-wide impacts of deploying application bundles and strategies under different operational conditions..

NUTC is developing the Chicago network into one of five national testbeds, focusing on the effectiveness and impacts of weather-related Connected Vehicle DMA, ATDM and other Road Weather Management strategies. The Chicago AMS testbed provides a mature urban network environment that experiences diverse weather conditions, hence enabling meaningful testing of ATDM and DMA bundles targeted at inclement weather.



## Core Research (continued)

### Analyze This! Practical Tools for ATDM Design, Evaluation and Deployment

**PROJECT TITLE:** *Active Transportation and Demand Management (ATDM) Analytical Methods for Urban Streets*

**SPONSOR:** Federal Highway Administration

**NUTC PI:** Hani Mahmassani, in collaboration with Leidos

There is growing interest among States and metropolitan areas in deploying relatively low cost, effective, and environmentally friendly operational strategies to improve safety and congestion on their roadway networks. Active Transportation and Demand Management (ATDM) strategies attempt to dynamically manage, the transportation system through real-time



Image: US DOT FHWA video on ATDM

traffic control and targeted interventions to influence travel choices. Under an ATDM approach the transportation system is continuously monitored. Using archived data and/or predictive methods, actions are performed in real-time to achieve or maintain system performance.

Existing methods used in practice to design and evaluate traffic management measures are not sufficiently sensitive to ATDM interventions. Moreover, real-world daily variations in weather, incident conditions and travel demand are typically not considered.

The objective of this project is to translate advances in methodologies and field deployment data into tools intended for everyday use by traffic engineers to design and evaluate ATDM strategies for urban streets. It is expected that the project will result in a set of recommendations to the Federal Highway Administration to revise some of the existing methodologies in engineering documents such as the Highway Capacity Manual to reflect the impact of ATDM actions that influence demand. The project will develop specific methodologies and performance metrics for the analysis of ATDM strategies that influence traffic demand on urban streets and networks.

### The Forecast Calls for Rain, and Stalled Traffic

**PROJECT TITLE:** *Integrated Modeling for Road Condition Prediction: Phase 2*

**SPONSOR:** USDOT

**NUTC PI:** Hani Mahmassani, in collaboration with Leidos

Transportation Systems Management and Operations (TSMO) are at the cusp of revolutionary changes spurred by increasing data availability from wide-ranging sources and the sophistication of models utilizing the data. The multi-disciplinary aspects of TSMO are exemplified by approaches to weather management that bring together meteorology, traffic management, law enforcement, maintenance and traveler behavior information to support agency decision-making and influence travel behavior. Similar efforts in work zone ITS, traffic incident management, and active traffic management seek to provide actionable information to travelers to make better choices for safe and reliable travel, and to agencies to minimize and mitigate the impact of disruptions.

Through these efforts and related private sector innovations, travelers have higher expectations for their travel experience. From being passive consumers of

information with unknown accuracy, travelers are now vital players in generating and validating information. This trend will accelerate with the deployment of Connected Vehicle Systems, which will create new opportunities for collecting and sharing information. Within this context, the role of prediction and forecasting will become more important to decisions made by private and commercial travelers and surface transportation management.



The objective of this new project is to create, build, deploy and test an integrated platform that incorporates real-time and/or archived data and results from an ensemble of forecast and probabilistic models (e.g., road weather, traffic, work zones, incidents, etc.) and fuses them in order to predict the current and future overall road/travel conditions for travelers, transportation operators, and maintenance providers. The resulting predictions will support decisions by agencies as well as individual users in the public and private spheres.

## Cool by Design – Improving the User Experience by Incorporating Customer Preferences in Engineering Design

**PROJECT TITLE:** *Multidimensional Network Analysis for Analyzing and Predicting Complex Customer-Product Relations in Engineering Design*

**SPONSOR:** National Science Foundation

**NUTC PI:** Wei Chen

Understanding customer preferences and needs is critically important in developing successful products. This interdisciplinary research project will develop a data-driven mathematical approach for analyzing and predicting consumer preferences in design of sustainable engineering products, such as alternative fuel vehicles and smart appliances. The relations among customers and products are conceptualized as a complex network and analyzed using network theory and techniques. This study will help industry produce more competitive products in shorter time to market. The findings will contribute to the development of new techniques for analyzing large complex networks.

The novelty of the research lies in the formulation of a Multidimensional Customer-Product Network (MCPN) framework, where separate networks of “customers” and “products” are simultaneously modeled, and multiple types of relations, such as consideration and purchase, product associations, and customer social networks are considered. The research will extend the Exponential Random Graph Model (ERGM) as a unified statistical inference framework for analyzing multidimensional customer-product relations and predicting unknown customer preferences (consideration or choice) under new design scenarios.

The researchers aim to overcome the limitations of the traditional statistical analysis and utility-based preference modeling by considering the dependency among product choices and the social influence induced “irrationality” of customer behavior. The research team is also exploring the use of text analysis of customer-generated data in social media thereby creating crowdsourced “virtual labs” for advancing data analytics and computational social science in product design.



## Sharing is Caring: Enabling New Mobility Service Models

**PROJECT TITLE:** *Dynamic Management of Autonomous Vehicle Fleets*

**NUTC PI:** Hani Mahmassani

Driverless cars hold the potential for new mobility services and ownership models. These range from outright ownership (like today’s conventional vehicles), to partial ownership or membership, to buying mobility for fixed time periods vs. buying individual rides. These models require effective management in order to

deliver the expected level of service at reasonable cost that would make the shared models competitive with private ownership.

The study is systematically identifying possible service models, and developing formulations for the dynamic fleet assignment, scheduling and routing that result. The work builds on a large body of work in dynamic routing for freight and logistics applications. In collaboration with doctoral researcher Michael Hyland, the NUTC team is taking the lead in developing, implementing and testing model formulations and solution algorithms for these classes of problems.



## Core Research (continued)

### Safer Marathons Through Advanced Analytics, Visualization and Optimization

**PROJECT TITLE:** GOALI — *Improving Medical Preparedness, Public Safety and Security at Mass Events*

**SPONSOR:** National Science Foundation

**NUTC PI:** Karen Smilowitz

The objective of this Grant Opportunity for Academic Liaison with Industry (GOALI) award is to improve medical preparedness, public safety and security at mass gathering events through the use of optimization methodologies. The nation engages in over 500 mass gathering events, such as marathons, each year. Such events are subject to medical emergencies for the participants, and other security related events.

This GOALI project brought together engineering and medical faculty at Northwestern University and the organizers of the Bank of America Chicago Marathon to study approaches for the mitigation of hazards and risks through course design. In the case of a marathon, course design decisions are related to the route to be followed and the locations of aid stations, medical tents and volunteers on the course. Multi-objective models and solution approaches will be developed for course design, coupled with data analytics and field observations to identify a safe and medically accessible course. The research plan is based on active integration across the areas of modeling, algorithms, data analysis and decision maker engagement.

Northwestern logistics expert Karen Smilowitz and her team of four engineering students custom-designed a new data visualization system that provides a computer simulation of the 26.2-mile race. Using data from the last seven Bank of America Chicago Marathons and from runners in this year's race (2015), the system forecasted where large concentrations of participants would be 20 minutes later and helped race officials to plan accordingly.

Two large one-stop "dashboards" in the busy forward command tent displayed the race simulation and important course conditions onscreen at the same time: location of lead runners, runner density on the course, medical tent and aid station capacity, current temperature, alerts of any issues on the course, and much more.

Partly as a result of the seminal work she has done with the Chicago Marathon, Smilowitz has become a key data adviser to the Chevron Houston Marathon and has provided guidance to the Boston Marathon, among others.

## Rolling on the River – How to Keep Tugboat and Barge Operators Awake on the Job

**PROJECT TITLE:** *Enhancing Sleep Efficiency on Vessels in the Tug/Towboat/ Barge Industry – NCFRP REPORT 36*

**NUTC PI:** Kathryn J. Reid, Fred W. Turek, Phyllis C. Zee

**S**afety is a major concern in all freight operations with human error often being a key factor in incidents and accidents. Fatigue increases the risk for human error, which is why managing fatigue should be a key component of any safety management system (SMS). For many years the usual way to manage operator fatigue has been to limit work hours, and while there is still a place for a scientifically valid restriction on work hours to reduce operator fatigue, many industries view this as simply one element in what would ideally be part of a larger program, such as a Fatigue Risk Management System (FRMS). Transportation Center affiliate faculty Dr. Kathryn Reid and Dr. Fred Turek have been working with the inland



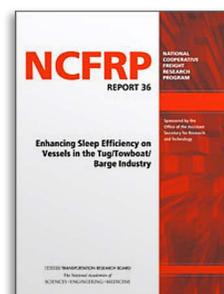
waterway industry (American Waterway Operators and member companies) on the issue of fatigue and safety since 2008. This work also includes several current/past BAC members: Ingram Barge, Schneider National and United Airlines.

To address the issue of fatigue related to sleep duration/quality, the Northwestern research team performed the following tasks as part of the National Cooperative Freight Research Program (NCFRP) 45 project within the tug/towboat/barge industry: (1) identified and described the metrics that could be used to evaluate current operational interventions (e.g., educational materials and programs; noise abatement; sleep disorders screening, especially sleep apnea; wellness and nutritional programs) for their effectiveness in improving sleep efficiency on tugs/towboats/barges; (2) evaluated the use of anchor-sleep/nap-sleep strategies on sleep behavior among personnel in the inland waterway industry; (3) identified barriers that inhibit waterway personnel from adopting good sleep management practices and proposed ways to overcome the barriers; and (4) developed a list of best

practices that could be implemented by the waterway industry, companies, crews, or individuals to enhance sleep efficiency.

Part of the impetus for this project was that while there are no hours-of-service regulations beyond the 15-hours-on-duty limit per 24 hours, increasing uninterrupted sleep duration to a threshold of at least 7-8 consecutive hours in one of the two available off periods is being considered by the Coast Guard. Strict adherence to such a pattern would conflict with the most common work schedule in the tug/towboat/barge industry, where crew often have a work/rest in alternating 6-hour shifts, commonly referred to as a square watch system. Each crew member has a total of 12 hours on duty with 12 hours off duty per 24 hours, and it has been customary for crew members to obtain sleep during both of their 6-hour off-duty periods. (i.e., an “anchor” sleep during one off-duty period and a “nap sleep” during the second period. In contrast, it is not clear if there would be sufficient time for a nap sleep if a second rest period was only 4-5 hours in length.)

The NCFRP Report 36 is the culmination of this NCFRP 45 project and the Northwestern University Team’s work conducted over the past 7 years. In the report ([www.trb.org/NCFRP/Blurbs/173857.aspx](http://www.trb.org/NCFRP/Blurbs/173857.aspx)) they provide details and industry specific support for 16 best practices that should be considered when implementing a FRMS. The researchers concluded that prescriptive hours of service (HOS) are not likely to be the most effective way to increase sleep durations and improve sleep quality or to manage and reduce the impact of fatigue. They also recommend further research to determine whether longer rest intervals are optimal or even required when schedules have more than one work and rest interval per 24 hours. Given



new scientific data that suggests that anchor-sleep/nap-sleep schedules might actually be as effective, or in some cases better, than a schedule involving a single rest period per day due to a balance between homeostatic and circadian control of sleep and alertness levels, further consideration is needed before changes to the current HOS rules are initiated. As part of this process, an assessment and better management of the factors that impede optimizing sleep efficiency and the recuperative value of sleep should be undertaken.

The team at Northwestern University has the expertise and is available to conduct research related to fatigue and to help develop FRMS in other transportation modes.

### How Resilient is Our Rail Network Vis-à-vis Weather Disruptions?

**PROJECT TITLE:** *Measuring Transportation System Resilience—Response of Rail Transit to Weather Disruptions*

**NUTC PI:** Joseph Schofer, Raymond Chan

**M**ajor disruptions of transportation systems due to severe weather events such as hurricanes, storm surges, and flooding are becoming more common. A logical response is to make those systems better able to withstand and rebound from large-scale weather assaults. Resilience is the term commonly used to describe this property of transportation systems, and while there are numerous definitions of resilience, there is no commonly used metric to characterize it.

In response, the investigators reviewed the concept of resilience in different fields and established a definition to encompass the three common strategies for making transportation systems more resilient: hardening, redundancy, and elasticity. In the process, they developed a graphical and analytic metric for assessing the resilience of scheduled transportation services in the face of weather disruptions, with a focus on heavy rail transit (HRT) systems. In the context of HRT, the researchers further propose a concept of planned service days lost to weather disruptions

as a useful aggregate measure of system resilience, normalized for system scale. The measure was applied to data from the New York Metropolitan Transportation Authority rail transit system to illustrate the effects of Hurricanes Irene and Sandy, as well as a major snow-storm that hit New York City. Professor Schofer and graduate student Chan suggested methods to apply the proposed tools and measures for ex-post evaluation of a response to weather events, as well as to support system management decisions. In this study, the application of the normalized measurement tool was compared against both the New York HRT and the New Jersey Transit (NJT) commuter rail transit systems.



### Health Call for Our Ailing Transportation Infrastructure

**PROJECT TITLE:** *Development and Field Application of a Multivariate Statistical Process Control Framework for Health-monitoring of Transportation Infrastructure*

**NUTC PI:** Pablo Durango-Cohen

**T**he American Road and Transportation Builders Association (ARTBA) reports that 59,000 bridges in the United States are structurally deficient (ARTBA 2015 Annual Report). To preserve and extend the life of bridges and other transportation infrastructure, active health-monitoring of infrastructure is a growing solution to this critical transportation challenge. In response, Northwestern researchers are developing a new two-part multivariate statistical process control framework to improve the science of infrastructure health monitoring.

The first part of this framework uses the estimation of regression and ARIMA-GARCH models to explain, predict, and control for common-cause variations in collected monitoring data—for example, variations

attributed to usual operating conditions, including traffic loads, environmental effects, and accidents causing damage. The second part of the framework uses multivariate statistical control charts to simultaneously analyze the outcomes of the models in order to detect possible special-cause or extraordinary events, such as unique/infrequent traffic, weather, or the onset of damage. The research approach specifically examines the construction of T2 control charts as a framework to jointly monitor the evolution and contemporaneous correlation of a set of measurements.

To illustrate the framework, the research team evaluated 27 months of strain and displacement data from the monitoring system on the Hurley Bridge (Wisconsin Structure B-26-7). The analysis of seven measurement sequences over this time period revealed six possible special-cause events. In conclusion, the team determined that the most significant special-cause events, in terms of magnitude and duration, could be attributed to unusual changes in weather and traffic.

## Start Me Up – Improving Electric Vehicle Owner Recharging Decisions

**PROJECT TITLE:** *Adaptive Routing and Recharging Policies for Electric Vehicles*

**NUTC PI:** Irina Dolinskaya, Diego Klabjan  
(Timothy Sweda – NUTC alumnus)

**B**attery electric vehicles (EVs) have become a practical and affordable option in recent years for environmentally conscious drivers looking to reduce their carbon footprint. EVs are powered solely by electricity and recharge by plugging into an outlet or charging station. Despite the numerous advantages that EVs have over conventional gasoline-powered vehicles, range anxiety—the worry that an EV’s range is insufficient for a driver’s commuting needs—remains a chief concern among many potential purchasers. The expansion of public charging infrastructure to increase opportunities for EV drivers to recharge their vehicles outside their homes has been one popular method for alleviating range anxiety and encouraging greater EV adoption. However, since each charging station can usually only recharge one or two vehicles at a time, and charge times can be on the order of hours, a driver who arrives at a fully occupied station may incur significant inconvenience (e.g., a long wait time) if no other nearby charging station is available.

To address this challenge, the researchers studied optimal route planning for drivers, taking into consideration charging station availability as well as charging station wait time predications. The uncertainty of charging station availability and wait times within the network, as well as the driver’s ability to adaptively make routing and recharging decisions, are unique and critical features of the problem. The study also incorporated differences between charging stations, as well as the anticipated charge levels of car batteries at the time of charge. For example, an EV battery already at a high state of charge absorbs energy at a slower rate than when it is more depleted. In addition, overcharging causes battery degradation due to greater stresses, including excess heat generation, from being charged at near full capacity. The end-goal was to determine an adaptive routing and recharging policy that minimizes the sum of all traveling, waiting, and recharging costs.

The research team was the first to consider adaptive routing and recharging (or refueling) for range-constrained vehicles, and to implement overcharging costs and uncertain charging station availability in the decision process.

## Taking a Sea Change in Bulk Shipping to the Finnish Line

**PROJECT TITLE:** *Information and Incentive Failures in Business Ecosystems—Application to Short-sea Shipping in the Baltic Region*

**NUTC PI:** James Conley, Mohan Sawhney and Hani Mahmassani

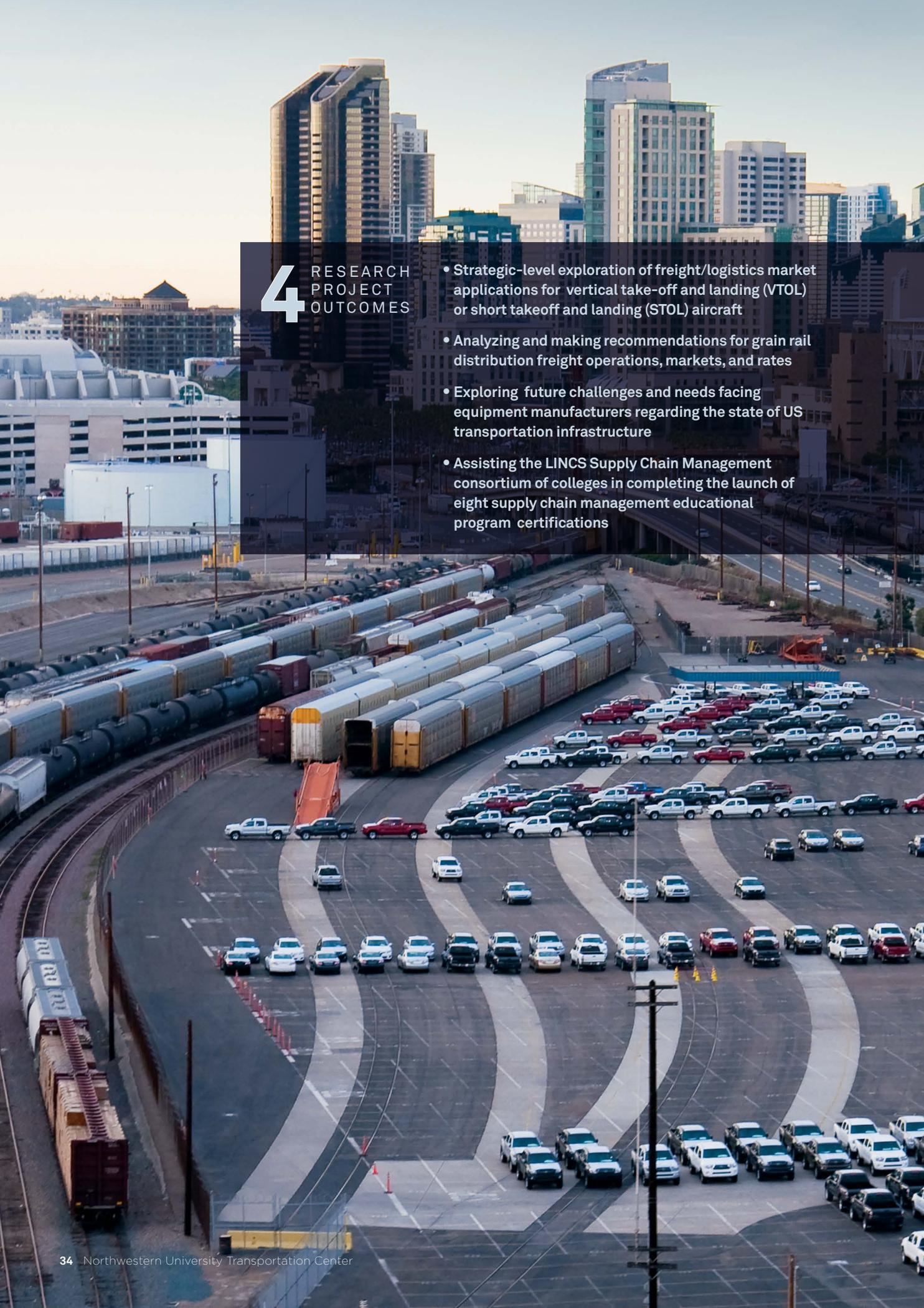
**N**UTC faculty affiliates James Conley and Mohan Sawhney from the Kellogg Center for Research in Technology and Innovation, in collaboration with Hani Mahmassani, have been working with and advising researchers from Abo Akademi University in Finland on a research project investigating improved business models for transportations systems in the Baltic Sea and shipping lanes around Northern Europe.

Shipping in the Baltic Sea is an essential part of Finnish industry and its economic livelihood. However, the utilization of the country’s shipping assets remains under 40 percent and traditional methods, for logistical movement, are well entrenched. Therefore, the research team, which includes Northwestern and

Stanford University researchers is evaluating the use of short-sea electronic freight marketplaces, real-time integrated production and logistics planning tools, and innovative cargo handling concepts, as well as performance-driven business and new financial models to drive efficiency.

The Finnish team intends to revolutionize short-sea shipping and increase the competitiveness of municipalities and ports in the Baltic region by better coordinating and organizing cargo flow among all stakeholders in the supply chain.





## 4 RESEARCH PROJECT OUTCOMES

- Strategic-level exploration of freight/logistics market applications for vertical take-off and landing (VTOL) or short takeoff and landing (STOL) aircraft
- Analyzing and making recommendations for grain rail distribution freight operations, markets, and rates
- Exploring future challenges and needs facing equipment manufacturers regarding the state of US transportation infrastructure
- Assisting the LINC Supply Chain Management consortium of colleges in completing the launch of eight supply chain management educational program certifications

## Industry Research

In addition to a scholarly emphasis on its core research areas, the Transportation Center devotes a significant portion of its resources to assisting industry with research on a wide variety of topics. These partnerships help the Transportation Center implement real-world solutions to complex issues in transportation and logistics, deepening the connection between industry and research.

### Freight and Logistics Applications for Vertical and Short Takeoff and Landing Aircraft



Throughout 2015 the Transportation Center, in collaboration with Boeing, conducted a strategic-level exploration of potential freight and logistics market applications of vertical take-off and landing (VTOL) or short takeoff and landing (STOL) aircraft that could carry significant payloads.

The team identified unique functional capabilities and advantages of next generation VTOL/STOL aircraft for the freight transport sector through analysis of technical specifications, mapping those against characteristics of potential application contexts, with input from a panel of logistics and transport experts. The resulting framework recognized commodity attributes that are critical in the choice of transport mode, such as: value of time; value of reliability; value of loss and damage; weight; frequency of moves; and cumbersomeness (e.g., odd shape and size). In addition to commodity attributes, the accessibility of origin and destination locations for a transport move were considered highly critical as well.

The team developed a novel analytical screening process using the NAICS classification system and the commodity attributes and applied data clustering techniques to generate high level insights into potential industry applications. Based on this systematic analysis and

guidance from industry experts, the research group identified five areas—urban delivery, logistics islands in concert with major import container ports subject to congestion, humanitarian logistics, specialized high-value construction, and manufacturing—for further investigation. In-depth assessments of potential market size and case studies in each of these areas further highlighted the potential for VTOL for urban delivery supply chains, especially in large congested metropolitan areas, humanitarian logistics and the logistics island concept.



# Industry Research (continued)

## Seeking Greater Capacity and Lower Transit Times: Grain Industry Dynamics and Rail Service



The logistics of grain production and distribution, especially in the North American western region, are undergoing significant restructuring driven by the desire to achieve economies of scale and reach export points to foreign markets where prices are at historically attractive levels. This has created important needs from a transport standpoint: (1) capacity to move larger loads from the production region to the main export ports, and (2) lower transit times from origin to destination to minimize the time that the grain stocks are tied in transit.

To achieve these dual goals, the rail industry has responded by offering shuttle trains, which travel as a single block of railcars from origin to destination, with no need for processing (disassembling inbound trains and reassembling outbound trains) at classification yards. In turn, to leverage these services, the grain industry has restructured some of its logistical operations to consolidate the shuttle train formation process at a smaller number of originating points. These typically take the form of larger grain elevators that enable more efficient asset utilization.

The scope of this project falls within this context of significant transformation of grain logistics in North American regions of production. At the request of the BNSF Railway, the Northwestern University Transportation Center (NUTC) research team performed an in-depth study of current industry dynamics, the implications for the demand and capacity, faster and more reliable service, and its subsequent impact on the rates offered to shippers.

The project was conducted in three parallel tracks by, (1) Examining the effectiveness of shuttle train service

and the terminal elevators supporting the shuttle train system, under different demand levels; (2) Examining the factors shaping the grain sector in terms of market competitiveness, demand and supply trends, and industry dynamics; and (3) Econometric analyses of transport rates (i.e., actual shipment records).

The first track entailed developing a suite of analytical models of rail operations to study cost, time and throughput and allow a comparison of shuttle and conventional rail systems on all three metrics.

The second track focused on the grain sector, and the extent to which global market developments are leading to the restructuring underway in the North American production regions as producers seek to improve and leverage their global market competitiveness. Statistical analyses of agriculture and transportation datasets formed the bulk of the methodology for this track. The team conducted fieldwork in Minnesota and North Dakota, visiting terminal elevators and meeting with key stakeholders across the grain supply chain, to gain direct appreciation of grain logistics operations as well as grain trading and hedging activities. Professor Parr Rosson, head of the Agricultural Economics department and director of the Center for North American Studies at Texas A&M University, served as an advisor on this track.

The third track made use of the Surface Transportation (STB) carload waybill sample (CWS) to analyze grain rail transport rates through advanced regression models. This yielded insights into the main factors and trends underlying transport rates.

The results of this study provide important insights for freight transportation planners and strategists, shippers and intermediaries in the agriculture sector and their representatives, as well as public policy makers at large that have an interest in the economic health of the grain industry and the role that rail transportation plays in this regard.



## LINCS Project on Track and Impacting Supply Chain Workers across the Country



In 2015, the LINCS (Leveraging, Integrating, Networking, Coordinating Supplies) Supply Chain Management consortium completed the launch of eight independent yet integrated supply chain management certifications for entry-level and career-changing employees. The nine community college partners in the consortium (Broward College, Columbus State Community College, Essex County College, Florida State College at Jacksonville, Harper College, Long Beach City College, San Jacinto College, St. Petersburg College, Union County College) busily rolled out credit earning and certificate driven supply chain management courses in the schools.

From inception through the end of 2015, more than 2700 certificate exams were administered through the Council of Supply Chain Management Professionals' SCPPro™ Fundamentals Certification program. CSMCP serves the consortium as its primary industry partner

## Infrastructure Vision 2050

The Transportation Center was selected by the Association of Equipment Manufacturers, an 800+ member trade association, to explore the future challenges and needs facing US transportation infrastructure. The effort is intended to characterize the nature and magnitude of the transportation infrastructure problem, and help promote interest and support to assure that US infrastructure can meet the future needs of our economy, society, and environment.

Under AEM's Infrastructure Vision 2050 program, eight faculty members affiliated with the Center held a series of workshops to develop and share visions of the future in their areas of specialty. Faculty participants were Fabian Bustamante, Sunil Chopra, Gianluca Cusatis, Kimberly Gray, Hani Mahmassani, Ian Savage, Joseph Schofer, along with Mike Hewitt from the Loyola University Quinlan School of Business. Associate Director Bret Johnson was the overall project coordinator. PhD student Lama Bou Mjahed served as research assistant on the project.

Each participant prepared a future scanning white paper addressing a particular area closely linked to demand for and supply of mobility services. These were presented in an integrating workshop and compiled into a monograph—*Mobility 2050: A Vision for Transportation Infrastructure*.

and certifying body for examinations, and develops the certification programs as a direct extension of the LINCS course materials.

NUTC serves the consortium as a member of its Academic Advisory Council. In 2015, Bret Johnson, along with Lisa Smith of Harper College, assumed co-chair roles for the AAC. The AAC reviews and approves all LINCS subject matter certification tracks for the consortium before the certifications are released for final editing, delivery to the full consortium, and to learning management team for online course development.

In 2015, Broward College, the consortium leader, initiated a revision process for all eight certification tracks based upon feedback from the community colleges and university partners and CSCMP, and testing process information. Out of this process, Broward College and the AAC enhanced and improved the *Transportation Operations* track, and initiated work on the *Warehouse Operations* track. Throughout 2016, the consortium will revisit and revise *Common Learning Blocks*, *Supply Chain Management Principles*, *Inventory Management*, *Manufacturing & Service Operations*, *Supply Management & Procurement*, *Demand Planning*, and *Customer Service Operations*.

The topics include sustainable cities, technology for urban personal mobility, the economy and the economics of transportation, freight and logistics, omni-channel retailing, information and computing technology, and infrastructure systems and materials. A separate chapter characterizes the current condition, performance, and funding for highways, mass transportation, air passenger and freight facilities, ports and inland waterways, and another addresses the status of and needs for US transportation infrastructure policy and funding.

The report, issued as a Transportation Center monograph, characterizes the key changes occurring in technologies, demographics, the environment, and social values, that together are leading to new demands for rapid, customized, and sustainable transportation services, supported by increasing degrees of automation that can make services better and safer, and free travelers and carriers to make better use of in-motion time and attention. The needs for transportation infrastructure will change, but they are not expected to diminish, particularly in terms of requirements for high levels of performance and efficiency while limiting negative externalities.

The challenges ahead include finding ways to implement the best ideas for new technologies and services, to balance individual and social values, and to develop sustainable mechanisms for paying for essential and productive infrastructure investments.

# Education

Northwestern University is recognized throughout the world as a premier institution for transportation and logistics education. The Transportation Center's interdisciplinary programs prepare students for careers in such diverse fields as transportation operations, planning, engineering, and management. Our students graduate into professional roles within a wide array of sectors—public and private, including government, business, independent consulting, and academia.

## Academic Programs

Northwestern's specialized academic programs in transportation are thorough, with a program structure that balances highly technical quantitative training in engineering and mathematics with theories and applications drawn from relevant disciplines such as economics, management, finance, marketing, energy, and the social sciences. Each section involves rigorous coursework, opportunities to become involved in research, and exposure to real-world learning experiences in industry.

**GRADUATE PROGRAMS** Northwestern University offers a number of different avenues for students interested in transportation at the graduate level. Master of Science and Doctoral degrees are offered through Civil & Environmental Engineering, as well as Industrial Engineering & Management Sciences.

The graduate programs in **Transportation Systems Analysis and Planning within Civil & Environmental Engineering** stress conceptual and quantitative approaches to the analysis of transportation and related systems. The goal is to develop our students' analytic, quantitative, and communication skills so they are well prepared to face the exciting and challenging transportation environment of today and tomorrow. The courses and related research integrate theory, methods, and applications. The strong quantitative focus of our program provides students with skills for analyzing all modes of transportation used for the movement of people and goods, within and between cities, under both public and private operation.

The **Master of Science in Civil Engineering (MSCE)** program in transportation integrates theory and applied analytical methods of transportation systems, public transit planning, traffic engineering, and environmental, urban, and regional development. This is a research-oriented program, requiring three quarters of course work and a three to six-month research period resulting in a thesis. The **PhD in Civil Engineering with a specialty in Transportation Planning and Analysis** is a natural continuation for MSCE students and those planning to work in academia or in advanced research and technical studies in industry and consulting.

The **PhD program in Industrial Engineering and Management Sciences (IEMS)** department is suited for students interested in the development of theoretical and practical tools for solving problems in industry and government.



PhD Graduates (left to right) Alireza Talebpour and Jiwon Kim with Professor Hani Mahmassani attend an international conference.

**Northwestern students graduating with MS degrees in transportation attain challenging positions in industry. In 2014-2015, MS graduates secured positions with the following companies:**

- AAR Corporation (Planning Analyst)
- Airbiz (Aviation Consultant) France
- Chicago South Shore Railroad (Analyst)
- Cambridge Systematics (Freight Analyst)
- Citilabs (Sales Engineering)
- HNTB, Inc. (Transportation Planning Engineer)
- McKinsey & Company (Associate)
- McMaster Carr (Management Trainee)
- MTA – NYC Transit (Operations Planning & Staff Analyst)
- Ricondo & Associates (Consultants)
- Shanghai Urban-Rural Construction & Transportation Research Institute (Transportation Planner)
- TNP Consultants (Industry & Service Consultant)
- Thomas Engineering Group (Engineer)
- Wayfair (Data Science Analyst)



## Education (continued)

Students enrolled in this program develop research strategies and tools used in scheduling, planning, distribution, design, location, and control. Application areas range from manufacturing to the service sector, finance, and public policy, including supply-chain management and logistics.

Students may also become involved with the NUTC through the **Master of Science in Analytics (MSA)** and the **Master of Engineering Management (MEM)** programs, both offered through Northwestern Engineering; or through a traditional **Masters of Business Administration** program at the Kellogg School of Management, or the specialized MMM Program, earning both an MBA from Kellogg and an **Master of Science in Design Innovation** from the Segal Design Institute at Northwestern. All graduate students affiliated with the Transportation Center have the opportunity to take advantage of the Center's wide array of faculty affiliates, business contacts, and academic advising.

An important element of the transportation program is the regularly scheduled Seminar Series, which is designed to enhance the student classroom experience and learning. Each year the Seminar Series features a wide variety of academic speakers, transportation professionals and researchers examining topics relevant to their course of study and future professions (see p. 65).

**UNDERGRADUATE MINOR** The Transportation Center manages the undergraduate **Minor in Transportation and Logistics**. Led by Professor Ian Savage, this program is available to all undergraduate students at Northwestern. The interdisciplinary program includes courses from the McCormick School of Engineering and Applied Sciences, as well as the Weinberg College of Arts and Sciences. Additionally, the Center provides participating students with personalized academic advising by senior faculty, opportunities for involvement in current research initiatives, access to specialized career counseling and job placement opportunities.

### Placement of Graduating Transportation & Logistics Minors in 2014 & 2015

**Cheah Derek** Pursuing Master Degree in Transportation Planning & Engineering, University of California, Berkeley

**Jamie Golinkoff** Associate Analyst, Travelers Insurance

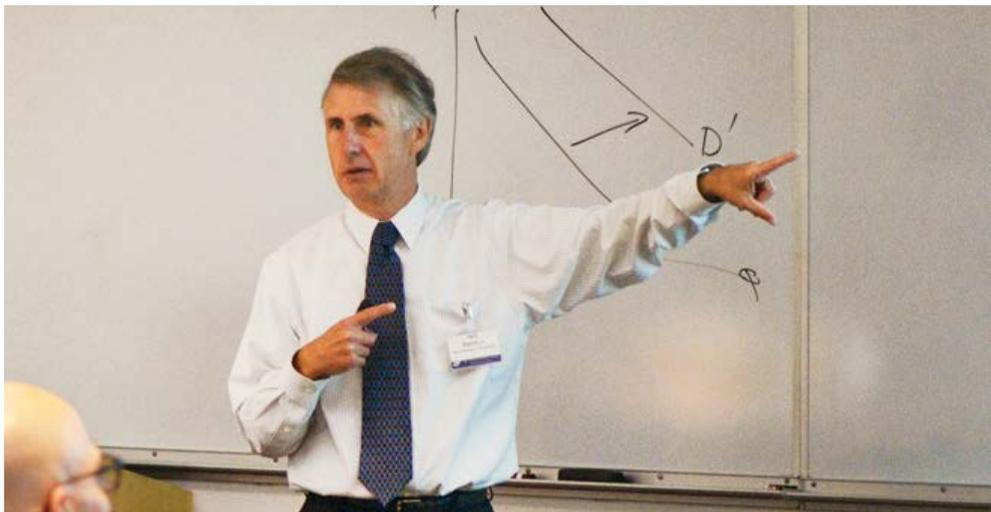
**Darian Jefferson** Transportation Analyst, NYC Metropolitan Transit Authority (MTA)

**Joshua Kaplan** Network Planning Analyst, Delta Air Lines

**Ryan Marcus** Logistics Engineer, J. B. Hunt Transport Services, Inc.

# 20

2015 SEMINARS  
TO ENHANCE  
STUDENT  
EXPERIENCE



Professor Ian Savage leads the Undergraduate Minor in Transportation and Logistics.

## Student Awards and Appointments

A primary goal of the Transportation Center is to promote the academic excellence and quality research of all students involved. To support this goal, the Center awards annual **Dissertation Year Fellowships (DYF)** to outstanding PhD candidates who are conducting thesis research on transportation, logistics, or supply chain management. The Fellowship offers full or partial funding for tuition, as well as a stipend to supplement the student's final year of study.

### Peng "Will" Chen

Civil & Environmental Engineering  
Advisor: Yu (Marco) Nie

*Topic: Hybrid Transit System: Optimal Routing and Design*

To reverse the trend of declining transit use in the US requires a concerted effort of planning, policy-making and engineering. Indispensable in this effort is to transform the way by which transit systems are designed and operated. Therefore, for his thesis Chen proposed to investigate a hybrid transit system that integrates fixed-route service (FRS) and demand-interactive service (DIS). Specifically, DIS functions mainly as a connector between FRS and passengers' origins and destinations. DIS directly responds to demand in that passengers can only use this service through reservation. Unlike conventional demand-responsive transit (DRT),



### 2015–2016 Dissertation Year Fellow

such as taxi and dial-a-ride, DIS neither offers a door-to-door service, nor guarantees all demands be fulfilled exactly as requested. Chen's thesis focuses on two research efforts: (1) the optimal routing strategy for passengers with real time information; and (2) the design problem of the hybrid transit system. Overall, the proposed research aims to create theories and tools to characterize, analyze, and evaluate the transit system that is suitable in US cities.

### Jie "Jeremy" Yang

Civil & Environmental Engineering  
Advisor: Diego Klabjan

*Topic: Data-Driven Optimization & Analyses in the Transportation Industry*

Advanced analytics have been widely used in the transportation industry such as for revenue management in the airline industry. Similarly, logistics managers also try to improve their supply chain efficiency with data analytics. With the advent of restoring large-scale data and more powerful computing infrastructure, traditional approaches can be restructured to create more value for industry practitioners. With this value proposition in mind, Yang's research is focused on studying and understanding these opportunities, and developing innovative solutions to solve problems in the



### 2015–2016 Dissertation Year Fellow

Jie Yang also received a 2015 academic scholarship from the Materials Handling & Management Society (MHMS) Chicago Chapter, and the Chicago Roundtable of the Council of Supply Chain Management Professionals (CSCMP). Noreen Ryan, VP of Education for the MHMS Chicagoland Chapter (left) gave out the awards at the CSCMP Chicago 2015 Annual Seminar.

transportation sector in the context of rapidly advancing analytics techniques. Yang's thesis covers the areas of vehicle routing optimization, semi-supervised choice modeling and choice modeling-based network development.

# Education (continued)

## Career Placement of PhDs

NUTC affiliated students who received PhDs in 2014 - 2015 from the departments of Civil & Environmental Engineering and Industrial Engineering and Management Science secured faculty and industry positions at a diverse array of schools and companies.

### CIVIL & ENVIRONMENTAL ENGINEERING

Name	Placement	Advisor(s)
Raymond Chan	Data Analyst, Strategic Services, PACE Suburban Transit	Schofer
Yikai Chen	Senior Revenue Management Analyst, FedEx Services	Durango-Cohen
Ying Chen	Research Assistant Professor, Northwestern University	Mahmassani
Madison Fitzpatrick	Consultant, Boston Consulting Group	Durango-Cohen
Charlotte Frei	Transportation Planner, Wight and Company	Mahmassani
Mehrnaz Ghamami	Assistant Professor, Civil & Environmental Engineering, Michigan State University	Nie
Tian Hou	AVP Quantitative Analytics, Global Markets, Barclay Investment Bank	Mahmassani
Jiwon Kim	Assistant Professor, Engineering, Architecture & Information Technology, University of Queensland, Australia	Mahmassani
Qianfei Li	Business Associate Consultant, ZS Associates	Nie
Christopher Lindsey	Freight Analyst, Cambridge Systematics	Mahmassani
Meead Saberi Kalae	Assistant Professor, Department of Civil Engineering, Monash University, Australia	Mahmassani
Alireza Talebpour	Assistant Professor, Zachry Department of Civil Engineering, Texas A&M University	Mahmassani
Ömer Verbas	Post-Doctoral Fellow, The Transportation Center, Northwestern University	Mahmassani
Weizeng Zhang	Associate, McKinsey & Company	Durango-Cohen
Ali Zockaie	Assistant Professor, Civil & Environmental Engineering, Michigan State University	Mahmassani

### INDUSTRIAL ENGINEERING AND MANAGEMENT SCIENCE

Name	Placement	Advisor(s)
Tingting Jiang	FIC STRAT, Deutsche Bank, London	Iravani/Smilowitz
Alvaro Maggiar	Research Scientist, Amazon	Dolinskaya
Samantha Meyer	Research Fellow, University of Michigan Ross School of Business	Smilowitz/Dolinskaya
Young Woong Park	Technical Professor of SMW Cox School of Business	Klabjan
Timothy Sweda	Logistics Engineer, Schneider National	Klabjan
Qiuping Yu	Assistant Professor, Indiana University Kelley School of Business	Iravani

## Student Comments



**Peng "Will" Chen**

"I'm interested in designing a more efficient and sustainable public transit system. Northwestern University provides students with excellent resources to learn and interact with people from both academia and industry."



**Hooram Halat**

"Along the path to my PhD degree, I have been involved with several projects with focuses on transportation demand modeling, coordinated signal timing, and micro-simulation extension to activity based models."



**Michael Hyland**

"The faculty at NUTC have created a nurturing and collaborative environment that makes learning and researching transportation's most challenging problems a fulfilling endeavor."



Snapshots taken at a few of the transportation PhD dissertation defenses.



### Mehrnaz and Ali

It's not too often that a husband and wife receive their PhD in the same field, the same year, and from the same institution. NUTC was especially pleased when both graduates received (and accepted) tenure-track faculty offers from the same Michigan State University department. Congratulations to NUTC students Mehrnaz Gamami and Ali Zockaie for accomplishing this unique feat in 2015. Professor Marco Nie supervised Mehrnaz; Professor Hani Mahmassani, Ali.

# Education (continued)

## Executive Education

The Transportation Center offers the Executive Education Series, an ongoing series of non-degree short courses, for professionals in the fields of transportation and logistics. Our Executive Education courses offer comprehensive exposure to a wide range of management techniques and decision-making skills, taught by leading authorities in the field, to better equip participants with skills needed to excel in a competitive global business environment.

### FREIGHT TRANSPORTATION & LOGISTICS

**JUNE 15-17, 2015** An international class of students attended the Transportation Center's fourth annual executive course in Freight Transportation and Logistics in 2015. The theme addressed in this iteration of the course was *Securing Capacity in a Dynamic Industry*. The course, moderated by NUTC's Business Advisory Council (BAC) chair Justin Zubrod, provided guidance and insight to transport operators and their customers who were experiencing a capacity constrained global market and rising cost structures.

The course covered all modes of transportation—truck, rail, intermodal, air, maritime—and featured industry experts from NUTC's BAC including: Rick D. Blasgen, President & CEO, Council of Supply Chain Management Professionals; Farrukh Bezar, Partner, Clarendon Group; Mike Brennan, Chief Operating Officer, Peapod; Lee Clair, Partner, Zubrod/Clair; Ken Heller, Vice President, Supply Chain Excellence, DSC Logistics; Shawn McWhorter, President, Americas Region, Nippon Cargo Airlines; Steve Rothberg, Founding Partner, Mercator International; and Jeff Starecheski, Vice President, Logistics Services, Sears.



Northwestern faculty contributed to the program as well. Hani Mahmassani provided insight into transportation data and analytics. Karen Smilowitz, Charles Deering McCormick Professor of Teaching Excellence, Industrial Engineering and Management Sciences, led a panel discussion on e-fulfillment and last mile delivery. And Jan Van Mieghem, Harold L. Stuart Professor of Managerial Economics, Kellogg School of Management, led his ever popular global sourcing and simulation exercise.



BAC Chair Justin Zubrod helped to organize and chaired the 2015 freight and logistics program.

**CHALMERS UNIVERSITY**  
**APRIL 19 – 23, 2015, U.S. Module of**  
**Chalmers University SCM Program:**  
**“The International Perspective”**

Each year, our colleagues at Chalmers University in Gothenburg Sweden, partner with the Transportation Center to hold the US Module of their annual International Supply Chain Management Program at Northwestern. The program is based on the knowledge resources in logistics and transportation at Chalmers University and an external network of leading international academics, experienced business practitioners, and management consultants. The program mixes state-of-the-art academic research results with practical experiences from successful companies and their management philosophies. Ola Hultkrantz, Assistant Professor in Supply Chain Management at Chalmers is the Program Director.

Participants in the program are senior level managers from noted international firms responsible for supply-chain decisions and management. By agreement, representatives of the NUTC’s Business Advisory Council companies are invited to participate in the week-long program, providing them the opportunity to network with the group of international participants and learn about the latest theories and best practices in the area of international logistics.

The program faculty featured experts from industry and academia, including Sunil Chopra and Eric Andersson of the Kellogg School of Management.

Topics covered in the program included:

- Performance Measurements in Supply Chain Management
- Sourcing & Risk in the Supply Chain
- SC Contracting & Incentive Design
- SC Social Responsibility
- Marketing Channels
- Lean Operations and/or SCM Strategy

**Tour Day:** A highlight of the program is the special day devoted to visiting local US companies to learn about their supply-chain expertise. This year, the group visited the UPS CACH (Chicago Area Consolidation Hub) facility, the BNSF Intermodal facility and the Caterpillar Heavy Equipment Facility in Aurora, IL. At each location they met with company managers for a discussion of operation strategies, practices and issues impacting those operations.



UPS Chicago Area Consolidation Hub



NUTC faculty affiliate Sunil Chopra

**Program Faculty**

**Sunil Chopra**, Kellogg School of Management,  
Northwestern University

*Expert on sourcing and risk in the supply chain*

**Tom Davis**, Pennsylvania State University

*Expert on performance measurements in supply chain management*

**Eric Andersson**, Kellogg School of Management,  
Northwestern University

*Expert on marketing channels*

**Gad Allon**, Kellogg School of Management,  
Northwestern University

*Expert in the science of lean six-sigma operations*

**Nicole DeHoratius**, University of Chicago  
Booth School of Business

*Expert in supply-chain management and operations strategy*

# Business Advisory Council

Unequaled by any academic transportation advisory board in the country, the Transportation Center's Business Advisory Council (BAC) has long been a major force behind the transportation center's success. The BAC is structured through four distinct levels of membership: Leadership, Sustaining, Individual, and Association. Each category carries with it a set of membership benefits, as well as a suggested level of commitment and financial support for the Center's research, education, and outreach initiatives.

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

The BAC meets twice annually 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.

## Leadership Members



**Susan Bee**  
Managing Partner  
Teradata



**Robert Martínez**  
Vice President,  
Business Development  
Norfolk Southern Corp.



**Gene Seroka**  
Executive  
Director  
Port of  
Los Angeles



**Jim Compton**  
Vice Chairman &  
Chief Revenue Officer  
United Airlines, Inc.



**Peter McCabe**  
Vice President,  
Global Services  
GE Transportation



**Dov Shenkman**  
Group VP, Supply  
Chain Global Inventory  
& Transportation  
Walgreens Co.



**Doug Cook**  
Vice President,  
Operations Planning  
& Engineering  
FedEx Express



**Paul Nowicki**  
Assistant Vice  
President, Government  
& Public Policy  
BNSF Railway



**Jeff Silver**  
CEO  
Coyote Logistics



**Edward Jenkins**  
Vice President,  
Market Strategy  
E-Business  
CSX Corp.



**Will Ris**  
Senior Vice President,  
Government Affairs  
American Airlines,  
Inc.



**Burt Wallace**  
President,  
Corporate  
Transportation  
UPS



**Robert M. Knight, Jr.**  
Executive  
Vice President & CFO  
Union Pacific Corp.



**Matthew K. Rose**  
Executive Chairman  
BNSF Railway



**Phillip C. Yeager**  
EVP of Account  
Management  
Hub Group, Inc.



# Business Advisory Council (continued)

## Sustaining Members



**Allen Adler**  
Vice President, Enterprise  
Technology Strategy  
Engineering Operations  
& Technology  
The Boeing Company



**Robert M. Chapman**  
Chief Executive Officer  
CenterPoint Properties  
Trust



**Andrew Fox**  
President  
Chicago South Shore  
& South Bend  
Railroad



**Billy Ainsworth**  
President and Chief  
Executive Officer  
Progress Rail Services



**William Cook**  
Director, Logistics  
and Customs  
FCA US LLC



**Eli Gross**  
Managing Director and  
Global Head Transporta-  
tion, Logistics and  
Infrastructure Group  
Morgan Stanley



**David T. Arganbright**  
Vice President of  
Government Affairs  
OmniTRAX, Inc.



**Richard Craig**  
President & CEO  
MOL (America) Inc.



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



**Andrew Boyle**  
Executive Vice  
President & CFO  
Boyle Transportation



**Jim A. Davis**  
CEO  
AccuFleet  
International



**Robert W. Hart**  
Vice President and  
Managing Director  
Surface  
Transportation  
Fifth Third Bank



**Michael Brennan**  
Chief Operating Officer  
& SVP  
Peapod LLC



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



**John C. Hellmann**  
President and Chief  
Executive Officer  
Genesee & Wyoming  
Inc.



**Michael Broaders**  
Vice President  
Transportation, Planning  
& Warehouse  
Coca-Cola Refreshments



**Ann Drake**  
Chairman & Chief  
Executive Officer  
Corporate Office  
DSC Logistics



**James R. Hertwig**  
President and CEO  
Florida East Coast  
Railway Company



**Michael Burton**  
President & CEO  
C&K Holdings  
Acquisition, LLC



**Reggie Dupre**  
Chief Executive  
Officer  
Dupre Logistics, LLC



**Heidi Hornung-Scherr**  
Partner  
Scudder Law Firm



**Perry A. Cantarutti**  
Chief Executive Officer  
Skyteam Airline Alliance  
Management



**Edmund J. Feeley**  
Managing Director  
Littlejohn & Co. LLC



**David A. Horwitz**  
Vice President &  
Executive Director  
Fleet Portfolio  
Management  
GATX Corporation



**Grace Cerocke**  
Vice President, Finance  
Matson Logistics Inc.



**Ken Fleming**  
CEO  
Eyefreight



**Regg L. Jones**  
Managing Partner  
Greenbriar Equity  
Group, LLC



**Amos Kazzaz**  
Senior Vice President  
Financial Planning &  
Analysis  
Air Canada



**Robert Nathan**  
CEO and Co-Founder  
Load Delivered  
Logistics, LLC



**Paul J. Schneider**  
Director  
Schneider



**H. Merritt Lane, III**  
President & CEO  
Canal Barge  
Company, Inc.



**Aurelio Perez Alonso**  
Associate Director  
and CFO  
Grupo ADO S.A. De C.V.



**Jeff A. Starecheski**  
Vice President  
Logistics Services  
Sears Holdings  
Corporation



**Stefan Loeb**  
Senior Vice President  
Marketing & Strategic  
Development  
Watco



**Nathaniel J. W. Pieper**  
Senior Vice President  
Europe, Middle East &  
Africa  
Delta Air Lines Inc.



**Richard Thompson**  
Managing Director  
Americas Leader, Supply  
Chain & Logistics  
Solutions, Jones Lang  
LaSalle Americas, Inc.



**Benjamin J. McLean**  
Chief Executive  
Officer  
Ruan



**James P. Rankin**  
President and CEO  
Columbia Helicopters



**Thomas Tisa**  
Director  
Network Strategies  
Canadian National  
Railway



**Shawn McWhorter**  
President,  
Americas Region  
Nippon Cargo Airlines



**Ogi Redzic**  
Vice President,  
Connected Driving  
HERE



**Douglas R. Waggoner**  
Chief Executive  
Officer  
Echo Global Logistics



**D. Stephen Menzies**  
Group President,  
Trinity Rail  
Senior Vice President  
Trinity Industries, Inc.



**Jean Regan**  
President & Chief  
Executive Officer  
TranzAct  
Technologies, Inc.



**Thomas F. Wells**  
President & CEO  
TTX Company



**Alfred Messina**  
Vice President  
Booz Allen Hamilton



**Kathleen L. Ross**  
Senior Vice President;  
Senior Client Manager  
Midwest Corporate Banking  
Group, Bank of America  
Merrill Lynch



**Seth E. Wilson**  
Managing Partner  
Headhaul Capital  
Partners



**Dennis Mooney**  
Group Vice President  
Global Product  
Development  
Navistar, Inc.



**Steven Rothberg**  
Founding Partner  
Mercator  
International LLC



**Dennis Nash**  
Chairman & CEO  
Kenan Advantage  
Group, Inc.



**Gilles Roucolle**  
Partner  
Global Transporta-  
tion Practice  
Oliver Wyman

# Business Advisory Council (continued)

## Individual Members



**Phil Bakes**  
Co-Managing Partner  
BBX Capital Partners



**Norman Carlson**  
Chairman  
Carlson Consulting  
International, LLC



**Craig E. Philip**  
Former CEO  
Ingram Barge



**Farrukh A. Bezar**  
Partner  
The Clarendon  
Group II, LLC



**Lee Clair**  
Managing Partner  
Transportation and  
Logistics Advisors



**Clifford J. Porzenheim**  
Former President  
& CEO  
Milestone  
Equipment Co.



**L. Price Blackford**  
Managing Director  
Group Head,  
Transportation & Logistics  
Scott-Macon, Ltd.



**Brendan P. Hickman**  
Managing Partner  
Transportation  
Management Group



**David J. Rohal**  
Senior Vice President  
Customer & Class 1  
Relations  
OmniTRAX



**John Bowe**  
Principal  
American Maritime  
Group, LLC



**Adam Inselbuch**  
Managing Director  
South Street Ventures,  
LLC



**James A. Runde**  
Special Advisor  
Investment Banking  
Division  
Morgan Stanley



**Vicki Bretthauer**  
Independent Consultant



**Timothy Krauskopf**  
Principal  
Round Lake Designs



**Andy Sze**  
Principal  
Fastraxx Group, LLC



**Edward A. Burkhardt**  
President  
Rail World, Inc.



**Charles B. Lounsbury**  
Former Senior Vice  
President  
Ryder System



**Justin F. Zubrod Sr.**  
Managing Partner  
Justin Zubrod &  
Company, LLC



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



**Regis Luther**  
President & Owner  
Regis Luther LLC

## Association Members



**Rick D. Blasgen**  
President & CEO  
Council of Supply Chain  
Management  
Professionals



**Bill Graves**  
President and Chief  
Executive Officer  
American Trucking  
Associations, Inc.



**Joshua L. Schank**  
President & CEO  
Eno Center for  
Transportation



**Bruce Carlton**  
President & CEO  
National Industrial  
Transportation League  
(NITL)



**Edward R. Hamberger**  
President, CEO  
Association of American  
Railroads

## Leadership and Sustaining Members



## BAC Spring Meeting, April 20–21, 2015

The Spring 2015 Business Advisory Council (BAC) Meeting kicked off with a workshop titled *Unmanned Aerial Vehicles: Applications and Emergent Technologies* (see p. 61). The workshop provided insight into the current and future potential of unmanned aerial systems (UAS) and introduced specific applications for infrastructure monitoring and inspection, package and cargo delivery. Speakers also addressed the evolution of the UAS market and policy developments.

**OPENING REMARKS** Following a call to order from BAC Chair Justin Zubrod, Dean Julio Ottino of Northwestern Engineering addressed three transformative educational concepts: (1) the engineering school invested vigorously in entrepreneurship several years ago, which now pervades the entire University community; (2) it spearheaded horizontal connections across all sectors of the University with an effort to cross-link ideas; and (3) he envisions a move from “departmental structures to network structures” in the university of the future. These themes are reinforced through the Transportation Center’s interdisciplinary connections throughout Northwestern.

**DIRECTOR’S COMMENTS** Director Hani Mahmassani thanked the Council for its continued support, particularly with NUTC’s 60th Anniversary Celebration featuring the 60th Anniversary Transportation Summit, Technical Symposium, and Gala Dinner with featured speaker Northwestern alumnus and president and COO of SpaceX, Gwynn Shotwell.



**NEW MEMBERS** Justin Zubrod introduced new BAC members attending a meeting for the first time, including David Arganbright, Vice President Government Affairs, OmniTrax; Robert Chapman, Chief Executive Officer, Centerpoint Properties; and Jim Davis, Chief Executive Officer, Accufleet International.



**GENE SEROKA ON SEA TRADE** The meeting featured BAC member Gene Seroka, Executive Director of the Port of Los Angeles, who spoke on how sea trade is changing dramatically in the twenty-first century. According to Seroka, port survival in the future will depend on being “big-ship ready” to meet the demand for mega-alliance business. In order to meet this demand ports will need to improve and innovate solutions to sort cargo more efficiently; enhance ship-to-rail efficiency in order to service inland destinations; improve secondary conveyance with real-time data and productivity tools; and find chassis solutions that can provide more availability where chassis are needed.

## PRESENTATIONS AND DISCUSSIONS

The rest of the meeting featured faculty and research staff presentations, followed by a panel discussion on crude (oil) by rail. And, in keeping with tradition, BAC members were introduced to the undergraduate and graduate students currently studying transportation.

Presentations featured: (1) David Morton, Professor, Industrial Engineering and Management Sciences, “New Strategies to Build Optimal, Prioritized Action Lists;” (2) Amanda Stathopoulos, Assistant Professor, Civil and Environmental Engineering, “Crowd Sourced Urban Delivery and Benefits of Various Sources of Data;” (3) Michael Beltran, Lecturer, Mechanical Engineering, Segal Design Institute, Northwestern University, “Disrupting Barriers: Printer in Three Dimensions,” where he advised that scaling 3D printing to widespread production is still in the future; and (4) panel on “Crude Oil By Rail—A Roadmap toward Enhancing Safety” featuring moderator Norm Carlson, Carlson

Consulting International, and speakers Pat Brady, Director, Hazardous Materials, BNSF Railway, Karen Darch, Village President, Village of Barrington, Bob Hulick, Chief Mechanical Officer, TrinityRail, and Sridhar Krishnaswamy, Professor, Mechanical Engineering, Northwestern University.

To continue the BAC’s discussion, a final question emerged from the meeting: *Will pending FRA regulations, potentially resulting in billions of dollars of infrastructure investments and retrofits, ultimately result in safer systems and outcomes?*



## BAC Fall Meeting, October 27–28, 2015

The Fall 2015 BAC Meeting began with an industry workshop titled, *The Internet of Things in Transportation and Logistics*. The workshop focused on the rise and emergence of e-commerce, as well as the direct delivery of goods to consumers and businesses. The program described the network of physical and mobile objects (or “things”) embedded with electronics, software, sensors, and network connectivity.

**MOSES LECTURE** Following a reception and dinner for attendees, Jan Brueckner, Chancellor’s Professor of Economics, University of California, Irvine, presented the 2015 Leon N. Moses Distinguished Lecture (see p. 57). In his presentation titled, *Convenient Flight Connections vs. Airport Congestion: Modeling the “Rolling Hub,”* Dr. Brueckner addressed the trade-off between convenient flight connections and airport congestion—a fundamental, yet untreated element in hub-and-spoke network economics.

**DIRECTORS REPORT** After BAC Chair Justin Zubrod called the meeting to order, Director Hani S. Mahmassani presented the Director’s Report. He welcomed MOL (America), Inc. and Walgreens as new BAC member companies, and announced awards recently received by DSC Logistics CEO Ann Drake (David Schultz Award by Northwestern University) and former Ingram Barge CEO Dr. Craig Phillip (Lifetime Achievement Award by the Seaman’s Church Institute). Hani also announced that Jeff Silver, CEO of Coyote Logistics, had agreed to serve as the next BAC Chair and that Justin Zubrod would pass the gavel to Jeff at the BAC 2016 Spring Meeting.

The Transportation Center would like to thank Justin Zubrod for his contributions. The Center is grateful to Mr. Zubrod for his many years of outstanding service, leadership and dedication to the BAC. Zubrod can be credited with re-energizing the Center’s Executive Programs, as well as helping with the planning and presentation of a fantastic Transportation Summit 60th Anniversary celebration.

**PANEL DISCUSSIONS** The Fall 2015 BAC Meeting featured one panel discussion titled, *Omni-Channel Retailing and e-Fulfillment*, and a second panel on the *Impacts of the Panama and Suez Canal Expansion on Global and Domestic Trade*.

The Transportation Center is especially grateful to Oscar Bazán, Executive Vice President of Planning & Business Development for



Top photo, left to right: Fall 2015 BAC Meeting panel participants: Oscar Bazán, Steven Rothberg, Dick Craig and Jeremy Haycock. Bottom photo, BAC Dinner attendees, top row: Justin Zubrod, Hani Mahmassani, Paul Schneider, Craig Phillip, Ron Braeutigam; front row: Milli Mahmassani, Ian Savage, Jan Brueckner, Robert Gordon.

the Panama Canal Authority, who flew in from Panama to deliver a report on the status of the Canal's expansion. Bazán spoke directly to BAC members about the anticipated impact the expansion will have on world trade and transportation.

Other panel discussion participants and presentations included: (1) "E-fulfillment and Last Mile Delivery," moderated by Sunil Chopra, Kellogg School of Management, and featuring panelists Patrick Allard, Vice President of Sales and Business

Development, Newgistics; Rich Byrnes, Associate Vice President, Transportation and Logistics, Ascena Retail Group; and David Meyers, Vice President of Sales, United Delivery Service; (2) "New Directions in Civil and Environmental Engineering at Northwestern," by Kimberly Gray, Chair, Department of Civil and Environmental Engineering, Northwestern Engineering; (3) "Future Scenarios for Our Nation's Transportation Infrastructure" by Joseph L. Schofer, Associate Dean for Faculty Affairs, Northwestern Engineering; (4) "Panama Canal: Expansion Status and Future Impact," by Oscar E. Bazán, Canal de Panamá; (5) Global and Domestic Trade Impacts of Panama and Suez Canal Expansions, a panel discussion moderated by Zubrod and featuring Bazán; Dick Craig, President & CEO, MOL (America), Inc.; Jeremy Haycock, Chief Marketing Officer, Direct ChassisLink, Inc. (DCLI); Steven Rothberg, Founding Partner, Mercator International.



Photos clockwise from top left: Sunil Chopra; Kimberly Gray; Panel members (left to right) David Meyers, Patrick Allard and Rick Byrnes; Joseph Schofer

## Events Lectures

“Are we just in one of the good times and more bad times will come? No, I believe things are different this time.”  
—Doug Parker, American Airlines CEO, April 2015 Patterson Lecture

34<sup>th</sup>

PATTERSON  
TRANSPORTATION  
LECTURE

### Doug Parker Provides Insights on Airline Business

Since forming in 1930, American Airlines has experienced many highs and lows. Highlights include lower fuel prices and higher profits in the 1990s. Grave setbacks include financial struggles after September 11, 2001 and, again, during the recession in 2008. The airline giant



rebounded in 2015 amid strong stocks and the highest profits in company history.

A lengthy transition period followed the Federal deregulation of the airline industry starting in 1978. Today, American Airlines is still in transition but, according to Parker, the end is in sight.

“Things are different now,” Parker explained, “because we are no longer being treated like a public utility. Now, we can operate like a real business. We’ve transformed American Airlines, and our goal was to restore it to the greatest airline in the world.”

In 2013, a merger between American Airlines and US Airways formed the world’s largest airline company. Parker oversaw the integration of operations at more than 100 airports, as well as the merging of staffs and the effort to combine American’s frequent flier program with the US Airways program. He said the key to successful mergers is to “integrate then innovate.” Now that the companies are successfully combined, Parker said they can focus on improving programs and services. American Airlines is adding 85 new airplanes per year to replace older ones and recently established a \$2 billion product improvement plan, which will include Wi-Fi on more planes and more comfortable seats on international flights.

While business is booming for American Airlines, Parker said one major challenge remains. Middle East based airlines are

“Things are different now, because we are no longer being treated like a public utility. Now, we can operate like a real business.” —Doug Parker

rapidly expanding their services into the United States. As stated by Parker, three of these leading airlines have received more than \$40 billion in subsidies from their governments, which he called unfair because

the US government does not subsidize airlines in the same way.

“People will do things that we can’t compete with,” Parker said. “But they eventually go away because they don’t make economic sense. It might not make economic sense to fly a plane from Dubai to Houston, but the government will continue to pay for it.”

Later, an audience member asked how American can ensure safety following several high-profile potentially avoidable accidents. Parker said that it would be hard for the same scenario to take place on an American plane because no one is allowed in the cockpit alone, and pilots are encouraged to seek mental health treatment without fearing repercussions.

“I can’t say for certain that it wouldn’t happen on American Airlines,” Patterson admitted, “but we do everything possible to keep our customers safe and pilots comfortable.”



Above: Doug Parker, CEO of American Airlines, makes the case for “integrate and then innovate” as he speaks before a large audience at the 34th Annual William A. Patterson Lecture on April 20, 2015.

## Jan Brueckner Delivers 3rd Leon N. Moses Distinguished Lecture

Dr. Jan K. Brueckner, Professor of Economics at the University of California, Irvine, delivered the 3rd Leon N. Moses Distinguished Lecture in Transportation in October 2015. His lecture, “Convenient Flight Connections vs. Airport Congestion: Modeling the ‘Rolling Hub,’” addressed the trade-off between convenient flight connections and airport congestion, a fundamental but untreated element in the economics of hub-and-spoke networks.

Professor Brueckner’s observations and insights were based on a paper describing a continuous spatial model that illustrates this trade-off in a framework where a small gap between flight operating times raises

congestion while also shortening a connecting passenger’s layover time. When the passenger’s cost per unit of layover time rises, the monopoly airline chooses to narrow the gap between its flights, yielding shorter layovers but more congestion. A discrete spatial model, where flights congest one another only if they operate in the same discrete period, makes this layover-cost effect discontinuous: the monopoly carrier concentrates (deconcentrates) its flights when this cost is high (low) relative to the costs of congestion. When fringe carriers are present, however, the hub carrier always concentrates its flights, either partially or fully. But the presence of a second hub carrier leads to an equilibrium mirroring the monopoly outcome: the carriers concentrate their flights in

*(continued next page)*



## Events Lectures (continued)

### Moses Lecture (continued)

different periods when the layover cost is high and deconcentrate them otherwise. The paper also presents a welfare analysis, showing that movement from the equilibrium to the social optimum typically requires greater carrier separation.

Professor Brueckner received a BA from UC Berkeley and a PhD from Stanford University and has published over 130 scholarly articles dealing with a variety of topics in applied microeconomics. His early work on the airline industry provided some of the first economic analysis of hub-and-spoke networks. He has written more recently on international airline alliances, and other

recent work deals with airport congestion, airport noise, and aviation emissions, and airline bag fees.

The Leon N. Moses Distinguished Lecture in Transportation is named in honor of noted transportation economist and former Transportation Center director, Leon N. Moses, who passed away on October 12, 2013.



## Events Symposium

### William O. Lipinski Symposium on Transportation Policy and Strategy

In June 2015, the Transportation Center hosted the 7th William O. Lipinski Symposium on Transportation Policy & Strategy. The daylong Lipinski Symposium offered the 150 attendees varied perspectives for transportation and infrastructure improvements. Speakers explored such mechanisms as tolling, user fees, and public-private partnerships as a means for Chicago and the nation to remain economically competitive on a global scale.

“Everybody knows a bridge that needs to be fixed, we all know a road that needs to be fixed.” —Ray LaHood

For Ray LaHood, former U.S. Secretary of Transportation, there was no sugarcoating the nation’s current transportation realities. “We’re in a crisis, and the transportation program in this country is on life support,” LaHood told his audience in a presentation formally titled, “Paths to Economic

Competitiveness: Advancing Supply Chain Performance in the Chicago Hub.”

LaHood drew attention to roads and bridges nationwide that continue to deteriorate amid consistent federal inaction for infrastructure maintenance. He stressed to audience members that a “big pot of money,” is a necessary remedy for the nation’s transportation woes. LaHood also called for legislators to raise the nation’s gas tax by 10 cents per gallon and index the increase to our cost of living.

“Everybody knows a bridge that needs to be fixed, we all know a road that needs to be fixed,” LaHood said. “At some point, legislators have to come to terms with the fact that the infrastructure is falling apart.

**A PUSH FOR ADVOCACY** As the United States has slid from the global leader in infrastructure to now the 28th rated nation, LaHood urged attendees to become advocates and to push policy makers for funding.

“We’re all in this together,” he said, adding that a federal investment in infrastructure represented an investment in the nation and its people. “It’s a win for America.”



Above: Gathered at the 2015 Lipinski Symposium for a photo: left to right: Bret Johnson, the Honorable William O. Lipinski, Ray LaHood – former US Secretary of Transportation, Hani Mahmassani, and Joseph Schofer.



Above: A luncheon for guests and those attending the Lipinski Symposium was the setting for the presentation of the David F. Schulz Award for Outstanding Public Service in Transportation and Infrastructure. Above right: Joseph Schofer presents the 2015 award to Ann Drake, Chairman and CEO, DSC Logistics. The annual Schulz award is named in honor of the late David F. Schulz (1949 – 2007), the founding executive director of Northwestern University's Infrastructure Technology Institute. The award recognizes individuals for technical or legislative innovation or public policy leadership in the fields of transportation or infrastructure.

LaHood's was a message repeated throughout the day, as speakers called attendees to be advocates for the pressing needs and necessary improvements of transportation infrastructure.

Meanwhile, U.S. Congressman Daniel Lipinski, son of the Lipinski Symposium namesake, provided a look into the present

state of transportation issues in the nation's capital. Lipinski, who serves on the Transportation Committee, reported increased interest among Congressional members to provide transportation solutions. He also acknowledged that "raising the revenue" remains a significant barrier to change.

*(continued next page)*

## Events Symposium (continued)

### Lipinski Symposium (continued)

“To get this done politically, you need to continue pushing this as a political issue,” Lipinski told the crowd.

To sell the value of freight and transit to the nation and its governmental leaders, Joseph Schofer urged attendees to champion outcomes, quality of life and the potential consequences of losing access to the transportation services so many of us take for granted.

“These are the things we have to work on together,” said Schofer, Professor of Civil and Environmental Engineering and Associate Dean, McCormick School of Engineering and Applied Science.

**LOOKING TO THE FUTURE** As other nations invest in infrastructure development, opening new airports, roadways and high-speed rail, the United States risks falling “further and further behind,” said Chicago Transit Authority president Dorval Carter, who was the former chief of staff for U.S. Department of Transportation Secretary Anthony Foxx.

“This is about remaining economically competitive,” Carter said, labeling transportation “not a geographic issue, but a national issue.”

Though conversations around funding tend to be less collegial, Lipinski expressed hope that the federal government would soon act and, in particular, become more involved in transportation research.

“That could accelerate the pace [of solutions],” said Lipinski.

As major technology companies like Google, Uber and Amazon continue to see opportunities for innovation in the transportation, mobility and logistics sectors, potentially disruptive technologies and service concepts may be on the horizon, notwithstanding continued federal inaction. Illinois Department of

Transportation Secretary Randy Blakenhorn said using public money to leverage private investment could create broader opportunities for public-private partnerships and spur more reliable and sustainable funding options for infrastructure improvements, which he considers necessary to the nation’s global standing.

“The boom-and-bust cycle to infrastructure improvements needs to stop,” said Blakenhorn. “This is our economy, our livelihood.”

**DSC LOGISTICS CEO HONORED WITH DAVID F. SCHULZ AWARD** DSC Logistics chairman and CEO Ann M. Drake received the David F. Schultz Award for Outstanding Public Service in Transportation and Infrastructure during the June 2015 symposium.



Since becoming DSC’s CEO in 1994, Drake has transformed her local family business into a national name and emerged a leading advocate for the logistics industry as well as a powerful force for women’s development in the supply chain field.

Most notably, Drake founded AWESOME (Achieving Women’s Excellence in Supply Chain Operations, Management, and Education). In just three years, the organization has grown to include nearly 600 female industry professionals, an annual symposium, and source for female student scholarships. To learn more about AWESOME and the organization’s mission, visit: [awesomeleaders.org/about/about-awesome](http://awesomeleaders.org/about/about-awesome)

**The William O. Lipinski Symposium on Transportation Policy & Strategy is a working conference that explores transportation and infrastructure problems facing the nation today and discusses new ways to plan, manage, and finance solutions for the 21st Century.**

# Events Workshops

## Unmanned Aerial Vehicles: Applications and Emergent Technologies

### Will Technology Outpace Regulatory Hurdles?

On April 20, 2015, the Northwestern University Transportation Center and the Center for the Commercialization of Innovative Transportation Technology presented *Unmanned Aerial Vehicles: Applications and Emergent Technologies*. This industry technical workshop, which was co-chaired by Hani Mahmassani and Breton Johnson, brought to light the current and future potential of unmanned aerial vehicles (UAVs), commonly known as “drones.” Speakers provided insight into infrastructure monitoring and inspection, package and cargo delivery, the evolution of the UAV market, and policy developments.



The workshop opened with Michael Drobac, Executive Director of the Small UAV Coalition, a partnership between UAV manufacturers such as DJI and client developers like Amazon Prime Air and Google X. Drobac outlined current issues surrounding commercial use of UAVs—firstly, that as of June 2015 it remains illegal to use drones for commercial purposes, but also that exemptions and the potential for bipartisan agreement on federal legislation are pushing the potential commercialization of UAV technology forward. Final rules for the commercial use of small UAVs are expected sometime in 2016 or 2017. Drobac’s feeling on whether or not licensing will eventually be granted, however, was unambiguous: “Technology always wins,” he

explained, adding that because the technology is already out there, it is only a matter of time before they reach common usage.

The second speaker of the day was Captain Joe Burns, CEO of Sensurion Aerospace. Burns highlighted the burgeoning Unmanned Aerial Systems (UAS) market, noting that it grosses between \$6 billion and \$14 billion annually worldwide, a number expected to jump to \$80 billion by 2025. Applications he cited included logistics delivery, noninvasive exploration in the energy industry, airborne video for the film industry and news media, and for training at flight schools and within the FAA. UAVs, in turn, are leading to the development of complementary technologies and support industries, such as sensors for toxic chemical, flammable gas, radioactive material detection.

Sean McCann, CEO of MMIST, provided the concluding speaker remarks. MMIST’s mission since 2000 has been aimed at developing safe and effective aerial transportation systems capable of delivering critical supplies when ground-based transportation is ineffective or impossible, particularly for military applications. From this experience, McCann envisions great potential for UAVs to deliver cargo. Thinking of the bigger picture, McCann is confident that UAVs will spur a new era of creativity and innovation in the air transportation industry.

Johnson moderated a question and session with the Workshop audience and panelists Drobac, Burns, McCann, and Mahmassani. The ensuing discussion foreshadowed a future of the UAS industry where “technology wins.”



Spring 2015  
INDUSTRY  
WORKSHOP

Fall 2015  
INDUSTRY  
WORKSHOP

### The Internet of Things in Transportation and Logistics

*The more we connect, the more we integrate data, the greater the potential for impact.*

Held in conjunction with the Fall 2015 meeting of the NUTC Business Advisory Council (BAC), NUTC hosted three industry speakers to discuss the Internet of Things in transportation and logistics. IoT describes a network of physical and mobile objects or “things” embedded with electronics, software, sensors, and network connectivity. In a transportation system, dynamic interaction between these “things” could enable vehicular communication, smart traffic control, logistics and fleet management and optimization, intelligent



port operations, vehicle control, and energy, maintenance and safety management, among others. But to what extent are IoT strategies infiltrating these many applications? NUTC’s Fall 2015 Industry Workshop aimed to answer that question.

At the workshop, Hani Mahmassani asked: “What is the Internet of Things and why should we care?” We should care, Mahmassani suggested, because the connected logistics and manufacturing—factories, inventories, distribution centers, components, packages, vehicles, drivers, dispatchers and customers—provide a more complete view of the entire system; allow better integration of production, inventory, distribution processes and decisions; and enable further management insights through enhanced business intelligence and value-enhancing analytics. Then, he pointed out that although IoT was missing from Gartner’s “Hype Cycle for

Emerging Technologies” in 2013, it is rising rapidly on the 2015 edition of the hype cycle chart toward “the peak of inflated expectations.”

Three industry speakers—Sunny Bajaj, Director, Telecom Engineering, Transport and Infrastructure, BNSF Railway, Kyle Connor, Business Development Manager, Transportation Cisco Systems, Inc., and Darryn Faulkner, Vice President, Latin America, Navman Wireless—presented IoT case studies in rail, port operations, and truck fleet management. Mr. Bajaj addressed big data and big data analytics opportunities emerging from connected things throughout the rail network, such predictive assessment of rolling stock and infrastructure condition. Mr. Connor described a “digital transportation” system providing improved safety, mobility, and efficiency for the operators and users. Mr. Faulkner posed another question: the data is talking, are you ready to listen to it?

While the applications described were unique, several common themes emerged. The onslaught of structured and unstructured data is real, and finding ways to manage the integration of these two data streams is essential. Also, small percentage gains in operational metrics can have large overall impacts on system performance. And perhaps most critically, customer expectations are changing, driven by data, thus improving the customer experience remain a critical priority.

Bret Johnson, NUTC associate director, moderated the Workshop.



Answering questions during the workshop (left to right): Darryn Faulkner, Kyle Connor, Steve Matthews, Sunny Bajaj and Hani Mahmassani.

## Illinois Transportation Secretary Blankenhorn Visits NUTC

Illinois Department of Transportation (IDOT) Secretary Randall (Randy) Blankenhorn spoke to more than 50 students and faculty about the Future of Transportation in Illinois. Blankenhorn indicated that he would like IDOT to move beyond managing “yesterday’s transportation system,” toward building a system that meets future needs for moving goods and people and works every day. To achieve this goal, he addressed the Department’s need to attract new talent to IDOT, including students with skills in computer science as well as traditional skills such as civil engineering.

During his visit, the Secretary met with NUTC Director Hani Mahmassani, Associate Director Bret Johnson, and Associate Dean of Northwestern Engineering, Joseph Schofer and discussed opportunities for future collaboration, notably in the area of connected and autonomous vehicles.



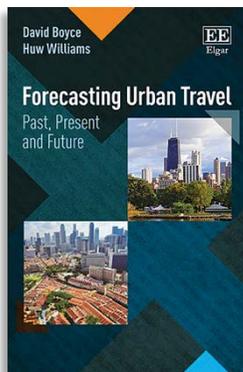
## David E. Boyce Book Launch

On October 22, 2015, the Transportation Center and the Northwestern University Transportation Library jointly hosted an event that celebrated the launch of a new book by NUTC Adjunct Professor David E. Boyce and Professor Emeritus Huw C.W.L. Williams.

*Forecasting Urban Travel: Past, Present and Future* is described by the publisher as presenting “a non-mathematical way the evolution of methods, models and theories underpinning travel forecasts and policy analysis, from the early urban transportation studies of the 1950s to current applications throughout the urbanized world.” The book is a true tour de force, the result of over a decade of meticulous research largely conducted through the Transportation

Library’s unique collections of original documents, and a transatlantic collaboration that provides an insightful comparative description of the field’s development in North America and Europe.

Following a presentation by the authors, explaining the inspiration for the book, its origins and major themes, and the approach followed while developing contents, the event featured a panel discussion that included distinguished transportation scholars Professor Anna Nagurney, Director of the Virtual Center on Supernetworks at the University of Massachusetts, Amherst, Professor Ram Pendyala, the Dickerson Chaired Professor of Transportation at the Georgia Institute of Technology and Dr. Kermit Wies, Former Deputy Executive Director for the Chicago Metropolitan Agency for Planning.



## Events Special (continued)

### NUTC Sandhouse Rail Group Co-Hosts Amtrak's Blue Ribbon Panel

Amtrak's Blue Ribbon Panel formed to examine recurring rail gridlock in Chicago reported its findings at a special meeting co-hosted by Amtrak, the Northwestern University Sandhouse Rail Group and the DePaul Chaddick Institute on October 1, 2015. The Panel recommended co-located train dispatchers, improved operating practices and capital improvement projects to help relieve rail gridlock in and around Chicago.

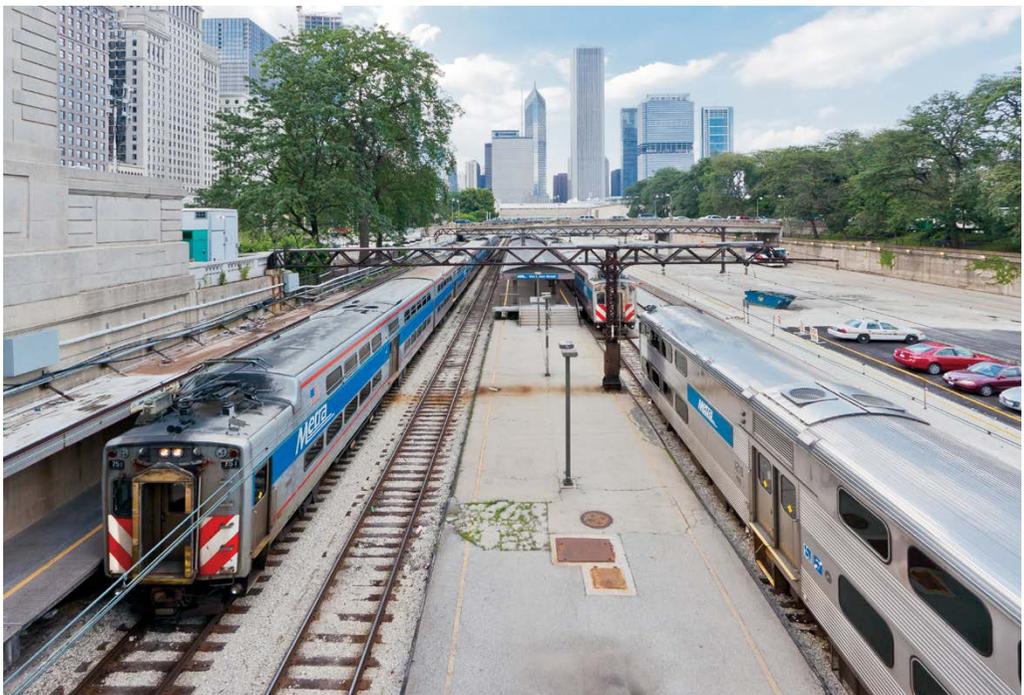


One of primary proposals called for each of the six major freight railroads and two passenger systems to work together in a central, unified control center, much as competing airlines do at airports. Amtrak officials offered to provide space for a dispatching facility at Union Station (which Amtrak owns) in order to bring all the rail dispatchers together.

The panel also advocated funding for several long-delayed rail modernization projects. In particular, they stressed the need for the 75th Street Improvement Project, which would eliminate the conflicts at three rail junctions, as well as a rail-roadway crossing, by building two flyover structures and laying nearly 30 miles of new track and bridges.

In summary per Amtrak President and CEO Joe Boardman, "The implications of failing to act are dire for the economy of the nation in general and the Chicago area in particular."

Photo at left (left to right): Joseph Boardman, Amtrak President & CEO; Panel Member, Howard Learner, Executive Director, Environmental Law & Policy Center; Thomas Carper, Amtrak Chairman



The NUTC Seminar Series allows students, faculty, and the community to learn from the real-world experiences of seasoned industry professionals and researchers in the field.

Date	Title/Presenter
January 8, 2015	<i>What Can Choice Modelling Learn from Behavioral Economics and Does it Matter</i> <b>Stephane Hess</b> , Professor of Choice Modelling, Institute for Transport Studies, University of Leeds
January 19, 2015	<i>Special TC Seminar The MLK Legacy and Human Rights in Chile</i> and... "Optimal Pricing for Travelcards under Income and Car Ownership Inequities" <b>Sergio Jara-Diaz</b> , Professor, Universidad de Chile
January 22, 2015	<i>Flexible Transit for Low-Density Communities</i> <b>Charlotte Frei</b> , PhD Candidate, Transportation Systems Analysis & Planning, Civil & Environmental Engineering, Northwestern University
January 27, 2015	<i>Developing an Integrated Transportation Infrastructure Decision Support Platform: Focusing on Big and Open Data Visualization</i> <b>Meead Saberi</b> , Lecturer (Assistant Professor), Monash University
January 29, 2015	<i>An Efficient Data-driven approach to Static and Dynamic Ambulance Location for Emergency Medical Services</i> <b>Lavanya Marla</b> , Assistant Professor, Industrial and Enterprise Systems Engineering, University of Illinois at Urbana Champaign
Feb. 19, 2015	<i>Microscopic Simulation and Safety Analysis of Roundabouts</i> <b>N. Nezamuddin</b> , Assistant Professor of Civil Engineering, College of Engineering, Valparaiso University
February 26, 2015	<i>Joint TC Seminar &amp; Sandhouse Rail Meeting: Potholes or Tolls? Perspectives on Transportation Finance</i> <b>Joseph Schofer</b> , Professor of Civil Engineering & Transportation; Associate Dean, Robert R. McCormick School of Engineering and Applied Science, Northwestern University
March 5, 2015	<i>Tactical Network Planning for Food Aid Distribution in Kenya</i> <b>Marie-Eve Rancourt</b> , Assistant Professor of Management & Technology, Business School of the University of Quebec at Montreal
April 2, 2015	<i>Modeling Driver Behavior in a Connected Environment: Integration of Microscopic Traffic Simulation and Telecommunication Systems</i> <b>Alireza Talebpour</b> , PhD Candidate, Civil & Environmental Engineering, Northwestern University
April 23, 2015	<i>The Impact of Activities while Traveling on the Subjective Valuation of Travel Time</i> <b>Patricia Lyon Mokhtarian</b> , Professor, School of Civil & Environmental Engineering, Georgia Institute of Technology
April 23, 2015	<i>Place Perception, Attractiveness, Meaning and Relationship to Activity &amp; Travel: Three case studies of different scales from Sana Barbara, CA</i> <b>Konstadinos G. Goulias</b> , Professor of Transportation, Geography Department, University of California, Santa Barbara
May 7, 2015	<i>Uncertainty in Hazardous Materials Transportation</i> <b>Changhyun Kwon</b> , Assistant Professor, Industrial & Systems Engineering, University at Buffalo, SUNY
May 14, 2015	<i>Green Urban Freight Strategies in the New Mobility Era</i> <b>Jie (Jane) Lin</b> , Associate Professor, Civil & Materials Engineering; Research Associate Professor, Institute for Environmental Science & Policy, University of Illinois at Chicago
May 28, 2015	<i>Connected Cars – Lifestyle Delivery</i> <b>Sanja Irwin</b> , Head of Systems & Applications, Chief Technology Office, Nokia Networks
Oct. 1, 2015	<i>The Digitally Connected Commuter: Is Growing Reliance on Personal Electronic Devices Increasing the Demand for Public Transit?</i> <b>Joseph P. Schwieterman</b> , Professor and Director, Chaddick Institute for Metropolitan Development, DePaul University
Oct. 8, 2015	<i>Estimation of Airline Itinerary Choice Models Using Disaggregate Ticket Data</i> <b>Laurie Garrow</b> , Associate Professor of Transportation Systems Engineering, Georgia Institute of Technology
Oct. 15, 2015	<i>The Neglected Impact of Measurement Error on Disaggregate Transportation Demand Models</i> <b>David Brownstone</b> , Professor of Economics, Institute of Transportation Studies, University of California, Irvine

(continued next page)

## Events 2015 Seminar Series (continued)

Date	Title/Presenter
October 22, 2015	<b>Special Event: Symposium and Book Launch <i>Forecasting Urban Travel: Past, Present and Future</i></b> New Book by <b>David Boyce</b> , Professor Emeritus of Transportation and Regional Science, University of Illinois at Chicago, and <b>Huw Williams</b> , Emeritus Professor of Transport and Spatial Analysis, Cardiff University
November 5, 2015	<b>How to Fundraise for Operational Expenditures in International Humanitarian Aid</b> <b>Maria Besiou</b> , Associate Professor of Humanitarian Logistics, Kühne Logistics University, Hamburg, Germany
November 12, 2015	<b>Joint Sandhouse Group &amp; TC Seminar <i>The Business Case for Higher Speed Freight Trains</i></b> <b>David Burns</b> , Railroad Industrial Engineering Consultant
December 3, 2015	<b><i>The END of Traffic; the FUTURE of Transport; the ROLE of Cycling</i></b> <b>Kevin J. Krizek</b> , Professor and Director, Program in Environmental Design, University of Colorado Boulder; Visiting Professor, Nijmegen School of Management, Radboud University, (the Netherlands)

**THE HAGESTAD SANDHOUSE RAIL GROUP** is a railroad discussion group that aims to explore rail-related issues and link active practitioners with students and academics at Northwestern.

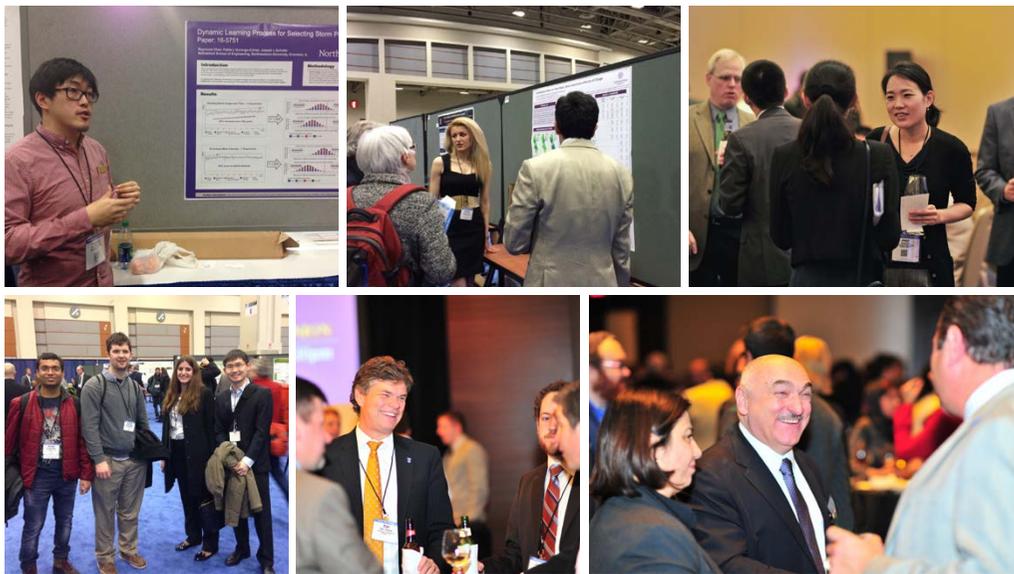
Date	Title/Presenter
January 22, 2015	<b>Metra and Create: Making a Difference in Chicago</b> <b>Donald A. Orseno</b> , Executive Director, Metra <b>Bill Thompson</b> , Program Manager, CREATE
April 16, 2015	<b>Civil War Railroads</b> <b>John (Jack) Barriger</b> , Trustee, John W. Barriger III National Railroad Library
May 7, 2015	<b>Market Development – Pre &amp; Post Staggers</b> <b>Gene Harmon</b> , CEO (Retired), Speedlink Corp.
June 25, 2015	<b>Restricting Signals Ahead</b> <b>Ed Ellis</b> , President, Iowa Pacific Holdings
September 16, 2015	<b>British Railway Study Association Special Program:</b> <ul style="list-style-type: none"> <li>• <i>How Much Competition Do You Need: Taking Stock of the UK Rail Situation in 2015</i></li> <li>• <i>Railroad Safety in the United States</i></li> <li>• <i>The Expansion of Intercity Bus Service in the US and the Changing Dynamics of Bus/Rail Competition</i></li> </ul> <b>Michael Holden</b> , President, Railway Study Association <b>Ian Savage</b> , Professor of Instruction, Northwestern University <b>Joseph Schwieterman</b> , Director, Chaddick Institute for Metropolitan Development, DePaul University
Oct. 1, 2015	<b>Special Sandhouse Event at DePaul University</b> Amtrak <i>Blue Ribbon Panel</i> presents findings on <i>Rail Congestion in the Chicago Area – Panel appointed by Amtrak President &amp; CEO, Joseph Boardman</i>
November 12, 2015	<b><i>The Business Case for Higher Speed Freight Trains</i></b> <b>David Burns</b> , Railroad Industrial Engineering Consultant
December 9, 2015	<b>Sandhouse Rail Group Luncheon <i>Railroad Renaissance: Dead or Alive? (or, is this the only Christmas we'll miss our lump of coal?)</i></b> <b>Anthony B. Hatch</b> , Senior Transportation Analyst & Financial Consultant, ABH Consulting



## Annual Transportation Research Board Meetings & Reception

Each year in mid-January, transportation professionals from across the country converge in Washington DC to attend the Transportation Research Board (TRB) annual meetings. In 2015, more than 35 NUTC faculty and students were in attendance—as organizers and session chairs, leading panel discussions, conducting workshops, presenting papers and participating in poster presentations on a variety of transportation research-related topics.

NUTC hosted its Annual TRB Reception and Alumni Reunion at the Marriott Marquis Washington Hotel on Sunday, January 11th. The event attracted over 500 guests from the expansive NUTC network of alumni and transportation professionals from industry, academia and government sectors. This NUTC-hosted event is highly regarded by friends, alums and colleagues as a not-to-be-missed event.

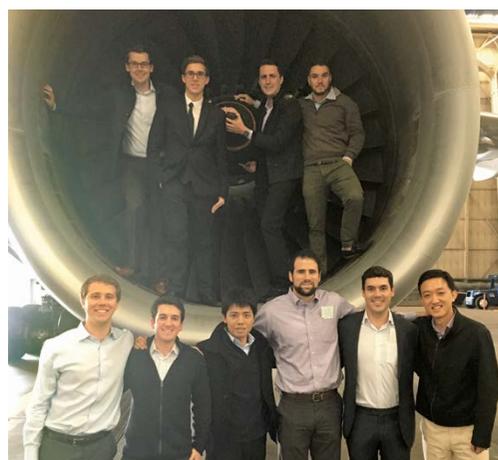


## Events Community

Beyond its world-class research and education, the Transportation Center is first and foremost about community—a community of students and faculty, of researchers and dedicated staff, loyal alums, industry partners and transportation professionals. Each year, the NUTC fosters this community by means of networking events, speaker forums, clubs, and social gatherings.

### Kellogg Transportation Club

Throughout the year, the Kellogg Transportation Club works to raise student awareness of exciting opportunities in transportation. The Club officers—MBA students in the Kellogg School of Management—organize field trips, host industry speakers, promote job opportunities in the field and encourage networking with students and faculty across the University with interests in transportation.



## Events Community (continued)

### NUTC Welcome Reception

In September 2015, NUTC hosted its annual Welcome Back Reception at Northwestern University's Stadium Club at Ryan Field. This impressive venue, which overlooks the university's football field, provided a perfect backdrop for new and continuing students, faculty and staff to network, get to know

each other and foster the bonds that would carry them through the coming school year.

As always, the NUTC continues to attract students from around the world. This year we welcomed new students from Brazil, Serbia, Iran, China, Morocco, Thailand, and across the United States.



### End of Year BBQ

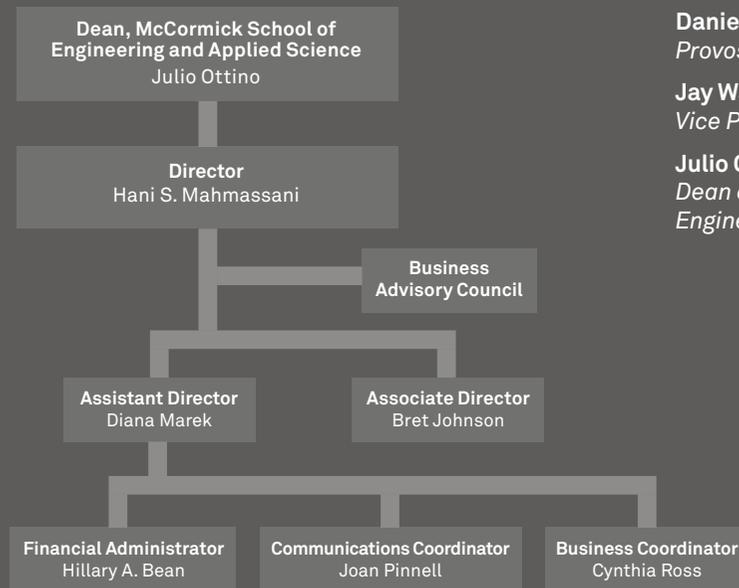
In June 2015, the NUTC hosted its annual End of Year BBQ/picnic on the lawn behind Chambers Hall. Always well attended by students, faculty and colleagues from around the University, the event also attracts alums staying connected and many friends and colleagues from our broad transportation community.



### Snapshots from PhD Farewell Luncheon



# Northwestern University Transportation Center Organization



## Northwestern University Administrative Officers

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*Vice President of Research*

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*Dean of McCormick School of Engineering and Applied Science*

## Staff



**Hani S. Mahmassani**  
Director  
masmah@northwestern.edu  
TEL: 847-491-2282



**Breton Johnson**  
Associate Director  
bretj@northwestern.edu  
TEL: 847-491-2194



**Diana Marek**  
Assistant Director  
d-marek@northwestern.edu  
TEL: 847-491-2280



**Hillary A. Bean**  
Financial Administrator  
h-bean@northwestern.edu  
TEL: 847-491-2275



**Joan Pinnell**  
Communications Coordinator  
joan.pinnell@northwestern.edu  
TEL: 847-491-2787



**Cynthia Ross**  
Business Coordinator  
cynthia.ross@northwestern.edu  
TEL: 847-491-2276

## Progress Report Production

**Managing Editor**  
Hani Mahmassani

**Editors**  
Bret Johnson  
Diana Marek  
Joan Pinnell  
Robert A. Reddy

**Designer**  
Robert A. Reddy

**Writers**

Raymond Chan	Joan Pinnell
Wei Chen	Robert A. Reddy
James G. Conley	Kathryn J. Reid
Brendan Diamond	Mohanbir S. Sawhney
Irina Dolinskaya	Joseph L. Schofer
Pablo Durango-Cohen	James Schummer
Bret Johnson	Karen R. Smilowitz
Diego Klabjan	Amanda Stathopoulos
Hani S. Mahmassani	Timothy Sweda
Diana Marek	Fred W. Turek
Yu (Marco) Nie	Phyllis C. Zee

## Contact Information

### Northwestern University Transportation Center

600 Foster Street | Evanston, Illinois 60208

847.491.7287 | tcinfo@northwestern.edu

transportation.northwestern.edu



# Northwestern University

## Northwestern University Transportation Center

600 Foster Street | Evanston, Illinois 60208

847.491.7287 | [tcinfo@northwestern.edu](mailto:tcinfo@northwestern.edu)

[transportation.northwestern.edu](http://transportation.northwestern.edu)