

INTERNATIONAL CONFERENCE ON Transportation and Development 2019

Smarter and
Safer Mobility
and Cities

Papers from Sessions of the International Conference
on Transportation and Development 2019

Alexandria, Virginia | June 9–12, 2019

ASCE

EDITED BY

This is a preview. [Click here to purchase the full publication.](#)



TRANSPORTATION
& DEVELOPMENT
INSTITUTE

INTERNATIONAL CONFERENCE ON TRANSPORTATION AND DEVELOPMENT 2019

SMARTER AND SAFER MOBILITY AND CITIES

SELECTED PAPERS FROM THE INTERNATIONAL CONFERENCE ON
TRANSPORTATION AND DEVELOPMENT 2019

June 9–12, 2019
Alexandria, Virginia

SPONSORED BY
The Transportation & Development Institute
of the American Society of Civil Engineers

EDITED BY
David A. Noyce, Ph.D., P.E.

ASCE



TRANSPORTATION
& DEVELOPMENT
INSTITUTE

Published by the American Society of Civil Engineers

This is a preview. [Click here to purchase the full publication.](#)

Published by American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia, 20191-4382
www.asce.org/publications | ascelibrary.org

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefor. The information contained in these materials should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing such information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

Photocopies and permissions. Permission to photocopy or reproduce material from ASCE publications can be requested by sending an e-mail to permissions@asce.org or by locating a title in ASCE's Civil Engineering Database (<http://cedb.asce.org>) or ASCE Library (<http://ascelibrary.org>) and using the “Permissions” link.

Errata: Errata, if any, can be found at <https://doi.org/10.1061/9780784482575>

Copyright © 2019 by the American Society of Civil Engineers.
All Rights Reserved.
ISBN 978-0-7844-8257-5 (PDF)
Manufactured in the United States of America.

This is a preview. [Click here to purchase the full publication.](#)

Preface

It is my great pleasure to welcome you to the ASCE International Conference on Transportation and Development (ICTD 2019) organized by the Transportation and Development Institute (T&DI)! ICTD is ASCE's flagship conference in transportation and development. The conference theme, *Engineering Smart Mobility for the Smart City*, represents our vision for exploring how society will adapt to transportation engineering and development challenges facing the cities today and tomorrow. We hope you join your peers and other leading practitioners, planners, researchers, and policy makers as they discuss innovative and necessary solutions to these needs and how our cities must appropriately adapt over three days of activities, June 9 through June 12, 2019, at the Hilton Alexandria Mark Center in Alexandria, Virginia.

Alexandria is a vibrant city on the Potomac River, just south of Washington, DC. It's known for its Old Town, with brick sidewalks and well-preserved 18th- and 19th-century buildings. A quick metro, transit, or vehicle ride opens you to all the wonders of Washington, D.C. The D.C. metro area, and the planned conference tours, offers many unique real-world examples for transportation and development professionals to feel, think, and learn about smart mobility and smart cities.

ASCE ICTD 2019's three days of technical programs features five plenary sessions which includes national leaders from ASCE, T&DI, government agencies, and private industry discussing core conference themes:

- Imagining and creating our future world & Understanding and harnessing smart mobility and smart cities.
- Disruptive technologies: powerful enablers for policymakers and operating agencies.
- Smart cities, now!
- Smart mobility, now!
- Unmanned traffic management and the future of unmanned systems in urban space

You will also hear from the conference chair and co-chairs who have spent countless hours preparing and outstanding ICTD 2019.

The program also covers deeper technical content on multiple topics and modes in transportation and development through eight (8) concurrent tracks. In addition to the podium speakers, poster sessions will provide the opportunity for attendees to learn about cutting edge research in smart cities and smart mobility and have the opportunity to speak directly with the authors. The program also includes a variety of special events such as the Younger Members' sessions on "The Best Advice I Ever Received" and "3-Minute Pitch Competition, along with a wonderful icebreaker reception and T&DI's annual Awards Banquet.

On Sunday, June 9, the conference is preceded with seven (7) workshops on the following topics:

- Truck Platooning Impacts on Infrastructure, Energy, and Environment
- Ethical Challenges of Disruptive Technologies
- How 5G Will Transform Society and Enable Smart Cities
- University Transportation Centers' (UTC) Smart City Activities
- National Science Foundation (NSF) Research
- Security in 'Smart' Applications—How to Outsmart the Hackers
- Integrating Transportation with Land Use and Development

All these workshops are carefully designed to enhance the experience of participants and provide the opportunity to earn PDHs.

The conference concludes by providing two technical tours, one at FHWA's Turner-Fairbanks facility, and one at the Reagan National Airport.

Last but not the least, conference attendees get the opportunity to attend over 15 technical committee meetings of ASCE, covering all areas of transportation and development.

ASCE ICTD 2019 has followed the great success of ICTD 2018 and attracted significant interest indicated by the rich technical program. A total of 62 papers were accepted for publication in the proceedings. Please be aware that each paper went through a rigorous peer review by at least three technical experts and a quality assurance process before becoming a publication of ASCE – the world's largest publisher of Civil Engineering content. The proceedings for this conference have been organized into two (2) volumes based on the topical distribution as follows:

- Volume I: Transportation & Development 2019 – Smarter and Safer Mobility and Cities
- Volume II: Transportation & Development 2019 – Innovation and Sustainability in Smart Mobility and Smart Cities

All these accomplishments are due to the incredible efforts of the ICTD 2019 Conference Chair, Walter Kulyk, Conference Co-Chair, Eva Lerner-Lam, the Conference Steering Committee, and the terrific support from ASCE T&DI staff. I would also like to express my sincere gratitude to all the authors and conference participants for their contributions. I am grateful to all paper reviewers for their outstanding volunteer efforts. Finally, special thanks goes to the entire Conference Steering Committee, T&DI technical committee volunteers, ASCE T&DI staff members, sponsors, exhibitors, invited speakers, and session chairs for their hard work and great efforts to help lead the development of ASCE ICTD 2019!

Our unique integration of private, government, and academic leaders makes the ASCE ICTD event series an excellent platform for information exchange, experience sharing, and professional networking. I hope ASCE ICTD 2019 will be another wonderful and rewarding experience, and I sincerely hope that ASCE ICTD becomes a 'can't miss' conference in each year that follows. On behalf of the conference leadership, organizing committee, and ASCE T&DI, I wish you a very pleasant stay in Alexandria!

ASCE ICTD 2019 Co-Chair & Proceedings Editor



A handwritten signature in black ink that reads "David A. Noyce". The signature is written in a cursive, flowing style.

David A. Noyce, Ph.D., P.E., F.ASCE
University of Wisconsin-Madison

Acknowledgements

Conference Steering Committee

Walter Kulyk, P.E., M.ASCE, Retd (Conference Chair)
Federal Transit Administration

Eva Lerner-Lam, P.E., F.ASCE (Conference Co-Chair)
Palisades Consulting Group

David A. Noyce, Ph.D., P.E., F.ASCE (Conference Co-Chair & Proceedings Editor)
University of Wisconsin-Madison

Yinhai Wang, Ph.D., M.ASCE (T&DI President)
University of Washington

Diniece Mendes, EIT, A.M.ASCE (Track Chair, Infrastructure Systems)
New York City Department of Transportation

Robert Bryson, P.E., M.ASCE Retd. (Track Chair, Traffic Operations, Transportation Safety)
City of Milwaukee

Jessie Jones, P.E., M.ASCE (Track Chair, Planning & Development)Arkansas Department of
Transportation

Walt Kulyk, P.E., M.ASCE, Retd. (Track Chair, Rail & Public Transit)
Federal Transit Administration

Rich Thuma, P.E., M.ASCE (Track Chair, Aviation Planning and Operations)
Crawford, Murphy & Tilly

Zhanmin Zhang, Ph.D., M.ASCE (Track Chair, Challenges and Opportunities for Emerging
Technologies, CAV Impacts)
University of Texas at Austin

Norelis Florentino, P.E., PMP, M.ASCE (Local Organizing Committee Chair)
Shrewsberry

Cong Chen, M.ASCE (Student & Younger Member Activities)
University of South Florida

T&DI Staff

Muhammad Amer, M.ASCE
Director, Transportation & Development Institute (T&DI) of ASCE

Debi Denney
Senior Manager, Transportation & Development Institute (T&DI) of ASCE

Rachel Hobbs, CMP
Administrator, Transportation & Development Institute (T&DI) of ASCE

Neal Sweeney
Coordinator, Transportation & Development Institute (T&DI) of ASCE

Donna Dickert
Senior Manager / Acquisitions Editor, ASCE Books

Sean Scully
Senior Manager, Exhibit & Sponsorship Sales, ASCE

Contents

Data Analytics in Intersection Operations and Safety

Efficient Left Turn Movements at Signalized Intersections by Applying Floating Car Data (FCD) Technology1
Nasima F. Bhuiyan

Exploring the Safety Effects of Adaptive Signal Control Systems8
Weimin Jin, Sakib Mahmud Khan, and Mashrur Chowdhury

Evaluating the Pedestrian Hybrid Beacon's Effectiveness: A Case Study in New Jersey.....19
C. Campbell, M. Mosely, B. Mulvihill, and M. Jalayer

CAV Safety

Predicting the Effect of Connected Vehicles on Safety near Traffic Incidents on Freeways.....30
S. Moradi Bajestani and R. N. Fries

The Crash Avoidance Effectiveness of Advanced Driver Assistance Systems in Real-World Environment41
Lishengsa Yue, Mohamed Abdel-Aty, and Yina Wu

Safety Analysis of Managed Toll Lanes Considering Connected Vehicles52
Moatz Saad, Mohamed Abdel-Aty, Jaeyoung Lee, Yina Wu, and Md. Sharikur Rahman

Transportation Safety—Crash Prediction and Assessment

A Comparison between Calibration Factors and Calibration Functions for Predicting Crashes on Freeway Speed-Change Lanes in Kansas.....62
Imalka C. Matarage and Sunanda Dissanayake

A Mixed Crash Frequency Estimation Model for Interrupted Flow Segments.....72
Seyedeh Maryam Mousavi, Hassan Marzoughi, Scott A. Parr, Brian Wolshon, and Anurag Pande

Analyzing the Safety Impacts of Raised Medians84
Marlee L. Seat, Grant G. Schultz, B. Wyatt Clegg, and Mitsuru Saito

Bivariate Ordered Modeling of Crash Injury Severity Level of Drivers and School-Age Passengers.....96
Jaeyoung Lee, Mohamed Abdel-Aty, and Qing Cai

From Traffic Analysis to Real-Time Control: A Hazard-Based Model to Estimate Post-Collision Recovery Periods	103
D. Pan, W. Zhang, and S. H. Hamdar	
Identifying High Crash Risk Highway Segments Using Jerk-Cluster Analysis.....	112
Seyedeh Maryam Mousavi, Zhao Zhang, Scott A. Parr, Anurag Pande, and Brian Wolshon	
Predicting Vulnerable Road User Crashes Based on Seasonable Pattern	124
Wei Zhang, Chenhui Liu, and Lin Xiao	
Road Traffic Fatalities Forecasts Based on Cointegration Analysis	135
Francesco Rouhana and Dima Jawad	
A Methodology for Analyzing Intersection Safety	143
Joshua D. Gibbons, Grant G. Schultz, and Mitsuru Saito	
Calibrating the Highway Safety Manual Crash Prediction Models for Urban and Suburban Intersections in Kansas	154
Rijesh Karmacharya, Sunanda Dissanayake, and Imalka C. Matarage	
<i>Human Factors in Smart Mobility Analysis</i>	
Perception of Time in Traffic Congestion and Drivers' Stress	165
Kiichiro Hatoyama, Masaya Nishioka, Muneo Kitajima, Katsuko Nakahira, and Kazushi Sano	
Response of Drivers to Variable Message Signs in Dynamic Lane Assignment Application Using Artificial Neural Networks and Other Traditional Techniques	175
Khaled J. Assi, Nedal T. Ratrouf, and Majed Al-Ghandour	
The Role of Psychology and Habit in the Choice Making Process of Car Users: The Case of Lebanon	187
Lourdes Salameh and Dima Jawad	
The Discrepancy between Actual Operating Speed and Drivers' Self-Reported Speed.....	199
Sajid Raza, Osama Abaza, Fazal R. Safi, and Arshad Hussain	
Neural Correlates of Older Driver Performance	213
Hiba Nassereddine, Madhav Chitturi, and David A. Noyce	
Investigating Driver Yielding Behavior at Roundabout Approaches	223
Beau Burdett, Ibrahim Alsgan, Madhav V. Chitturi, Andrea R. Bill, and D. A. Noyce	

Driving Simulation in Smart Mobility Analysis

**Influence of Mobile Work Zone Barriers on Driver Behavior on Freeways:
A Driving Simulator Study235**
Snehanshu Banerjee and Mansoureh Jeihani

Operational Analysis of School Zones Using a Driving Simulator.....247
Didier Valdes, Benjamin Colucci, Alberto Figueroa, Enid Colon, Maria Rojas,
Ricardo Garcia, Yindhira Taveras, Ivelisse Ramos, and Carolyn Arroyo

Modeling Traffic Flow in Smart Mobility

A Probability Bias Model of Trip Distribution258
Rae J. Furlonge

**Analyzing Modal Shift Based on Critical Travel Time for Different Trip
Purposes in Medium-Sized City269**
Yavuz Delice, Halit Özen, and Ehsan Amirnazmiafshar

**Development of a Reliable Trip Distribution Matrix Based on Sparse and
Limited Data Using Regression and ANN.....280**
Varghese George, Akash Anand, M. S. Padmashree, and Rohini Kanthi

**Impacts of Downstream Observability on the Traffic Performance within
a Tunnel.....291**
E. Beheshtitabar, M. Cetin, and G. List

**Impact of Urban Arterial Traffic LOS on the Vehicle Density of Different
Lanes of the Arterial in Proximity of an Unsignalized Intersection for
Autonomous Vehicle vs. Conventional Vehicle Environments.....303**
Seyedeh Maryam Mousavi, Osama A. Osman, and Dominique Lord

Safe and Efficient Commerical Transportation

**The Link between For-Hire Service Pick-Ups and Built Environment:
A Longitudinal Analysis315**
Jina Mahmoudi and Lei Zhang

**A Simulation Modeling Approach for Deciding the Scale of Buffer Areas
and Gate Lanes in Container Ports327**
Xinglu Xu, Wenyan Wang, Yun Peng, Tianqi Zheng, and Xiangda Li

**Estimation of Container Port Efficiency Using Data Envelopment Analysis
and Free Disposal Hull Approaches: The Case of the Caribbean337**
Anastasios Charisis, Stavroula Manta, Evangelos I. Kaisar, and Majed Al-Ghandour