SAE INTERNATIONAL®

Automated Vehicles and Infrastructure Enablers

Kelley Coyner, JD
Jason Bittner, MPA

EMERGING ISSUES IN NEW MOBILITY

SAE EDGE™ RESEARCH REPORT

SAE EDGE™
RESEARCH REPORT

Automated Vehicles and Infrastructure Enablers

Kelley Coyner, JD
Innovation4Mobility

Jason Bittner, MPA
Applied Research Associates

EDGE DEVELOPMENT TEAM

Jeff Paniati, PE, *Institute of Transportation Engineers*
Carmine Dwyer, PE, *Applied Research Associates*
Finch Fulton, *Locomation*
Darko Babić, PhD, *University of Zagreb*
Kristin White, JD, *Intelligent Transport Society of America*
Paul Carlson, PhD, *Automated Roads*
Brian Norris, PE, *Stantec*
Robert Dingess, *Mercer Strategic Alliance*
King Gee, *American Association of State Highway and Transportation Officials*
Jane Lappin, *Lappin and Associates*
Greg McGuire, *Mcity, University of Michigan*
Edward Straub, *SAE International*

SAE INTERNATIONAL®
Warrendale, Pennsylvania, USA

About the Publisher

SAE International® is a global association of more than 128,000 engineers and related technical experts in the aerospace, automotive, and commercial-vehicle industries. Our core competencies are lifelong learning and voluntary consensus standards development. Visit sae.org

SAE EDGE™ Research Report Disclaimer

SAE EDGE™ Research Reports focus on topics that are dynamic, in which knowledge is incomplete, and which have yet to be standardized. They represent the collective wisdom of a group of experts and serve as a practical guide to the reader in understanding unsettled subject matter. They are not meant to provide a recommended practice or protocol. The experts have assembled as a community of practitioners to contribute and collectivize their thoughts and points of view. These are not the positions of the institutions or businesses with which they are affiliated, nor is one contributor's perspective advanced over others. SAE EDGE™ Research Reports are the property of SAE International and SAE alone is responsible for their content.

About this Publication

SAE EDGE™ Research Reports provide state-of-the-art and state-of-industry examinations of the most significant topics in mobility engineering. Contributors to SAE EDGE™ Research Reports are experts from academia, government, industry, and research who have come together to explore and define the most critical advancements, challenges, and future direction in areas such as vehicle automation, unmanned aircraft, cybersecurity, advanced propulsion, advanced manufacturing, Internet of Things, connectivity, and quantum technology.

SAE Team

Frank Menchaca, Chief Growth Officer
Michael Thompson, Director of Standards, Information, and Research Publications
Monica Nogueira, Director of Content Acquisition and Development
Beth Ellen Dibler, Product Manager
William Kuchinski, Managing Technical Editor

Printed in USA

EPR2022008
ISSN 2640-3536
e-ISSN 2640-3544
ISBN 978-1-4868-0012-9

To purchase bulk quantities, please contact: SAE Customer Service.

E-mail: CustomerService@sae.org
Phone: 877-606-7323 (*inside USA and Canada*)
+1-724-776-4970 (*outside USA*)
Fax: +1-724-776-0790

https://www.sae.org/publications/edge-research-reports

About the Editors

Kelley Coyner, JD is a transportation practitioner and researcher with 30 years of experience in developing, deploying, funding, and evaluating accessible, automated, connected, electric, and shared mobility systems. The National Academies Press recently published her report on *Low-Speed Automated Vehicles* (*LSAVs*) *and Public Transportation,* and in 2020, she served as Principal Investigator for nine topical briefing papers for the Transportation Research Board Forum's collection on *Preparing for Autonomous Vehicles and Shared Mobility.*

In 2017, Kelley co-founded Mobility e3 to provide cities and campuses with the technical knowledge needed to deploy automated vehicles. A three-time Chief Executive Officer, Kelley served as the Senate-confirmed Head of Agency for the Research and Special Programs Administration at the US Department of Transportation, led homeland security and emergency planning programs in the National Capital Region, and served as Executive Director of the North Virginia Transportation Commission. Profiled in the recent book *Women Driven Mobility: Rethinking the Way the World Moves* for developing accessible, automated, connected, electric, and shared mobility systems, she has honed her expertise in transportation innovation at the Massachusetts Institute of Technology, Harvard Kennedy School, Volpe National Transportation Systems Center, and George Mason University.

Jason Bittner, MPA, a researcher and planner, specializes in transportation infrastructure asset management, connected and automated vehicles, and policy analysis. Recognized as a leader in planning for vehicle automation and connectivity, Jason coordinated the Transportation Research Board Conduct of Research Committee's Automated Vehicle Working Group and has lectured on connected and automated vehicle policy at national and regional research conferences and at the University of South Florida, University of Wisconsin, and National Highway Institute.

Additionally, Jason oversaw the completion of a series of policy documents related to vehicle automation for the Tampa Hillsborough Expressway Authority. He was a primary author on a recent National Cooperative Highway Research Program synthesis looking at infrastructure enablers and modeling tools for automated vehicles and shared mobility. Currently a principal and employee-owner at Applied Research Associates, Inc., Jason previously served as Executive Director of the Center for Urban Transportation Research at the University of South Florida.

contents

Automated Vehicles and Infrastructure Enablers

Abstract

The deployment of automated vehicles (AVs)—especially driverless ones—has fallen significantly short of expectations. Some specific use cases possess momentum; however, production numbers generally appear to be more hopeful than realistic. Even before the COVID-19 pandemic, automated freight applications gained greater traction. For the most part, currently deployed freight-focused AVs are limited to narrowly defined operational design domains (ODDs) and may require human intervention to exit a highway or interact with law enforcement officers and weigh stations. Remaining business cases are often built around the so-called structural AVs—or AVs that operate in relatively constrained environments. In these scenarios, a narrow use case may support an investor's requirements; however, this is not the case for infrastructure owners and operators (IOOs). The safety, efficiency, mobility, and accessibility benefits that IOOs seek depend on wide-scale deployment across multiple ODDs, state boundaries, and even international borders. Original equipment manufacturers (OEMs) and automated driving system (ADS) developers often maintain that no infrastructure enablers are needed to achieve full AV deployment, regardless of IOO infrastructure investments (e.g., connected traffic signals, designated stops, booking software, mobile applications, separated lanes).

At the same time, IOOs asked what infrastructure is needed to put AVs on the road, OEMs and ADS developers alike answer that a state of good repair and clean markings are sufficient. What does that mean to IOOs? Much of the US receives poor grades when it comes to state of good repair and pavement markings. Additionally, signs and traffic signals are not included in those ratings. Could some paint and regularly refreshed markings help transition us to wider AV deployment? What do IOOs need to know about what constitutes effective lane markings or what to prioritize in terms of safety and mobility? How do policy considerations impact these choices?

This first SAE EDGE™ Research Report in a series on AVs and infrastructure will consider ways in which infrastructure can speed or delay deployment, capture benefits, and mitigate hazards related to AV rollout. These reports will review approaches being taken in the US, UK, and EU, as well as Canada, Singapore, and elsewhere. While future reports will address specific topics, this report will touch on the relationship between infrastructure and key factors related to operations and capture of benefits, including accessibility, safety, reduced climate impacts, and integrated supply chain logistics.

NOTE: SAE EDGE™ Research Reports are intended to identify and illuminate key issues in emerging, but still unsettled, technologies of interest to the mobility industry. The goal of SAE EDGE™ Research Reports is to stimulate discussion and work in the hope of promoting and speeding resolution of identified issues. These reports are not intended to resolve the challenges they identify or close any topic to further scrutiny.

KELLEY COYNER, JD
Innovation4Mobility

JASON BITTNER, MPA
Applied Research Associates

Edge Development Team

Jeff Paniati, PE, *Institute of Transportation Engineers*
Carmine Dwyer, PE, *Applied Research Associates*
Finch Fulton, *Locomation*
Darko Babić, PhD, *University of Zagreb*
Kristin White, JD, *Intelligent Transport Society of America*
Paul Carlson, PhD, *Automated Roads*
Brian Norris, PE, *Stantec*
Robert Dingess, *Mercer Strategic Alliance*
King Gee, *American Association of State Highway and Transportation Officials*
Jane Lappin, *Lappin and Associates*
Greg McGuire, *Mcity, University of Michigan*
Edward Straub, *SAE International*

ISSN 2640-3536