

2017 Pennsylvania Automated Vehicle Summit

Program Summary

Ramada Hotel and Conference Center

Thomas D. Larson Institute Test Track

State College, PA

September 11-12, 2017

Convened By



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Introduction

State College, Pennsylvania, was the scene of a remarkable gathering September 11 and 12, 2017. Nearly 300 (primarily) Pennsylvania citizens from all corners of the Commonwealth gathered to learn and talk about vehicle automation and what it might mean for our great state, its communities and people. The first Pennsylvania Automated Vehicle Summit was convened jointly by the state Departments of Transportation and Community & Economic Development. While there have been many conferences and meetings about vehicle automation all over the world in recent years, the Pennsylvania AV Summit was unusual, if not unprecedented, in that it assembled a statewide meeting expressly to focus on the implications of vehicle automation in two critical areas: local and regional infrastructure planning and workforce development.

This report documents the highlights of the Summit. What this volume is probably incapable of conveying is the energy and intensity with which the Summit participants took on the issues at hand. Many and complex those issues are. It was clear from the tenor of the proceedings that there is an appetite for and excitement about this transformative technology and the benefits it offers, particularly with respect to enhanced mobility, emissions reductions, throughput efficiencies, economic development, and, foremost, a vastly safer transportation system.

But there was also expressed undeniable concern about unintended and potentially negative consequences affecting jobs and businesses, land-use, public acceptance, equitable access and the tricky process of transitioning from human to automated control.

Solutions to these puzzles are not yet fully in sight. Vehicle automation is only an infant; its future still to be shaped. But the engagement and enthusiasm of the Pennsylvanians participating in the Summit foretell a future in which this Commonwealth will have a vigorous shaping hand – one that aims to ensure the benefits of vehicle automation are shared by all.

Roger J Cohen

Policy Director, Pennsylvania Department of Transportation



Message from the Summit Co-Hosts

On behalf of our respective organizations, we thank everyone who attended the Summit and made it the success that it was. To our speakers, exhibitors, and poster session presenters...thank you for taking time to share your expertise with our Summit attendees. With over 55 speakers, 10 different sessions, and a series of AV demonstrations, it was quite an endeavor that we could not have accomplished without your assistance. We look forward to continuing our ongoing work with PennDOT as it seeks to maintain Pennsylvania's leadership status nationally in AV.

Thank you again for your support of what figures to be a seminal event for Pennsylvania transportation.

Orla Pease, P.E., PTOE
Mid-Atlantic Section of ITE (MASITE)



Vijay Varadarajan, P.E., President
Intelligent Transportation Society of PA (ITSPA)



Welcome Message

On behalf of Pennsylvania's Departments of Transportation and Community and Economic Development, we are pleased to welcome you to Pennsylvania's inaugural Automated Vehicle (AV) Summit. PennDOT and DCED have convened this conference, with the invaluable support of the cohosts, the Mid-Atlantic Section of the Institute of Transportation Engineers (MASITE) and the Intelligent Transportation Society of Pennsylvania (ITSPA), to foster a wider public understanding and discussion about the benefits and issues of AV technology.

To our knowledge, this is the nation's first statewide conference specifically focused on two critical questions facing autonomous and connected vehicles in the years ahead:

- How should local, county and regional governments and planning organizations prepare their infrastructure and other programs for the coming automated transportation revolution;
- What training requirements and programs will best prepare our workforce to capture the new jobs created and minimize the job disruptions that accompany technological breakthroughs?

There is little doubt that automated vehicles will transform our transportation system and society, much as automobiles did a century ago. We are particularly excited about the tremendous increase in roadway safety that AVs promise to bring about, as well as their potential to be a force for community and economic vitality.

Pennsylvania is already firmly established as one of the leading states in the research, development and testing of AVs, and our departments, along with our sister Commonwealth agencies, are working diligently to ensure that continuing innovation progresses in balance with the safety of the traveling public on our system. We believe that robust public discussion of the issues and opportunities this amazing technology presents will ensure that it will provide the greatest benefit to all Pennsylvanians and the state as a whole.

Leslie S. Richards

Secretary of the Pennsylvania
Department of Transportation



Dennis M. Davin

Secretary of the Pennsylvania Department of
Community and Economic Development



Summit Proceedings in Brief

Monday, September 11

8:00-9:00 A.M. Morning Networking

9:00-9:30 A.M. Introduction

Welcome Video and Opening Remarks

9:30-10:00 A.M. Keynote Address

Featured Speaker – Raj Rajkumar

10:00-11:00 A.M. Plenary Session

“When Will It Happen?”

11:00- 11:15 A.M. Break

11:15-12:30 P.M. Session 1

1a. “Complete Streets in the Age of AVs”

1b. “Planning for Connected & Autonomous Vehicles”

1c. “Who is Responsible?”

12:30-1:30 P.M. Lunch

Featured Speakers: Leslie S. Richards; Ken Leonard

1:30- 1:45 P.M. Break

1:45- 3:00 P.M. Session 2

2a. “Future of Transit”

2b. “How Much Will It Cost & Who Will Pay?”

2c. “To Protect & Serve”

2d. “Training the New Workforce”

3:00-3:15 P.M. Break

3:15-4:45 P.M. Plenary Session

“Economic & Social Roundtable”

Tuesday, September 12

8:00-8:30 A.M. Morning Networking

8:30-9:30 A.M. Facilitated Session

“What did you think before? What do you think now?”

10:00-12:00 P.M. Thomas D. Larson Institute Test Track Demonstrations

12:00 P.M. Summit Adjourns

Opening Remarks



Roger Cohen, PennDOT Policy Director and Co-Chair, Pennsylvania Autonomous Vehicle Task Force

- Pennsylvania's leadership in AV development is an established fact that is increasingly recognized nationally and even internationally.
- Public engagement will be a critical ingredient for ensuring that AV technology delivers the promised benefits to society.
- There is a pressing need for an open, forthright public discussion of the key issues
- This Summit aims to foster a deeper understanding of both the extraordinary opportunities as well as the complex challenges AVs present.
- PennDOT hopes this Summit generates an ongoing 'Community of Participation' that shapes the outcomes as vehicle automation progresses in the years ahead.



Renee Sigel, Director Office of Safety Programs, Federal Highway Administration, former Pennsylvania Division Administrator, FHWA

- This Summit is an opportunity for you who are here to think without restrictions and limitations - it's an 'Outside-the-Box' moment.
- You should not let budget constraints constrain your ideas at this conference.
- Pennsylvania is one of the leading states in this emerging technology.
- FHWA will support your efforts and looks forward to working with you as you move forward.

Morning Keynote



Raj Rajkumar, Director of the National USDOT University Transportation Center for Safety

- We stand at the cusp of a revolution in the domain of transportation. It is customary to call these opportunities “once- in-a-lifetime,” but more accurately it is closer to “once-in-a-hundred-years”—the question is “what will we, in Pennsylvania, do about that?”
- We have already established leadership in this domain, and now is the time to act to maintain, sustain and expand that leadership. If we wait even a short time (a few years) that opportunity will be gone forever. From a policy and regulatory standpoint, it is time to establish leadership.
- Fully automated vehicles will not be coming in the very short term, but getting the policies in place now so that when they do arrive, we will have the momentum and have already attracted jobs and industry to the commonwealth. We can be pioneers of the domain but only if we put in the groundwork and foundations in place for the mass adoption of AVs.
- Globally 1.3M people die due to vehicular crashes and 94% of those are due to human error. Almost all of these fatalities can be avoided or at least mitigated by AVs. Productivity will go up on a global scale. The quality of life improvements for isolated seniors can be massively increased by allowing independent mobility in seniors who would otherwise avoid asking for help. About 1.5M legally blind, 5M physically disabled and unable to drive, and all of whom would benefit in terms of personal mobility.
- Ride-sharing will also create a massive revolution in transportation, like automation.
- Connectivity in vehicles is valuable and we can see the usefulness of these technologies in mobile phones daily.



Kurt Myers, Deputy Secretary for Driver & Vehicle Services for the PennDOT

- Our automated vehicle task force is important to PennDOT but also to Pennsylvania.
- If you look back before a year and a half ago, PennDOT had already invested the time and effort in developing ideas that lead to and support autonomous driving.
- Then about a year and a half ago, the Secretary decided the task force would be the best vehicle to move the priorities forward. The first meeting was in Pittsburgh on June 1, 2016, and we didn't expect to have come this quickly in just over a year.
- We have done our best to reach diverse stakeholders to ensure we represented everyone's opinion included in our task force and have collaboration.
- Unsurprisingly we didn't all agree on our findings when we presented them to the Secretary in November of 2016. But the task force allowed for all voices to be heard by presenting a section for dissenting views in its report, and did so very specifically since this is intended to be a transparent document, and a living document which can change over time.
- Excited to see how the technology and the task force evolve moving forward—Pennsylvania is a leader, we're proud of that fact and we're here because of a lot of the folks in this room. Thank you!

“When Will It Happen?” – Monday Morning Plenary Session

The timeline for the implementation and deployment of automated vehicles: when, where, and how it will happen.



Moderator



Dr. Eric Donnell, Director, Thomas D. Larson Pennsylvania Transportation Institute

- A recent survey showed that about 80 percent of people today would not buy an AV if it were available.

Panelists



Steve Boyd, Co-Founder and VP of External Affairs, Peloton Technology

- There has been an acceleration of global activity in driver-assistive truck platooning, especially in Europe. Automated truck platooning improves safety and fuel efficiency, resulting in a greater net profit for trucking companies.
- There is currently a driver shortage and automation technology can help fill this employment gap, as well as enhance existing roles for drivers.
- On the spectrum of automation, Peloton is at level one – acceleration control, brake control, and collision avoidance systems are in use, but drivers still steer.
- In addition to technological advances, significant regulatory steps must be taken to advance the timeline and outlook of vehicle automation.



Steve Buckley, Manager of Northeast U.S. Planning, Environment, and Traffic Practice, WSP

- There are two paths for automated vehicles: the private ownership model (initiated by the auto industry) and the shared mobility model (initiated by technology companies like Google and Uber).
- Deployment of AVs is no longer an “if” but a “when,” and it will be very disruptive.
- There are five key factors to consider in determining the timeline for implementation: speed of technological advancement, economics, public acceptance, political support, and shared mobility.



Jackie Erickson, Founder, Jackie Group

- There are three themes to consider as AV technology advances toward implementation:
 - **Experience:** Pittsburgh has been called the birthplace of self-driving cars. After testing the technology for over a decade, many other companies have settled in the city due to the experience and expertise that has grown.
 - **Environment:** There needs to be optimum environments for testing: challenging networks, four seasons, various complexities of how the product will react, etc.
 - **Engagement:** Following experience and environment, it is critical that all the right decision makers and innovators are at the table to advance the technology.
- We need more engagement with groups like those represented here at today’s AV summit...particularly with tech companies like UBER, Delphi, and ARGO.



Damon Shelby Porter, Director of State Government Affairs, Global Automakers

- In addition to getting technology and innovation right, policy and regulations surrounding the technology need to be right. Similarly, communities need to be thinking long term about infrastructure needs.
- An important question to consider is how can HAV solve longstanding societal problems. Also, outside of the immediacy of creating new jobs, how do we sustain these new jobs as the technology evolves?
- As HAV technology becomes more prominent, there needs to be a focus on civic efforts and safety. HAVs can be used to erase food deserts or transport goods in addition to people. It can also be used to save lives, particularly in rural communities.

“Complete Streets in the Age of AVs”

AVs will revolutionize the movement of people and goods; how can we leverage data and policy to ensure that streets are safe and convenient for all users?



Moderator



Ngani Ndimbie is a MS Candidate for Public Policy and Management at CMU

Panelists



Eric Boerer, Advocacy Director of Bike Pittsburgh

- A recent survey showed that people feel safer around AVs than around a human-driven vehicle. There are many crashes and injuries related to vehicles and bikes, especially with vehicles taking left turns, and into the path of a bicyclist. This can be minimized using AVs.



Rich Farr, Executive Director of rabbitransit

- Replace fear with curiosity. People want to move individually than in group settings within the US.
- We're optimistic about the affordability and flexibility of AVs, especially for transit users, as it would be an opportunity to compete on the roadway and have similar level of service to cars.

- With AV technology, transit operators might be able to request signals... or there may be real time information that can be shared with health care providers.



Jeff Iseman, Program Analyst for the Pennsylvania Statewide Independent Living Council

- Persons with disabilities will benefit much from this technology.
- Distracted driving and inattentiveness can be addressed through AV.



Paul Mackie, Communications Director at Mobility Lab

- Approximately 80 percent of the U.S. population drives alone.
- We need people to use transit more. This is a historic opportunity to reshape travel patterns using public transport.
- Not many places have plans for HAVs. They need to understand the movement of people, listen to what people want and need for their particular communities.
- Pilot projects on busy travel corridors to win hearts and minds for shared autonomous travel.

Audience Questions

What are the community challenges you see for this technology?

BOERER: It brings us to the “Law vs Behavior” thing. One example involves yielding to pedestrians. Some states don’t follow that (so they don’t yield to pedestrians) but some states do. So should AVs yield to pedestrians or not, and if they do what will happen for the states who don’t follow that?

FARR: Driver assistance stuff, deliveries. If we are moving people from a traditional vehicle to AVs, we still have the same problem remaining, that is, people not taking transit, and still travelling individually.

ISEMAN: There are physical concerns, as well as dealing with resources and funds. This technology is going to require more funding.

MACKIE: Getting people into transit and creating a shared society. How can we start sharing things? In Arlington people are using a huge parking lot to park their car and then take transit. That parking lot needed an enormous amount of funding to be built. If people could rideshare, it can help alleviate a lot of costs associated with large parking areas.

What are the main policies we need to think about?

BOERER: What do we do with curb spaces?

FARR: Standardized disembarkment space.

ISEMAN: Picking up people with disabilities. Not all vehicles are handicapped-accessible. Being inclusive to disabled people is the biggest key.

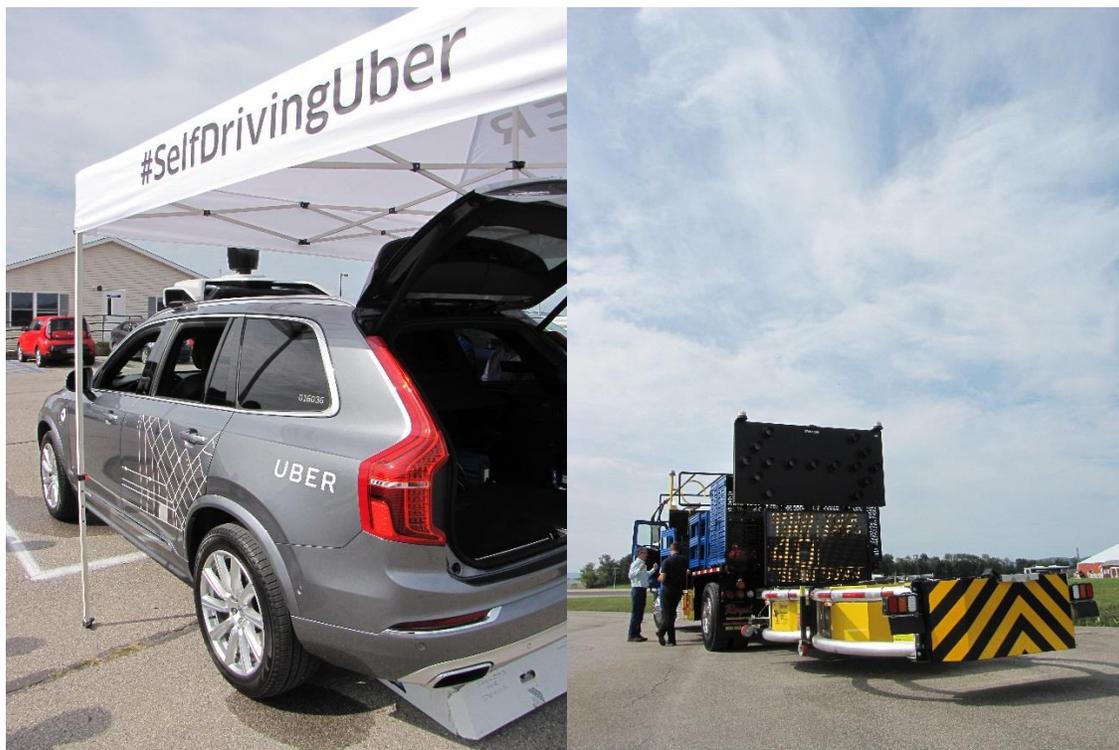
MACKIE: For V2Is, how do we move people through existing infrastructure not build a new one? Can we do something like Disney? Can we convince people not to take their car everywhere, and take transit?

What are the limitations of communicating UBER AVs with bicyclists or pedestrians?

BOERER: Vehicles stop when it can't go through. Like some vehicles they put up a sign like "how's my driving" with numbers to collect data that way.

How do we meet the perception that AVs benefit only the disabled versus the larger population?

ISEMAN: You want to design a system that's consistent, something sustainable.



“Planning for Connected and Autonomous Vehicles”

Exploring how municipalities and regions can prepare their infrastructure for connected and autonomous vehicle deployments in the short- and long-term.



Moderator



Stan Caldwell, Executive Director of the Traffic21 Institute, Carnegie Mellon University

Panelists



Brett Fusco, Manager, Long-Range Planning, Delaware Valley Regional Planning Commission

- We look at transportation as an eco-system.
- The gas tax is becoming obsolete.
- HAVs could be electric.
- We have to ensure that regulations are not stifling.



Alex Graziani, Township Manager, Penn Township

- Insurance might help people embrace HAV technology. In the township, we pick up the pieces when things go wrong: speeding, road rage, distracted driving. There is a lot of harassment of bike riders, especially in suburban areas.
- Zoning ordinances will either make things better or worse.
- Telecommuting may mean you won't need an auto. We could go to airborne vehicles.
- HAVs will mean mobility for persons with disabilities.
- There is limited transit in the suburbs because there is not enough density to support transit. America is built on auto dependency. By contrast, in Amsterdam, 65 percent of riders use bicycles. That is not happening here.
- As a township manager, we have the responsibility to protect people and property in a 30-square mile area. We have a lot of local roads that are not designed for speeds over 20 mph.



Alex Pazuchanics, Assistant Director for Planning, Policy and Permitting, Department of Mobility and Infrastructure, City of Pittsburgh

- It's important to think about all of the tools local governments have to drive outcomes, not just local ordinances. Cities procure, manage right-of-way, advocate for policy, and establish zoning, along with a host of other activities. All of these levers should be a part of the discussion of autonomous vehicles in our communities, and the ways that they can benefit our residents.
- It is critical for cities to begin thinking seriously about the impact of autonomous vehicles on traditional revenue sources, and identifying new ways to preserve and maintain infrastructure.
- It's impossible to talk about autonomous vehicles absent a discussion of connected, electric and shared vehicles, and the adoption rates of those technologies will produce dramatically different effects depending on the mix.
- Local communities partnering with academic institutions provide new ways for communities to think about the impact of this and other technology.



Rick Vilello, Deputy Secretary for Community Affairs and Development, the PA Department of Community and Economic Department

- HAVs were not previously on the radar at DCED.
- We need a statewide policy not just for testing. We need a Pittsburgh-style vision statewide.
- What are the standardized requirements for municipalities? Funding needs to be consistent. Parts of rural Pennsylvania didn't have phone lines until the 1940s. We can't take the same approach with HAVs. Rural areas need to get it right. They are more dependent on cars. HAVs have to benefit all of Pennsylvania.
- How do we pay for it? We are in an era where government is trying to do more with less. We can't raise taxes or fees. Will insurance companies benefit from HAVs? We need a way to fund without relying on ever-shrinking tax bases.
- What will be the impact on car manufacturers? What are the policies for consistent funding for rural and urban area and for different roads?
- What if a municipality bans HAVs? We will need a standardized statewide policy to encourage the market and improve lives.

Audience Questions

Good government stands for things we do together. How will we work together so we improve all lives?

CALDWELL: Advanced technology needs not be disruptive. The benefits will be added safety, better traffic conditions and more job opportunities. The sooner we start planning for the workforce, the better off we will be.

FUSCO: We have an opportunity to get it right. We lost 100,000 people in western Pennsylvania in a decade. We need a pipeline for work force training and we have to start building at the middle school level.

GRAZIANI: Local governments have a responsibility to maintain safe streets. With funding moving away from the fuel tax we have got to do a better with infrastructure to accommodate aging needs and technology. The advent of HAVs will depend on the conditions of the roads and the sightlines. Private sector investment will be needed. We will need infrastructure improvements: wider streets, clear signage. We don't have the resources to be investing in technology; we can't even invest in Smart Streets. The Turnpike and PennDOT will be able to do it but no local government can get in the game.

PAZUCHANICS: Basic road maintenance will be important.

“Who Is Responsible?”

Who is liable when an AV crashes? AVs must continually decide how to allocate risk. What are the ethical behaviors they should follow?



Moderator



Jason Sharp, Acting Chief Counsel, PennDOT

- We have strong interest in how we will deal with the liability of the eventual crashes that will occur with AVs. Who is the driver? And who is the insured? The Feds are leaving liability insurance issues up to the states.
- We need experts to help us get to the legislative solutions we need, or it will be decided by the courts. PennDOT wants to define who the driver is, to help the insurance industry and the courts.
- Current law in Pennsylvania is that AV is legal, but limited. Pennsylvania has created a Task Force to get ahead of the curve and guide AV legislation. We want to have best practices in place for both testing and deployment.

Panelists



John Lacek, Department Counsel, PA Department of Insurance

- Many other states have not addressed the issue of insurance and liability.
- AV accidents will typically be more minor in nature with limited damages.
- There needs to be a discussion as to how we move forward with liability.



Chris Marzacco, Partner, Anapol Weiss

- Most motor vehicle crashes are not intentional; most are from human error, typically negligence.
- Incidences of drunk driving has declined, but distracted driving has increased. Will continue to have until we eventually get to Level 5.
- We have to get the liability language correct from Day One.
- We could be moving away from human error toward product liability or software defects. These are entities we will have to look at. “Are we taking a responsible party away from an innocent victim?”
- “When machine and man combine to cause harm, each must be held accountable.” – Larry Coben, Esq.

Audience Questions

Have you looked at other industries as to how they structure their insurance for liability?

The industry kept telling us to look at liability for cruise control as a good model, but we are going to go far beyond that. Autopilot in aircraft is “strict products liability” unless you can demonstrate something clearly went wrong. With cruise control, there are two bodies of law that have developed: we hold the person who put it in command of it as liable. The other is the rebuttable presumption that assumes there was no error in the cruise control, which is how case law has developed.

Level 3 automation is fascinating and frightening, since the driver has to be ready to take over. Tesla is not a good example of this (but it is close). This might be fertile ground in the future for lawyers.

Do you know where the insurance industry is at the national level?

They are like everyone else...they have no idea what to make of it. Insurance is looking at this as a products liability issue. There’s not much of a developed market right now, and the industry tends to self-insure. That might be the case until we see some actual claims develop. The insurance industry will control this at some point.

How do we prepare the Pennsylvania State Police for reconstructing an AV crash scene?

When an AV gets into an accident event, it is loaded with cameras and sensors, with a blueprint of the accident. So we may not need reconstruction as much. AVs will be recording everything that happens. As plaintiffs injury lawyers, we’re using black box technology in cases, although it’s not always completely reliable...sometimes there are glitches. For example, the data may not measure why the driver did not pick up, unless there are cameras on the driver. Why was there reaction time wrong? Will change from physical evidence to data. PSP: The EDR download is huge...this will be invaluable as the technology progresses.

Lunch in the Atrium



Leslie S. Richards, Secretary of Transportation

- PennDOT wants you to make your voices heard and have your ideas shape the future of transportation in Pennsylvania.
- Pennsylvania is already firmly established as a leader, with world-class research universities and leading innovators calling the state home: Argo AI, Delphi, Aurora, UBER, Royal Trucking, and Volvo.
- PennDOT supports research and development, balanced with public safety.
- We must be mindful of the complicated issues and challenges, as well as the potential for unintended consequences.



Ken Leonard, Director, U.S. Department of Transportation Intelligent Transportation Systems Joint Program Office

- We have to be willing to go beyond innovation.
- In the future, data will be as important as asphalt and concrete. Data, and data sharing, will be key. We need to ask ourselves in what ways will data be made available, and to what ends will it be used?
- We need to expand our vision to yield more innovation and value as we integrate the technology to move toward a more connected society. This will affect energy, public safety, and public health and accessibility.

“Future of Transit”

Imagining the future of multimodal transportation; what will change when transit is automated?



Moderator



Courtney Ehrlichman, Deputy Executive Director of the Traffic21 Institute, Carnegie Mellon University

Panelists



Sheila Gombita, Executive Director, Freedom Transit

- Should be a conversation about how to enhance public transportation using these vehicles.
- Limited hours in the weekend for shared ride users.
- The payment method matters a lot for low income riders. Are you forced to have a pre-loaded card or a bank account to use these new methods?
- Automakers should make vehicles that are accessible for users of all physical and mental capabilities.
- CTA Autonomous for all of us will be released soon.



Art Guzzetti, Vice President of Policy, American Public Transportation Association

- Transit is going to be a big part of what we need going forward.
- Automated Transit Shuttles are coming to a town near you – they have been used in Las Vegas and are planned for Jacksonville and Tampa.
- APTA’s Shared Mobility and the Future of Public transit report and initial research suggests that there will a symbiotic relationship; later research suggests it may not be quite as positive.



Christopher Puchalsky, Director of Strategic Initiatives, Philadelphia Office of Transportation and Infrastructure Systems

- Equity is important in transportation, and it’s important that the new, shared autonomous mobility is okay for all of us.
- Transit policy is often written by people who don’t ride transportation very often.
- Transit provides a good job for the individual without a college education.
- “You’ve gotta Uber yourself or you’re gonna get Kodaked”



David Woessner, National Harbor and Washington DC General Manager, Local Motors

- There are four tiers of mobility: Level 1 is local neighborhood mobility, and Level 2 is regional car travel, 3 is flight, and 4 is inter-planetary. What does local and neighborhood mobility mean? It should be slow.
- Low-speed, controlled environments will be the use case for automated vehicles.

Audience Questions

Is the glass half empty/half full? Give us your predictions. What keeps you up at night?

PUCHALSKY:

- Half Empty: Zero occupancy cars
 - New York data suggest that for every mile of transporting passengers there’s 4/10ths of a mile of transporting no passengers
- Half full: We can bicycle safely?
- Creating shared spaces where pedestrians are allowed to use the cart way
- Wildcard
 - Doesn’t seem foretold that Automated Vehicles will operate safely

GUZZETTI:

- Half empty: Government needs to step in with policies to prevent more traffic, more sprawl, and more emissions
- There’s a lot of talk about transportation agencies becoming mobility authorities if there’s a significant shift from private to public

What strategies are you using to take things to the next step? Labor concerns?

PUCHALSKY:

- The city's labor folks would have to take this on.

WOESSNER:

- In the short-term there's a job creation surge because every vehicle will have a steward or an engineer or a driver. In the long-term there will be some sort of retraining – a transference from driving responsibilities to loading, unloading, and customer service.
- We're looking at subscription services for us. Looking at it being an operations cost rather than a capacity cost.

GOMBITA:

- Education is how we get further along.

GUZZETTI:

- Boston's Demand Response partnership has found a way to lessen the cost by using TNCs.



“How Much Will it Cost and Who Will Pay?”

Helping communities identify critical infrastructure investments for a safe and effective AV future.

Moderator



Mark Kopko, Manager of Advanced Vehicle Technology, PennDOT

Panelists



Steve Buckley, Manager of Northeast U.S. Planning, Environment, and Traffic Practice, WSP

- We need to bring a local government perspective to this.
- There's no clear path or consensus. Do we want a shared model or not? Municipalities operate their own traffic signals, so getting a uniform direction statewide on AV will be challenging.
- Cities don't have budgets for pavement markings, so it will be challenging to think the municipalities will be bearing the burden of advancing AV technology.
- There will be a need for computer scientists at a municipal level. This is a big ask of municipalities. Implementation of this needs to be in a coordinated and cohesive manner, and at a state level.
- The value-add of this technology, people will move toward it quickly. By 2050, we may be seeing a ban on human drivers.



Tony Mento, Director of Technical Services, Federal Highway Administration

- There are many funding opportunities to fund AV technology, including CMAQ and safety money.



Matt Smith, Connected and Automated Vehicle Manager, Michael Baker International

- We might not see Level 5 on passenger cars until 2023, and that is being optimistic. Technologies will take time before they become available on every car. Typical vehicle fleet age is 11.5 years.
- For the next 30-40 years, we will have a mixed fleet. It's not until 2053 when we can start making new design decisions. We still have to design for humans for the foreseeable future.
- We have to make a case for spending our safety money on technology as opposed to constructing a left turn lane somewhere.
- For transportation agencies, there are some challenges that delve into realms that we're not used to dealing with. There are some sizeable partners that may be willing to invest in the data infrastructure, including data analytics companies. That could help offset some of the future infrastructure costs.
- Will AV increase or decrease congestion? What we do know is that there will be increased mobility for elderly and disabled drivers. Car ownership models are going to change, and will have a drastic impact on our overall funding. As an industry, we need to grasp this technology; we need the public private partnerships and events like we're having today to share information. That will drive the success of AV.



Mike Wagner, Co-Founder and CEO, Edge Case Research

- "Deep Learning" is a new buzzword these days. It is the highest-performance way to detect objects in images.
- The biggest gap that we're seeing is there's no technical standard or approach that the developers can use to convince you that these problems won't occur out in the field.
- 80% of the money you need to spend in machine learning is in verification and validation.

Audience Questions

Data will be a major commodity in the future. Who will own that data?

SMITH: It depends on where it is being generated. There is mutual benefit to sharing some of the data.

BUCKLEY: Google and GM fought over who owned the data, and there was a divorce. Data could be used in ways that consumers may not be comfortable with.

MENTO: There's not a good answer for this question. First responders may want data coming off of these vehicles, as well as the State DOT to learn how their network is performing.

What is your recommendation to a public agency for validating the roadworthiness of an AV?

Use simulation in a smart way.

What does the future look like? In 30 years we need to be thinking three dimensional (e.g., drones).

SMITH: If we can solve the 2-D problems, then 3-D may be easier. For example, airlines are not allowed to use the automatic pilot when they're on the ground taxiing.

What happens when mobility in society is controlled by a certain somebody? How does society come to an agreement to yield liberty and mobility of movement to corporate government?

That may be a bigger issue than machine learning.

BUCKLEY: This will have to be regulated like a private utility.

What is the most appropriate level of government to pull this off?

SMITH: It has to be all levels of government. The sharing comes when there is a consortium being funded by the federal government, where cooperation is enforced. They have to work together.

MENTO: Funding mechanisms will need to change when we get into full-scale implementation. There will need to be a source of revenue being generated. We'll have to re-think how we generate transportation dollars, but even that may not keep up with our basic infrastructure needs. We may see some changes to this beyond the end of the FAST Act.

KOPKO: Act 101 of 2016 funded the state's Green Light-Go program, and \$40 million can be set aside for locals to fund connected and automated vehicle deployments.



“To Protect and Serve”

Interactions between AVs and law enforcement and first responders will look different; what new dynamics must be established to protect and serve the public?



Moderator



Stacia Ritter, Policy Director, PA Turnpike Commission

Panelists



Fred Bergstresser, Government Account Manager, Royal Truck & Equipment

- Autonomous TMA Truck (ATMA): impact protection vehicle guarding workers and equipment from oncoming traffic, can be used in a static form or moving operation. It might have cone truck in advance, followed by one or two TMA trucks.
- In most states, TMA trucks get hit all the time. Leader-Following Concept: the lead vehicle, which has a driver, sends data to trailing vehicles, which use the information to mimic the lead vehicle's path.

- CO just bought a truck and it's tech, plan on buying 10 more.
- Colas (UK) CEO Lee Rushbrooke said: "We are dedicated to advancing the health and safety issues and will continue to invest in cutting-edge research. We are extremely excited about new technology and are looking forward to giving this a global reach to save lives of road workers, across the world."
- Not just taking the driver out of the truck, we're not just saving his life, we're letting the equipment do the job that its designed to do-taking human emotion out of work. Texas guy driving in TMA truck, looks in his rearview mirror and sees a tanker coming at 70 miles per hour, his first instinct is to get out of the way which means he leaves all the human workers at risk. An automated truck would not have that instinct.
- Eliminates human error, human drivers cannot perfectly estimate the distance between vehicles, whereas automation can keep that proper distance.



Terence J. McDonnell, Staff Sergeant, Traffic Services Section of NY State Police

- Need AVs: 1) safety- the element we should never forget; 2) mobility - ability to move huge segment of population; 3) Economics- the global economy.
- Felt very lucky to be a part of American Association of Motor Vehicle Administrators. Met with industry and stakeholders to look at vehicle issues, driver issues, and law enforcement issues. Our guidance will be broken out into these issues. Guidance could change by the end of the calendar year. Issues arrive at level 3 automation, although there will be concerns all levels. Super-cruise coming out in Cadillac in next two weeks- limited access highway only technology.
- Designing should include adherence to Rules of the Road and keeping up with legal changes. Object & Event and Detection Response (OEDR) will be there to detect debris, crashes, road maintenance, etc. Post-Crash Behavior to know that there is something predictable about this vehicle. Last thing we'd ever want to see is a self-preservation factor, so that the vehicles don't just want to go home after a crash. EDR (Event Data Recorder = black box) Access and Retrieval for Crash Investigations.
- Law Enforcement Concerns are Vehicle ID, System Misuse vs Abuse, Potential for Criminal Use, Victimization when vehicle behaviors are predictable and Training Needs.
- Cox Automotive: one of biggest car companies in the world. The CEO said the most important thing is that somebody needs to be the watchdog - even people from the industry realize the need for a watchdog.



Troy Park, Assistant Director, PA State Police Bureau of Patrol

- From AMVA perspective, police need to have knowledge of the minimum approval criteria. Need to comply with existing statutes which are all based on having a human driver. Everything police do is about people, but now they will have to deal with technology. Could try to enhance data collection with kits for crash reconstruction to determine whether the vehicle or human is at fault. More training is needed.
- Expect detailed crash reports from police, this could now be a challenge. How do they figure out who was in charge or the vehicle at the time of the accident? Need to know if vehicles on the road are autonomous. Platooning is statutorily not allowed (tailgating)- how will officers know that the vehicles are connected? Data collected on crash reports is critical.
- Two main issues facing law enforcement as AV testing moves forward on PA Highways: 1. Education and Training: We don't want to be catching up with the industry, we want to meet the demand. 2. Communication: Open communication between the AV industry, legislators, highway administrators and law enforcement is most important to the success of AV testing and integration.



Skip Yeakel, Principal Engineer, Volvo

- 1 tow truck driver is killed every week, 23 highway workers and 1 law enforcement officer is killed every month and 6 firefighters are killed every month/week.
- Routinely dangerous operations-167 Law Enforcement Officers died in fatal vehicle accidents 2011-2015.
- Connected Vehicles, Key Concepts are Standards-Based Architecture, Well Engineered Foundation and Market Expansion.
- In emergency response, every second counts- response time and cleanup time.
- Benefits of CV technology includes reduction of agency involved crashes, reduction of citizen vehicle crashes and reduction of secondary incidents. NHTSA estimated an 80% elimination or mitigation of non-impaired crashes because of V2V and V2I. 2015: 10 million crashes, 94% caused by human error. 40% of workplace fatalities take place on the roads, not much smaller than the 48% of workplace fatalities on the railroads at the turn of the century.

Audience Questions

Should automated vehicles have a sticker or some sort of visual label?

Doesn't need to be text, or something that everyone understands, but needs to be something that law enforcement understands. In the past, they tried to mandate that all cars using ethanol be labeled in text on the back of the car, which didn't work. There's a possibility that that label could be a symbol representing level of automation. OR information could be transmitted via DSRC.

Do you think that vehicle manufacturers give you good access to useable data?

McDonnell: no, not at all. You often need manufacturer-specific software to view data. Rule doesn't say that data needs to be expressed so that all users can view the info. There may be hard drivers or the cloud or some specific storage mechanism. EDRs may be out dated soon.

What do these changes mean for local police departments? Will there be a shift toward state involvement in local crashes?

It is hard to know, as tech moves forward, we will know better. State police for now would cover that township until they're able to themselves.

FAA, black boxes are the only things that survive a crash?

As soon as you transition to FAA, that's an entirely different model. The scary thing is that the privacy advocates want the operator of the vehicle to opt-out, owners of testa's can't see their own data, if they could and could opt out of sharing data, that would have bad results. It all comes back to safety- if there is no safety, then there is no public acceptance.



“Training the New Workforce”

Identifying and developing skill sets required to transition today’s workforce to meet the demands of tomorrow.

Moderator



Dr. Pamela Carter, Dean of Business and Technology, Philadelphia Community College

Panelists



Sean Brennan, Professor of Mechanical and Nuclear Engineering, Pennsylvania State University

- From the University perspective, there is currently a lack of hands-on implementation experience and it is a detriment to students enrolling in the Mechanical Engineering Program.
- Many of the academic programs are very regimented and students do not have much research flexibility until their last year (e.g., a student with an interest in robotics and automation design cannot fully explore that until their senior year, etc.).



Allie Medack, Chief of Staff, Global Public Policy, General Motors

- Hands-on training is a pressing need for industry. General Motors is the only US automaker producing AV in a plant next to conventional vehicles. They are trying to address workforce development needs through hands-on educational programs.



Carol L. Kilko, Deputy Secretary for Administration, PA Department of Community and Economic Development

- DCED works with employers and community colleges in PA to increase skills of current employees.
- L&I’s apprenticeship program - they have committed a full time staffer to increase the number of apprentices in PA. It’s a proven way to bring people into an industry of any kind. DCED is getting into this with funding to help companies interested in

apprenticeships. Part of the training and certifications need specific certifications and it is expensive. DCED helps deflect this cost.

- In talking to CareerLinks, one of the fastest growing training needs is CDLs because there are a lot of jobs and you can get them quickly.



Frederic Sargent, Founder & President, Great Services Forums

- Many years ago, Great Services Forums had a difficult time recruiting minority apprentices. They created an explorer post and today they have journeymen electricians as a result. There is a pressing need to recruit young people who can learn the skillset early.

Audience Questions

What programs are currently in place or should be in place to support HAV technology?

BRENNAN: When a person completes a degree program, they should be allowed to have continuous access to educational resources available through that program. Also, certification programs should have more weight and clarity in what the end result is so employers are aware.

KILKO: DCED works with employers and community colleges in Pennsylvania to increase skills of current employers. If an employer has a new piece of equipment that requires training, funding is available to the company to increase employee skills. DCED also reviews work completed through Labor & Industry's apprenticeship program and has a full time staff member dedicated to increasing the number of apprentices in Pennsylvania; it's a hands-on training program. A program is needed for education and awareness of career options available to drivers. In talking with CareerLinks statewide, one of the fastest-growing training certifications is CDLs because there are so many jobs and an individual can begin working quickly.

Regarding training and education, what opportunities exist for people interested in AV who are looking to enter the workforce now or in the next few years?

BRENNAN: The way the economy adapts in Pennsylvania historically is through innovation and small businesses. Individuals and companies should look for niches and dive into the subject matter.

MEDACK: GM has purchased small businesses who specialize in different technologies and agrees that finding a niche with the opportunity to grow is important.

What kind of economic impacts are reliant on workforce issues right now?

BRENNAN: If AVs can prevent people from getting injured and killed, gross domestic product can grow. Additionally, if you gain an extra hour every day, there are impacts in the form of free time or added productivity. This small change can have large economic impacts.

MEDACK: Going forward, policy is going to be important for shaping economic impacts. We need to create a policy atmosphere where businesses can innovate quickly and evolve as technology evolves.



Economic & Social Roundtable – Monday Afternoon Plenary Session

A discussion of the broad economic and social impacts of AVs, including changing business models, employment, land-use, and public finance.



Moderator



Megan S. Ryerson, PhD, Assistant Professor in the Departments of City and Regional Planning and Electrical and Systems Engineering at the University of Pennsylvania

Panelists



Lee Branstetter, CMU

- There have been quantum leaps in recent years in machine vision. Some commercial automation will happen faster than others.
- Economists refer to spatial mis-match...often the jobs appropriate to people's skill level are being generated in other areas.



Eileen Cipriani, PA Dept. of Labor & Industry

- The lack of transportation to training and health care are obstacles.
- PA is experiencing a downturn in manufacturing jobs, even as productivity has increased. AV will disproportionately affect this population if they do not have access to training.
- We need to look at policies and training programs today in order to line up with this emerging technology.



Dennis Davin, DCED

- It is our mission to foster innovation and enable it to thrive. Worker training will be vital to businesses that are seeking to adapt to this new technology.
- Our strategic position in the Northeast offers prime location for company access to the Northeast and the Midwest and major markets.
- We are within a day's drive of 60% of US and Canada population, and 40% of all U.S. manufacturing. We rank 10th in the U.S. in the number of Fortune 500 companies, and we have the 19th-largest GDP in the world.



Patricia Hendren, I-95 Corridor Coalition

- We need to clarify why we need to have these CV/AV vehicles and how we measure success. As our vehicles are changing, we must re-think how we gather revenue to pay for the infrastructure we're driving on.



Mike Lorenz, Sheetz

- We have 560 stores in 6 states with 2 distribution centers, and we have over 400 drivers. We serve customers on the go.
- The people using these vehicles haven't even been born yet. Consumers can be very resistant to change.



Jack Machek, 10,000 Friends of PA

- We need data, and a vision for how we're going to use AV to increase opportunity and access. We don't want this to be a toy for only the richest people.



Frank Snyder, AFL-CIO

- We represent 700,000 people across Pennsylvania.
- We are not obstructionists: organized labor has been no stranger to automation.
- Biggest union in 1900 was horseshoers. Today it has 14 members.
- The automobile created whole new industries.
- We just began a manufacturing apprentice program.
- There was little vision for job retraining in the 1980s when manufacturing tanked.
- It has been a race to the bottom in the trucking industry. Truck drivers must sustain low pay, and are often saddled with enormous truck payments. They're exploited by having to drive longer hours, and all the other social costs associated with that (e.g., divorce, poor health, early death). As long as labor is cheap, business will say we'll do it cheaper this way for now.

Audience Questions

Automation could unlock career options for some, and harm others. From the state perspective, how do you balance this to make it as socially optimal as possible? What do you want this to look like?

CIPRIANI: As we develop our workforce development strategies, we want all to have an opportunity to have a high-paid, family-sustaining job. We have a high turnover in CDL drivers. We are focusing on apprenticeship programs. We've been adopting this for occupations. We are working with DCED to establish some funding to put behind it as a good way to train workers and take workers who have been displaced and put them into a job. We are working to get lower-skilled workers "upskilled."

DAVIN: Governor Wolf has been promising funding for job training and job retraining.

LORENZ: This is more evolutionary than revolutionary. It will be a slow burn as the technology continues to improve and the markets evolve. The leading edge could be the bleeding edge in this case.

Pennsylvania is so diverse in its landscape with major cities and rural areas. Let's discuss inter-city transportation. Many smaller cities have lost an economic engine in their airport. Could there be a growing boundary in what a city is? Does a place like Allentown become more a part of Philadelphia, etc.?

BRANSTETTER: AV could reshape the choice between air and ground transportation. We could see trips moving from air to ground with AV. AV could reshape the geography of cities.

SNYDER: There is an ongoing issue of infrastructure investment. Our roads and bridges are in a mess. As exciting as [AV] is, there has to be something driving across it that is safe. This problem has been many years in the making...a lack of investment in our infrastructure.

What kind of projections/planning are you doing in reference to automation?

SNYDER: We are taking the approach that this is happening NOW, and on a fast track.

BRANSTETTER: This is highly non-linear. There will be many years where adoption is steady and gradual, then we'll reach an inflection point. Now is the time to get our policy apparatus in place, before we reach that inflection point. We'll need to move very fast.

There was a recent article in the *New York Times* about taxi drivers getting displaced by Uber. If we have automated cabs, how would we regulate them?

DAVIN: It will have to be regulated. This will not happen within the next five years. I don't think we'll be a follower...we're a leader. And we will continue to try and be a leader and do what we can at a policy level.

CIPRIANI: This technology will be different than other types. We will need to work with other states on this. This particular technology, the industry wants standardization across the states, so this will go beyond state boundaries, and so the Federal government, NHTSA, FCC, DHS, will have to play a role and require coordination beyond our boundaries.

Tuesday Morning Facilitated Session

What did you think before? What do you think now?



Moderator



Sheri Collins, DCED Deputy Secretary for the Office of Technology & Innovation

- This is one of the best conferences I have attended in quite some time. This has been an amazing undertaking.

The Future of Transit

- Pennsylvania has a mandatory reporting law from doctors for people who cannot operate a motor vehicle. AV may change the world for those individuals. Today we take licenses away from individuals, to where they now have to depend on their family and friends, or some other transit system that may no longer be on their schedule.
- We have 775,000 licensed drivers that are over the age of 75. Pennsylvania is aging, and AVs offer a tremendous opportunity at a community and family level to give individuals options that they don't currently have.
- Many younger people are afraid to drive, or can't afford to drive. There is a wave of people who just don't want to drive themselves, and would rather Uber everywhere. The advent of this technology will be transformational.

- There are so many resources here in Pennsylvania. We drove a Tesla here in self-steering mode. Will we trust 14- and 15-year-olds to operate a self-driving car? We can soon give mobility to those who are disabled.
- There are equity issues, with rural versus urban.

COLLINS: Parking is at a premium in a lot of our cities. What will happen to the loss in revenue as it relates to the loss of those parking spaces?

- As someone who is responsible for running a municipality, parking is an issue I came to ask about. Often when we build a parking garage, its structured on a self-liquidating loan. In my municipality, people are clamoring for a parking garage. This would require obtaining a 30-year self-liquidating loan, which puts us into the timeframe when AV will be here. Why should we take on this debt? A recent *New York Times* article stated that 15 percent of the City of Pittsburgh's revenue comes from parking garages and parking areas. Self-driving cars will not speed, so there will be no revenue there. What will our small municipal police departments be doing? Much of what they do is to regulate traffic. What will they do, and how will we pay them? There are a lot of answered questions. Our road paving plan is a 30-year plan, and so we need to know something now if self-driving cars will require less asphalt, as it will change our budgets significantly.
- What do you do with parking garages? Maybe we need to design them for adaptive reuse. We're creating spaces for the AVs to be maintained. Where will the AV fleet be parked when they're not in use? We have mixed-use high rises that have parking in them. Can they be adapted into commercial or residential uses? The buildings we put up today will still be here 50 years from now.

Training the New Workforce

- There were a number of people in the session with Comprehensive Transition Programs (CTP) from community colleges. One question is what are we supposed to be doing next, and what direction should we be moving in? We don't know what standards are there. We have students coming from different backgrounds and perspectives who are used to working in structured partnerships. Given the current interactions from those involved in AV technology, there needs to be a lot more communication as things evolve. There was much discussion on educational paths, and inter-disciplinary work in academia. GM's representative spoke on the need for credentialing and validating credentials although consumers aren't always educated on what certain credentials are worth and where they can be used.
- What will happen to truck driver jobs? The panel said their lives would be dramatically improved, but I think there would be a problem, since many would be afraid to ride next to a truck that doesn't have a driver in it.
- What about the way we are teaching our younger students? Should we be teaching them coding in order to create the workforce of the future and meet the needs of this industry sector?
- With Artificial Intelligence, these vehicles are learning on their own, which requires a different kind of programming.

- For the CNT schools out there, we are doing a lot of that already. We also have robotics classes. We should change the way we look at career/technical schools. To steer students away from vo-tech schools is short-sighted. Parents need to understand the role those schools play and the opportunities they afford to our students.
- I was hoping to see more of a “call to arms” from our state leadership. About 50% of students in our school district don’t go on to college. We need them to be able to quickly assimilate into emerging job opportunities.
- Secretary Richards facilitated a diversity session for recruit at the Nittany Lion Inn, which also featured some of the same themes and substance. PennDOT faces an imminent human resources and talent deficit. The pipeline is not full, and that is a condition that is not unique to PennDOT. There were many in attendance from the TMAs, as well as the MPOs and RPOs. They are typically focused on the delivery of services, and are uniquely positioned to work with their communities to ensure that the school districts are focusing and refocusing on STEM education and recruiting minorities and girls. A sound transportation system for tomorrow needs to begin in our schools today.

COLLINS: Tell us what it is you would like to see at the next conference and what we can do to prepare now for it. How do we enlist the support of more community colleges and transit agencies? Who pays for this? Is it public or private? What else do you want to see?

- This is a great kick-off to what I expect will be a series of conferences. The discussion has been practical, with a discussion on vocational training and STEM education. Pennsylvania remains a leader in this. A practical collaboration between government, private sector, and education will be needed on an ongoing basis.
- With disabled riders, an AV may pull up to the house, but will require the level of assistance that’s provided by a typical paratransit operator. Machines are good at doing repetitive things, but humanity is superior at taking on a situation they have not encountered before. The human role is never going to go away...we just need to re-think what those roles are. There will be changes, which could be positive, or negative. We need to move beyond the technological questions, and address the social ones as well.
- There are four elements to this: connected vehicles, automated vehicles, electric vehicles, and shared vehicles. AVs do not represent a problem for parking...shared vehicles are. Airports are already seeing the economic impact of this.

Poster Sessions



Xiaoxia Dong, Pennsylvania State University
Transit User Perceptions of Driverless Buses

Owen Hitchcock, Pennsylvania State University
Electronic Beacon to Guide Autonomous Vehicles through Work Zones



Lingyu Li, Pennsylvania State University
Development of Regionalized SPFs for Rural Two-Lane Roads in Pennsylvania

Joyce Liang, Pennsylvania State University
Signal Timing Optimization with Connected Vehicle Technology: Platooning to Improve Computational Efficiency



Nicholas Page, Lock Haven University
An Autonomous Robot for Maze Solving – Configuration and Algorithm in Java



Yipeng Peng, University of Pennsylvania
What Impact Does Driverless Goods Movement have on the Regional Economy?

Speaker Bios



Fred Bergstresser is the Government Account Manager for Royal Truck and Equipment, Inc. Fred's primary project is management and oversight of the Autonomous TMA development and commercialization project. He also leads Royal's Texas A&M TTI study to measure the effectiveness of a mobile radar board (on a TMA Truck) to reduce highway traffic speed in work zones. Fred also serves on ATSSA's Innovation Council and Manufacturers and Suppliers Committee. (American Traffic Safety Services Association). Fred oversees all government relations and government procurement for Royal Truck & Equipment.



Eric Boerer is the Advocacy Director of Bike Pittsburgh, a 15-year old bicycle and pedestrian advocacy organization. Having worked for the organization since 2005, it has grown to a staff of nine, with over 3,000 members in the Pittsburgh area. His work in advocacy helped usher in Pittsburgh's first bike lanes, a Complete Streets Policy, and making biking and walking issues a priority within the City. As Pittsburgh is one of the first US cities testing Autonomous Vehicle technology on public streets, BikePGH felt it necessary to create the first survey of bicyclists and how they feel about sharing the road with AVs.



Stephen Boyd is Co-founder and VP of External Affairs for Peloton Technology, a Silicon Valley-based connected and automated vehicle technology company that is bringing innovations in safety and efficiency to the freight transportation industry. In this role, he leads public affairs, government relations and market development for the company. For the last decade, Steve has worked with leading edge transportation and energy enterprises and advocated for policy change and market innovation to accelerate progress in these sectors. Previously he has held a variety of roles with technology companies, federal agencies, political campaigns, and public policy initiatives. Steve holds an Environmental Science degree from Pennsylvania State University with minors in Economics and Political Science and studied international business at the University of Manchester (UK).



Lee Branstetter is a professor of economics and public policy at Carnegie Mellon University and a nonresident senior fellow at the Peterson Institute for International Economics. Branstetter is also a research associate of the National Bureau of Economic Research. He served as a Senior Economist at the Council of Economic Advisers in 2011-2012. Before moving to Carnegie Mellon, Branstetter was the Daniel Stanton Associate Professor of Business at Columbia Business School, where he directed the International Business Program. Branstetter also served as an Associate Editor of the Journal of International Economics from 2003-2011. Branstetter received his PhD in economics from Harvard University in 1996 and his BA from Northwestern University in 1991.



Dr. Sean Brennan is an associate professor of mechanical engineering in the Department of Mechanical and Nuclear Engineering at Penn State. He has a wide range of research interests including dynamic systems and control with application to automotive systems, robotics, biological sensing and mechatronics. Brennan is the Director of the Vehicle System and Safety Program at the Pennsylvania Transportation Institute, Director of the Intelligent Vehicles and Systems Group and a member of ASME, IEEE, and ASEE.



Steve Buckley currently serves as the Northeast Regional Manager for WSP's Planning, Environment and Traffic practices. Steve is a licensed engineer and planner, and has over twenty years of experience in many aspects of the transportation industry. Steve most recently served as General Manager of Transportation for the City of Toronto. Steve earned Master's Degrees in Transportation and in City Planning from the University of California - Berkeley and a Bachelor's Degree in Civil Engineering from Syracuse University. He currently serves as the Chair of the Transportation Research Board's Committee on Transportation Issues in Major Cities, serves on the Board of ITS Canada and the University of Toronto Transportation Research Institute. Steve is also a Lecturer in the City & Regional Planning program at the University of Pennsylvania.



Stan Caldwell is the executive director of Traffic21 Institute and the T-SET University Transportation Center. In 2014, Stan was appointed Adjunct Professor of Transportation and Public Policy at Carnegie Mellon University, where he teaches courses and advises student projects. Additionally, Stan serves as the Director of State Relations for CMU's office of Government Affairs. Before joining CMU, Stan served as the Executive Director to U.S. Senator Arlen Specter's Pittsburgh office, in addition to serving for many other Pennsylvania elected officials. Stan received his Master of Public Policy and Management degree from the University of Pittsburgh.



Dr. Pam Carter has over 30 years of experience in higher education and industry. Pam received her MBA from the University of Maryland, her Ph.D. in Business Administration from Florida State University, and she holds several industry certifications including Senior Professional in Human Resources (SPHR), Certified Information Systems Auditor (CISA), and Project Management Professional (PMP). Pam currently serves as Dean of the Business & Technology Division at Community College of Philadelphia, where she thoroughly enjoys working with a diverse range of students.



Eileen Cipriani is deputy secretary for workforce development at the Pennsylvania Department of Labor & Industry, where she oversees the 23 local workforce areas that make up the commonwealth workforce system. She is responsible for the Center for Workforce Information and Analysis, the office for labor market information, the PA State Workforce Development Board, and the commonwealth's Apprenticeship Training Office. She has a Bachelor of Science from Bloomsburg University and a master's in organizational management from Misericordia University.



Roger Cohen has been PennDOT Policy Director since July 2015. As Policy Director, Roger advises Transportation Secretary Leslie S. Richards on all matters affecting transportation policy within the Department and the Commonwealth. He is directly responsible for serving as the Department's liaison with the Governor's Office and other Commonwealth agencies on policy and regulatory matters. He serves as co-chair of the Pennsylvania Autonomous Vehicle Policy Task Force. His other principal areas of policy focus have been improving pedestrian safety and reducing the climate impacts of the transportation system. PennDOT's Highly Automated Vehicle leadership group that Roger co-leads was honored with the 2017 President's Award for Performance Excellence from the national organization of state transportation departments, AASHTO. Before joining PennDOT, Roger had a diverse career in public service, law, politics, consulting and journalism. For

eight years, he was at the Port Authority of New York & New Jersey, where he served as policy aide to the agency's Executive Director and Board Chairman, manager of the agency-wide business planning process, and deputy director of the Port Authority's office of policy analysis and planning.



Sheri Collins is the Deputy Secretary for the Office of Technology & Innovation at the Pennsylvania Department of Community and Economic Development. She is committed to supporting Pennsylvania's innovators and entrepreneurs, and she works directly with Pennsylvania's business community, its colleges & universities and strategic partners such as the Ben Franklin Technology Partners, Pennsylvania's three Life Science Greenhouses and the Partnerships for Regional Economic Performance to ensure that our commonwealth is competitive in a global economy.



Dennis M. Davin was appointed to serve as Secretary of the Department of Community and Economic Development in January 2015 by Governor Tom Wolf. Prior to his appointment, Secretary Davin served as Director of the Allegheny County Economic Development since March 2004. During his time at the Allegheny County Economic Development, Secretary Davin managed funding from local, state and federal resources to implement economic development activities such as: site development, new job creation initiatives, community development and affordable housing for approximately 1.25 million citizens in 130 municipalities. He also served as Director of the Allegheny County Redevelopment Authority and Executive Director of the Industrial Development Authority, Hospital Development Authority, Higher Education Building Authority and Residential Finance Authority.



Dr. Eric T. Donnell is the Director of the Thomas D. Larson Pennsylvania Transportation Institute, and a Professor of Civil Engineering at Penn State University. He is chair of the TRB Geometric Design Committee and of the PennDOT-FHWA Safety Technical Advisory Group. Dr. Donnell has 18 years of research and teaching experience related to traffic safety, speed management, and highway design. He has been Principal Investigator on research valued at more than \$6 million for a variety of federal, state, and local transportation agencies. Dr. Donnell is a past leadership fellow of the ENO Foundation.



Courtney Ehrlichman is Deputy Executive Director of Traffic21. Courtney was previously a researcher and Special Faculty at CMU, where she spun out the Flight School Fellowship in 2010, which she still directs today. She has also designed and/or managed projects at many non-profit organizations including the Friendship Development Associates, cityLAB, Waffle Shop, Conflict Kitchen, and Red Star Ironworks. Overall, Ms. Ehrlichman has personally raised over \$2.5 million in federal, state, and private funds to implement the projects she has designed and managed. She holds a Masters of Public Management from the Heinz College at Carnegie Mellon University and a bachelor's degree in Urban Planning and Architectural Studies from the University of Pittsburgh.



Jackie Erickson is a robotics-focused public relations and government affairs consultant based in Pittsburgh, Pennsylvania. After a decade of public policy experience including service as Southwestern Pennsylvania Regional Director for U.S. Senator Robert P. Casey Jr., Jackie chose to follow her passion for robotics, serving first as Director of Communications for Astrobotic Technology then founding a boutique consulting firm dedicated to telling the stories and advocating for the Pittsburgh robotics community. Jackie's clients span sectors such as defense, logistics, health care, agriculture, and transportation. Jackie is the Pittsburgh robotics cluster representative for the Robotics Industry Association and is a founding member of the Pittsburgh Robotics Network.



Rich Farr is the Executive Director of rabbittransit, a regional public transportation provider serving the residents of ten Central Pennsylvania counties and providing over 2.5 million trips per year. Farr's leadership has resulted in several initiatives, including piloting paratransit software and the Find My Ride PA project for the Commonwealth. Farr has served as Chairman of the Pennsylvania Public Transportation Association, the Susquehanna Regional Transportation Partnership, York County MPO, and is the current Chairman of the Adams County MPO.



Brett Fusco is the Manager of Long-Range Planning at the Delaware Valley Regional Planning Commission. He's conducted numerous regional what-if scenario analyses, worked on funding and financial planning issues, asset management, and written a variety of key policy papers such as Networking Transportation. He was instrumental in forming the Futures Group, an interdisciplinary working stakeholder expert group that analyzes how change is reshaping Greater Philadelphia. He holds a B.A. in Mathematics from Wichita State University and Masters in City and Regional Planning from the University of Pennsylvania.



Sheila J. Gombita is the Executive Director of the Washington County Transportation Authority (Freedom Transit), a position she's held since 2001. She is responsible for managing and directing the public transit agency, providing approximately 300,000 trips per year with an operating budget of \$6.6 million. Ms. Gombita is a Certified Community Transit Manager and holds a Bachelor's Degree in Psychology from Edinboro University of Pennsylvania. Ms. Gombita was the first female elected to Chair the Pennsylvania Public Transportation Association Board of Directors, and has served on the board since 2010.



Art Guzzetti, a 38 year professional in public transportation at the local, state and national levels, serves as Vice President-Policy for the American Public Transportation Association (APTA), the trade group for the public transportation industry. Among other things, Mr. Guzzetti is responsible for APTA's extensive policy development and research agenda, and for advancing policies favorable to public transportation with Congress, the Administration, state and local governments, with grass-roots and stakeholder organizations, and with public policy think tanks. A key current focus is to integrate and leverage transit networks with new and emerging public and private mobility services, including micro transit, transportation network companies, automated vehicles and bicycles. The public transit agency of the future will weave these services into a system, with high-capacity transit lines in key corridors as the backbone. Prior to coming to Washington in June 1997, Mr. Guzzetti had 16 years of management experience with two of the nation's leading public transportation systems: New Jersey Transit, and the Port Authority of Allegheny County. Among other position, he is the immediate past national president of the Transportation Research Forum



Patricia (Trish) Hendren is the Executive Director of the I-95 Corridor Coalition, a multi-state, multi-modal organization dedicated to improving transportation from Maine to Florida. She has spent her career working with State DOTs, MPOs and transit agencies to turn data into useful information, implement data-based decision making, and demonstrate the value of transportation investments. Trish has been actively involved in TRB chairing or serving on committees, research panels and conference planning efforts. Dr. Hendren's contributions to the field and focus on mentoring were recognized in her selection as the 2014 WTS -DC Chapter Woman of the Year. Trish holds a Ph.D in Transportation Technology and Policy and a Master's Degree in Ag Econ, both from the UC Davis, and a B.A. in English from Duke University.



Jeff Iseman is the Program Analyst for the Pennsylvania Statewide Independent Living Council (PA SILC) since 2007. He is the Chair of National Council of Independent Living (NCIL) Transportation Subcommittee and lead staff support for Pennsylvania Transportation Alliance. Jeff is active with the Pennsylvania Disability Budget Coalition and Keystone Transportation Funding Coalition (KTFC) regarding state and federal issues on various transportation modes that impact people with disabilities of all ages. A life-long Pennsylvanian, Shippensburg University MPA candidate and Grove City College graduate, Iseman relocated to Central PA in 2005 from SW PA after a brief period in SE PA. Prior to joining the PA SILC, he worked as the Public Policy Analyst (Adult Issues) for The Arc of PA, for Congresswoman Melissa Hart, in Human Services and Housing.



Carol L. Kilko joined the Department of Community and Economic Development (DCED) in June of 2015. As the Deputy Secretary of Administration, Carol manages the internal administrative operations of the agency and acts as training coordinator for DCED staff professional development. From 2006 to 2015, Carol served as the Director of Training Services for the Pennsylvania State Association of Township Supervisors (PSATS). Carol holds a Master's in Public Administration and a Bachelors of Public Policy from Penn State University.



Mark Kopko is the manager of PennDOT's Advance Vehicle Technology program. Mark is currently in charge of all day-to-day operations related to connected and automated vehicles including the deployment of Dedicated Short-Range Communications (DSRC) and the development of the Statewide Connected and Automated Vehicle Strategic Plan. Mark has previously served as a technical advisor for the PennDOT's 2040 Connected and Automated Vehicles Vision and committee member for NCHRP 20-24(98) - Connected and Automated Vehicles Research Roadmap. Mark is PennDOT's representative to the Connected Vehicle Pooled Fund, Vehicle-to-Infrastructure Deployment Coalition, AASHTO's Connected/Automated Vehicle Working Group, Smart Belt Coalition, and numerous other groups/committees. Mark is a graduate of The Ohio State University.



John Lacek is Department Counsel for the Pennsylvania Insurance Department. In this capacity, Mr. Lacek advises numerous Department program areas with regards to issues involving property and casualty insurance. Mr. Lacek is the Department's subject matter expert in emerging issues such as cybersecurity, unmanned aerial vehicles and autonomous vehicles. Prior to joining the Department Mr. Lacek practiced law at a private insurance regulatory firm where he counseled clients on how emerging technology effect the insurance industry.



Mike Lorenz is currently the Executive Vice President responsible for the petroleum supply and trading at Sheetz, a family owned convenience store chain which operates over 550 stores in 6 states. Having worked in the petroleum industry for almost 40 years, Mike has extensive knowledge and experience in refining, domestic and global supply and trading, and wholesale and retail marketing. Before coming to Sheetz, Mike spent over 20 years with Mobil Oil serving in a wide variety of midstream and downstream roles including international assignments in London and Rotterdam. Mike is on the Board of Advisors at the Fuels Institute and is a frequent speaker at industry events. He holds a Bachelor of Science degree in Chemical Engineering from Clarkson University.



Jack Machek joined the 10,000 Friends of Pennsylvania as President & CEO in 2010. Prior to joining 10,000 Friends, he worked at the Pennsylvania Department of Community and Economic Development (DCED). Jack initially was a Strategic Investment Officer for the new Governor's Community Action Team (CAT) before ascending to the role of Regional Director of DCED's Southwest PA Regional office. Jack has a Master's degree in Public Administration and Applied Policy Analysis, and currently serves on the Board of Directors of Smart Growth America, including Transportation for America, the National Brownfields Coalition, and the National Complete Streets Coalition.



Paul Mackie has been Communications Director at Mobility Lab since 2012. He specializes in reporting, writing, editing, helping journalists, and speaking about how places can become vibrant through public-transportation initiatives. For the eight years prior to joining Mobility Lab, he was Climate Change Communications Director at The Nature Conservancy and Director of Media Relations at the World Resources Institute. Paul obtained his master's degree in media studies and political science from Georgetown University and his bachelor's in English literature and journalism from Southern Illinois University.



Christopher J. Marzacco is a partner at Anapol Weiss, a Philadelphia personal injury law firm. Christopher earned his law degree in 1996 from Widener University School of Law, and concentrates his practice in automobile, motorcycle, and trucking accidents. He has written about automobile law and automobile insurance issues for the Legal Intelligencer and other publications. Christopher also teaches trial advocacy for Widener University's Intensive Trial Advocacy Program, and has done so since 2001.



Staff Sergeant Terence J. McDonnell is a 30-year veteran of the New York State Police assigned in the Traffic Services Section at Headquarters in Albany, where for the past 24 years he has overseen the agency's statewide traffic safety programs and initiatives, including a recently created autonomous vehicle test permit process. He is a member of the Highway Safety Committee of the International Association of Chiefs of Police and a member of the AAMVA Autonomous Vehicles Working Group, where he serves as Chair of the Law Enforcement Subgroup.



Alexandra (Allie) Medack is the Chief of Staff for Global Public Policy at General Motors, and is based in their Washington D.C. office. As Chief of Staff, Ms. Medack coordinates GM's government relations and public policy activities around the world, with a focus on autonomous vehicles. As part of GM's emerging technologies team, she leads engagement efforts with regulators, industry leaders and policymakers to advance the next generation of automotive technologies. Prior to joining GM in 2014, Ms. Medack worked on the U.S. House of Representatives Committee on Foreign Affairs and at Public Strategies, a leading business advisory and strategic communications firm.



Tony L. Mento has worked for the Federal Highway Administration for more than 29 years. He currently serves as the Director of Technical Services overseeing a staff of experts focused on structures, ITS, safety, and pavement and materials. Before serving as Director, Tony was an Engineering Team Leader, and a Senior Field Engineer. Tony has a Bachelor of Science in Civil Engineering from Syracuse University and a Master's Certificate in Project Management from George Washington University. Tony is a registered Professional Engineer in the state of Pennsylvania.



Kurt J Myers was appointed Deputy Secretary for Driver & Vehicle Services for the Pennsylvania Department of Transportation (PennDOT) in June 2007. In this position, Myers oversees nearly 1,200 driver and vehicle services employees who provide quality customer service, while keeping the safety and security of the commonwealth's 8.7 million licensed drivers and 11.3 million registered vehicle owners a paramount focus. He also serves as co-chair of the Pennsylvania Autonomous Vehicle Policy Task Force. As Deputy Secretary for Driver & Vehicle Services, Myers oversees key highway safety improvements relating to driver behavior, a customer-conscious business approach, implementation of motorist-related legislation, and integration of new initiatives that improve customer services, streamline processes, and upgrade quality through the use of new technologies. Myers also is responsible for the regulatory oversight of 97 facilities across the commonwealth that issue driver's licenses and identification cards as well as approximately 5,000 new and used car dealers, 2,500 agents, 17,000 vehicle safety inspection stations, and more than 7,000 emissions inspections stations. Myers is a Central Pennsylvania native and received a bachelor of arts degree from Kenyon College in Gambier, Ohio, in 1978.



Ngani Ndimbie is a MS Candidate for Public Policy and Management at CMU. She's a Pittsburgh native who is passionate about equitable policymaking, economic justice, and healthy communities. Before joining Traffic 21 as the Women in Transportation Fellow, she held positions at some of Pittsburgh's most influential non-profits including the ACLU of Pennsylvania and the Black Political Empowerment Project. Most recently she served as the communications manager for Bike Pittsburgh, a bike and pedestrian advocacy organization. In 2016, Ngani was a Pittsburgh Magazine 40 Under 40 awardee.



Captain Troy H. Park enlisted in the State Police in 1991. He has served in numerous capacities and locations throughout his career and is currently the Assistant Director of the Pennsylvania State Police Bureau of Patrol.



Alex Pazuchanics serves as the Assistant Director for Planning, Policy, and Permitting in the Department of Mobility and Infrastructure. He led Pittsburgh's response to the USDOT Smart City Challenge, which was named one of 7 finalists; manages the City's designation as an Autonomous Vehicle Proving Ground; and is a member of the PennDOT Autonomous Vehicle Policy Task Force. Alex has testified before Congress and presented at South by Southwest on Smart City policy. A graduate of The George Washington University and Carnegie Mellon University, Alex previously served as the Mayor's Policy Advisor, and has worked in the Pennsylvania House of Representatives and Pittsburgh City Council.



Damon Porter's state and local public policy expertise grew from his background in both the public and private sectors. Prior to joining Global Automakers, he was a senior adviser to Missouri Governor Jay Nixon on technology and innovation issues. Previously, Damon was director of public affairs for a Fortune 100 telecommunications company, chief of staff and legislative director for two speakers of the Missouri House of Representatives, an assistant attorney general of Missouri and an associate for a boutique integrated communications firm. He was chairman of the transition team for Missouri State Treasurer Clint Zweifel and has served on several civic, trade and philanthropic boards of directors. He is a life member of the Council on Foreign Relations and admitted to bars of Missouri and the Supreme Court of the United States.



Chris Puchalsky is a nationally recognized transportation expert with a passion for livable cities. He has Bachelors and Master's degrees in Mechanical Engineering from Temple University, as well as a PhD in Urban Transportation Systems Engineering from the University of Pennsylvania. He currently serves as Director of Policy and Strategic Initiatives at Philadelphia's Office of Transportation and Infrastructure Systems. His professional experience includes three years designing engines for the Ford Motor Company, working as a transportation consultant both in the United States and abroad, teaching and advising as an adjunct at the University of Pennsylvania and the University of Waterloo, and serving the greater Philadelphia region as Director of Transportation Planning at the Delaware Valley Regional Planning Commission (DVRPC).



Appointed by Governor Tom Wolf in 2015, Secretary Leslie S. Richards is the first planner and female to lead PennDOT, an agency with a \$9 billion annual budget, 11,525 employees, 40,000 miles of state-owned highway miles, 25,000 state-owned bridges, oversight of 38 public transit systems and 3 ports, and responsibility for issuing 9 million driver licenses and registering 12 million vehicles. She has developed such innovative programs as PennDOT Road Map, to address maintenance needs with an increased emphasis on the interstate and rural road systems, and PennDOT Connects, to enhance PennDOT's collaboration with local governments and ensure investments consider mobility needs as well as community goals. The Secretary was recently named chair of the Pennsylvania Turnpike Commission and serves as chair of the Pennsylvania Public Private Partnership board. A graduate of Brown University and the University of Pennsylvania, she has also served her township and county as a local elected official in Montgomery County while working in various capacities in the planning and engineering fields.



Stacia (Stacey) Ritter is director of Policy & External Affairs for the Pennsylvania Turnpike Commission. She began her governmental career in the Pennsylvania House of Representatives after graduation from Shippensburg University as a budget analyst for the Democratic Appropriations Committee. After earning her juris doctor degree from Widener School of Law in 2001, she served as legal counsel for the Democratic Committee on Committees. She also served as executive director of the Democratic Intergovernmental Affairs Committee, executive director of the Democratic Commerce Committee, executive director of the Majority Transportation Committee and assistant executive director of the Democratic Appropriations Committee before taking her current position with the Turnpike Commission in September 2011.



Megan S. Ryerson, PhD is an Assistant Professor in the Departments of City and Regional Planning and Electrical and Systems Engineering at the University of Pennsylvania. She is the Research Director of the Mobility21 Transportation Research Center, a national University Transportation Center (UTC) and a Senior Fellow at the Center for Injury Research and Prevention at Children’s Hospital of Philadelphia. Dr. Ryerson builds models to understand the system effects of transportation and how perturbations to the system – from new technologies like autonomous vehicles to disasters and infrastructure outages – impact traveler choice and mobility, facility congestion, and, more broadly, the local and regional economy and environment.



Fred Sargent is founder and president of Great Service Forums, a program—exclusively for union electrical contractors—to provide union electrician service department managers with unique learning experiences tailored specifically to the demands of their role in service and maintenance. Fred is a former CEO of Pittsburgh-based Sargent Electric Company. During his tenure with the company he devoted many years to the Joint Apprenticeship Training Committee serving the 22-county market area covered by IBEW Local Union #5, of which he is a member. For the past several years he has worked closely with the IBEW Education Department on a national scale in the development and promotion of Market-Driven Contracting, it’s educational program that prepares and supports union members who have elected to start their own contracting businesses that energetically focus on underserved sectors of the marketplace.



Jason D. Sharp was appointed Acting Chief Counsel for the Pennsylvania Department of Transportation in June of 2017. Prior to his appointment, he was the Executive Deputy Chief Counsel, serving as chief administrator for three regional PennDOT legal offices that provide litigation and legal support services for forty-five counties. Mr. Sharp also acted as counsel on priority projects and litigation matters including service as lead counsel to Pennsylvania’s Autonomous Vehicle Task Force. Prior to his appointment as Executive Deputy, Mr. Sharp was a member of the Office’s Real Property Division. Mr. Sharp is a graduate of Widener University School of Law and holds a Bachelor of Arts degree in Political Science from King’s College.



Renee Sigel has served the transportation industry for over 20 years, most recently as the FHWA's Division Administrator for the Commonwealth of Pennsylvania. She previously served as an assistant division administrator for the Idaho Division of the Federal Highway administration (FHWA). She also served as a quality coordinator for the Central Federal Highway Lands Division in Denver, and before that the planning and environment team leader in the Maryland Division Office. Ms. Sigel is a native of Pennsylvania and started her career in with FHWA in 1991 as an environmental specialist. During her term as the FHWA PA Division Administrator she has become known as a leader in transportation sustainability and role model for transportation professionals throughout the state. She has lead FHWA PA Division efforts in initiatives and programs such as Smart Transportation (livability/green), Every Day Counts and the formation of the STIC, and part of a national leader in improving freight transport in the United States.



Matt Smith is Michael Baker's Connected and Automated Vehicles (CAV) Program Manager, located in Detroit, MI. He serves as the national lead for CAV projects, initiatives, research, technical consulting and programs. He has 23 years of experience in traffic engineering, intelligent transportation systems (ITS), and transportation system management and operations (TSMO) while spending the last five years dedicated to connected and automated vehicle initiatives. Previously at Michigan DOT, Mr. Smith held the position of statewide Intelligent Transportation Systems Administrator.



Frank Snyder is the Secretary-Treasurer of the Pennsylvania AFL-CIO, a 700,000-member organization. He began his career at a titanium factory in Western Pennsylvania, served 18 years as a United Steelworkers of America local union leader, became Special Assistant to the Northeast Region Director of the National AFL-CIO, and in 2007 became the AFL-CIO's Pennsylvania State Director. In 2009, Frank was called on by AFL-CIO President Richard Trumka to direct the national field program for the AFL-CIO's Political Department. Frank was elected in 2010 and 2014 to be Secretary-Treasurer on the Pennsylvania AFL-CIO where he continues to serve today.



Rick Vilello joined the Pennsylvania Department of Community and Economic Development in March of 2015, as the Executive Director of the Center for Local Government Services. In this capacity, Rick also directed the efforts of the Tax Equalization Division and the Resources Recovery Team. Before coming to DCED, Rick served four terms as Mayor of Lock Haven and was previously the President of Pennsylvania Municipal League. As Deputy Secretary, Rick oversees the work of the entire deputate including the Centers for Community Development, Community Services, and Compliance Monitoring and Training.



Michael Wagner is the CEO of Edge Case Research, a company he co-founded to help make autonomous vehicles and other complex software-based systems safer and more robust. Mr. Wagner has almost twenty years of relevant experience in this field, developing safety architectures and verification tools for cutting-edge unmanned vehicles at Carnegie Mellon's National Robotics Engineering Center. Earlier in his career he built robots that operated the most extreme environments on Earth, including a meteorite-hunting robot in Antarctica, a solar-powered Arctic explorer, and a robot that searched for life in the barren Atacama Desert.



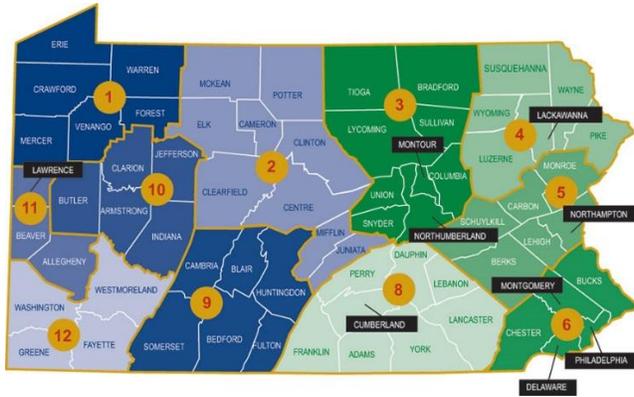
David Woessner currently serves as the first General Manager of Local Motors in Washington DC. After launching an award-winning facility along with the world's first self-driving, cognitive, low-speed, electric shuttle, Olli, in 2016, he is now responsible for operations of the sales, demonstration, and service facility in National Harbor, MD. His primary focus is working with local stakeholders and partners to demonstrate, pilot, and sell self-driving Ollis in the Washington DC region and beyond. David earned his MBA and MS in Mechanical Engineering from Georgia Institute of Technology and received his BA in Physics and German from Wabash College in Crawfordsville, Indiana.



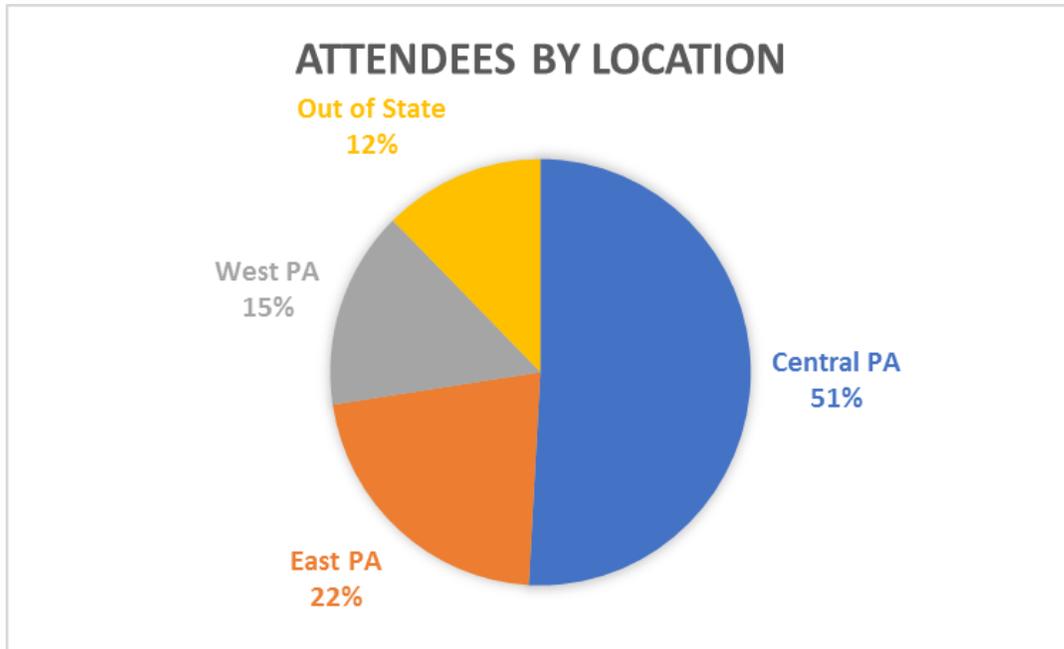
Skip Yeakel has 54+ years in trucking and is a registered Professional (Penn State) Engineer with 33 years for Volvo Group North America where he serves as Principal Engineer. Skip has chaired the Philadelphia SAE Section, Truck Manufacturers Association, and Technology & Engineering Policy Committee of the American Trucking Associations. He spearheaded Volvo efforts for the USDOT Intelligent Vehicle Initiative, NTRCI Trusted Truck® Program, I-95 Corridor Coalition, and similar projects. He currently serves on the Executive Committees of the USDOT Transportation Safety Advancement Group and the USDOE 21st Century Truck Partnership for which he received a "lifetime achievement" award in 2014.

Summit Attendees

Summit Attendees by Location:

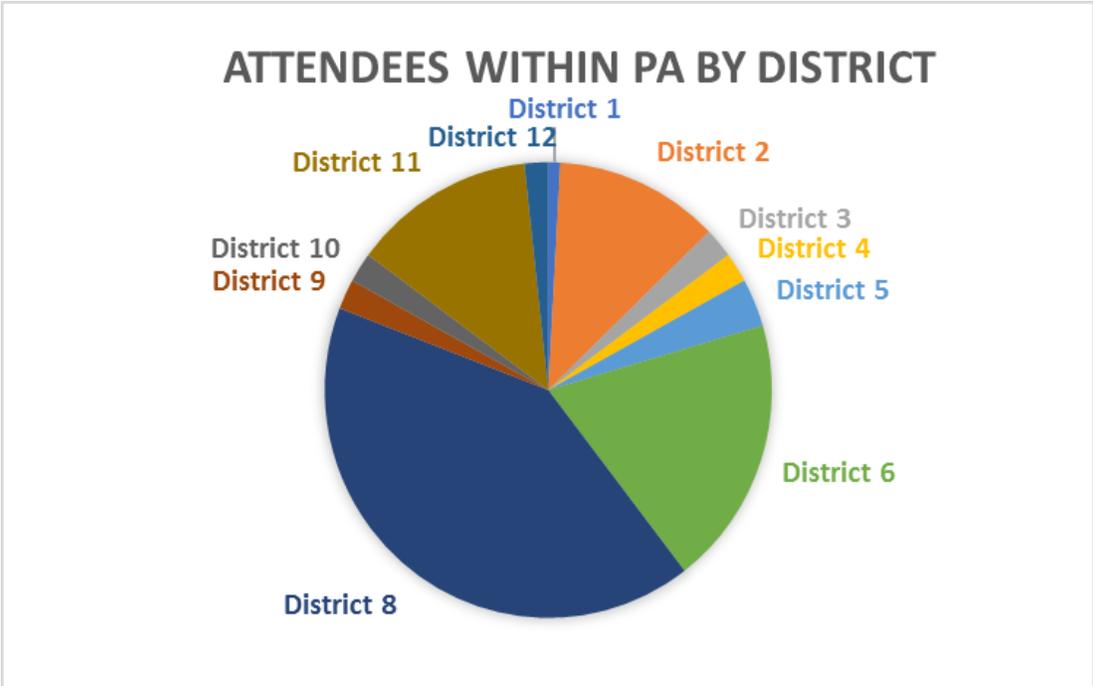


Region	Number	Percentage
Central PA (D2, D3, D8, D9)	139	48%
East PA (D4, D5, D6)	55	19%
West PA (D1, D10, D11, D12)	41	14%
Out of State	27	9%
Other	28	10%
Total	290	100%
PA Total	235	81%



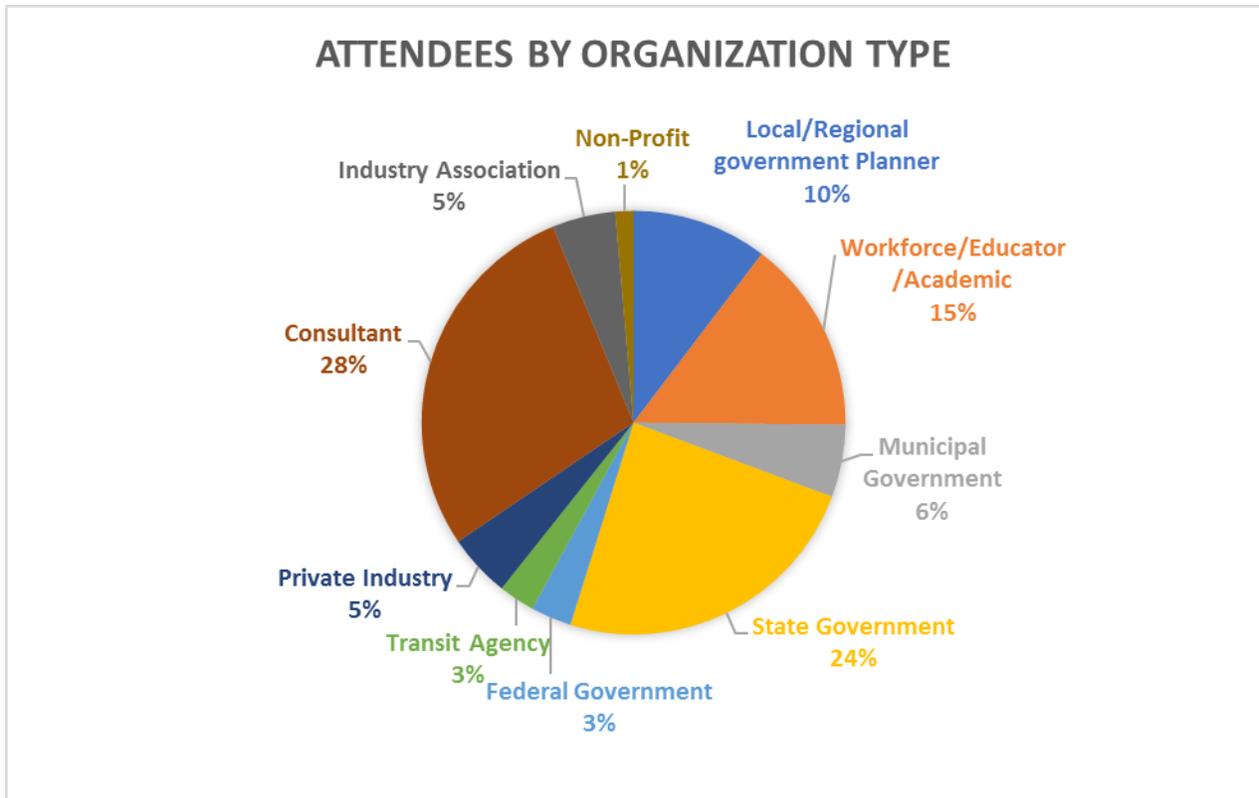
Attendees by PennDOT Engineering District:

Districts	Number	Percentage
District 1	2	1%
District 2	28	12%
District 3	5	2%
District 4	5	2%
District 5	8	3%
District 6	45	19%
District 8	97	41%
District 9	5	2%
District 10	5	2%
District 11	31	13%
District 12	4	2%
Total	235	100%



Attendees by Organization Type:

Organization Type	Number	Percentage
Local/Regional government Planner	30	10%
Workforce/Educator/Academic	43	15%
Municipal Government	16	6%
State Government	70	24%
Federal Government	9	3%
Transit Agency	8	3%
Private Industry	14	5%
Consultant	82	28%
Industry Association	14	5%
Non-Profit	4	1%
Total	290	



Summit Attendees:

<u>Name</u>	<u>Affiliation</u>
Abram, Marie	Penn State University
Alden, Andy	I-81 Corridor Coalition
Alisesky, Mark	McMahon Associates
Allan, Richard	Pugliese Associates
Allison, Chris	Cambria County
Arcuicci, Janet	Montgomery County
Armitage, Earl	Pennoni
Azzato, Dave	Traffic Planning & Design
Bagley, Leo	PennDOT
Baxendale, Casey	Harrisburg MPO
Behrend, David	NJTPA
Beiler, Michelle	Bucknell University
Bender, Rodney	PA PUC
Bergsten, Jeff	Michael Baker
Bergstresser, Fred	Royal Truck & Equipment
Bierly, Douglas	Gregg Township
Biggica, Meredith	Commonwealth of PA
Blacklaw, Stuart	CCAC
Blum, Andrew	PennDOT
Bobitz, Phil	FHWA
Boerer, Eric	Bike Pittsburgh
Boice, Randy	JMT
Bonarek, Leonard	Bicycle Coalition of Greater Philadelphia
Bouabdellaoui, Leila	HDR Engineering
Boyd, Steve	Peloton
Boyer, Matthew	Commuter Services of PA
Bradley, Becky	Lehigh Valley MPO
Brandt, Barry	RK&K
Branstetter, Lee	Carnegie Mellon
Brennan, Sean	PSU
Brown, Corey	
Buck , Tom	NCPRPDC
Buckley, Steve	WSP
Bugaile, Eric	Commonwealth of PA
Burkhart, Megan	Traffic Products LLC
Burnett, James	RK&K
Caldwell, Stan	CMU
Campbell, Gordon	Lehigh Valley Planning Commission
Cardinale, Joseph	PA PUC
Carson, Brandon	SAP&DC
Carter, Pam	Community College of Philadelphia
Chapman, Chris	Lackawanna county
Chianelli, Evelyn	DCED
Cipriani, Eileen	PA Dept. of Labor & Industry
Clark, Will	York County Planning
Cohen, Roger	PennDOT
Colello, Jeremy	HNTB
Collins, Sheri	DCED
Conahan, Kevin	Drive
Conklin, Scott	Commonwealth of PA
Conklin, Cliff	HNTB
Corman, Jake	Commonwealth of PA
D'Andrea, Domenic	SPC
Davin, Dennis	DCED
DeKort, Michael	Tempest Rite LLC
Dell, Felicia	York County Planning
D'Ettore, Steve	PADCED
Di Bono, Ross	Zarwin, Baum, DeVito, Kaplan, Schaer & Toddy, P.C.
Ditterline, Kristin	Gannett Fleming
Doebler, Matthew	Aleppo Twp
Dong, Xiaoxia	University of Pennsylvania
Donnell, Eric	PSU
Drenevich, Ron	STC
Eddy, Martha	KCI
Ehrlichman, Courtney	Traffic21
Einsig, Barry	Cisco
Erickson, Jackie	Jackie Group
Everly, Lucas	PennDOT Ofc of Administration
Ewald, Jonathan	TMACC

Farr, Richard	rabbittransit	Hitchcock, Owen	Penn State University
Fauver, Toby	PennDOT	Hitchens, Preston	Taylor Wiseman & Taylor
Ferro, Anne	AAMVA	Holubec, Lauren	HACC
Ferry, James	Lackawanna-Luzerne MPO	Horn, Jennifer	McCormick Taylor
Fillman, Barry	Jefferson Tech School	Hunt, Kevin	Gannett Fleming
Fisher, Josh	Global Automakers	Huzvar, Jan	PennDOT
Fitzkee, Jonathan	LebCo	Iseman, Jeff	PA SILC
Flanagan, Benjamin	PennDOT	Jain, Nihit	IBI Group
Frederick, Jerome	PennDOT	Jehanian, Karen	KMJ
Friday, Christopher	Erie MPO	Johnson, Amanda	Student
Funkhouser, Brian	Michael Baker	Johnson, Anthony	The Partnership TMA
Fusco, Brett	DVRPC	Johnson, Tim	PennDOT
Gamelier, Liz	Trans Associates	Katsafanas, Jim	Michael Baker - Pitt
Gannon, Edward	Urban Engineers	Katzenmoyer, Charlotte	City of Lancaster
Garner, Ron	PA College of Technology	Kausch, Gregory	Center Regional Planning Agency
Gayah, Vikash	PSU	Keaveny, Brian	Pennoni
Geiger, Kevin	PTC	Keiser, Mike	PennDOT 8-0
George, Doug	Stantec	Kessler, Amy	NCPRPDC
Gerard, Jason	Commonwealth of PA	Kilko, Carol	DCED
Giurintano, Theresa	Lebanon Transit	King, Chris	PennDOT
Glick, Shawn	Traffic Planning & Design	Kinnee, Mark	Urban Engineers
Glover, Benjamin	Mifflin Co Academy	Kinney, George	Lehigh Valley MPO
Golembiewski, Mike	Reading MPO	Kirkpatrick, Richard	PennDOT
Gombita, Shelia	Freedom Transit	Klavan, Tom	SPC
Gomez, Francisco	NHTSA	Kline-Elsier, Nichole	McMahon Associates
Graf, Kristen	JMT	Kopko, Mark	PennDOT
Graziani, Alex	Penn Township	Krajewski, Thomas	Lycoming Co Dept. of Planning
Grescavage, Anthony	Stahl Sheaffer Engineering	Lacek, John	PA Dept of Insurance
Grimes, Naomi	McCormick Taylor	Lain, Sean	JMT
Guler, Sukran	Penn State	Latham, Robert	APC
Guzzetti, Art	APTA	Leary, Neil	WRA
Hacker, Andrew	Harrisburg University	Legault, Jeff	NREC
Harris, Mike	Kimley-Horn	Leonard, Ken	USDOT
Hendren, Patricia	I-95 Corridor Coalition	Leonori, Al	Pennoni
Henry, Robert	GVF Transportation	Li, Lingyu	PSU
Hernandez, Angela	State College Borough	Liang, Joyce	PSU
Herr, Elam	PSATS	Loeb, Helen	Children's Hospital of Philadelphia
Hetrick, Lisa		Loeb, Jonathan	JITSIK
		Lopez, Alexandra	Gannett Fleming

Lorenz, Mike	Sheetz
Lucic, Ivana	Jacobs
Machek, Jack	10,000 Friends of PA
Macioce, Thomas	PennDOT
Mackie, Paul	Mobility Lab
Main, Scott	CCAC
Manion, Lynn	Airport Corridor Transportation Assn
Marrero, Moises	FHWA
Marshall, Jim	Commonwealth of PA
Martz, Eric	KCI
Marzzacco, Chris	Anapol Weiss
Matkowski, Laurie	DVRPC
McAliney, Conor	Drive
McAuley, Jr., George	PennDOT
McClain, Samuel	Travelers Marketing
McClain, Kenneth	PennDOT 6-0
McCormick, Cindy	City of Lancaster
McDonnell, Terence	New York State Police
McGinley, Steve	JMT
McGowan, Hugh	PennDOT
McMahon, Kate	NEPA-Alliance
Medack, Allie	GM
Melley, Allen	PennDOT
Mento, Tony	FHWA
Michael, Karen	PennDOT 2-0
Miller, Jim	Michael Baker
Montanez, Richard	City of Philadelphia
Moore, Steve	Stantec
Mose, Hugh	retired
Myers, Kurt	PennDOT
Ndimbie, Ngani	Traffic21 Institute
Nelson, Eric	PennDOT
Newcomer, Stacy	Commuter Services of PA
Nicholas, Henry	NUHCE
Noll, Stephen	Bucks County TMA
O'Halloran, Peter	Urban Engineers
O'Neill, Jina	Oakland TMA
Ottley-Francois, Candice	JMT
Overn, Larry	Stantec
Pacifico, Matthew	City of Altoona

Pack, Michael	PTC
Page, Nicholas	Lock Haven University
Palmer, Kevin	250
Paral, James	FHWA
Park, Troy	PA State Police
Pascale, Alison	Audi of America
Paterno, DJ	Sageminder
Patterson, Mike	PennDOT
Payne, Travis	
Pazuchanics, Alex	City of Pittsburgh
Pease, Orla	Urban Engineers
Peng, Yipeng	Student
Peters, Brandon	SAP&DC
Peterson, Daniel	Dewberry
Petit, Bill	PennDOT 1-0
Phelps, Timothy	TMACC
Pierce, Benjamin	HDR Engineering
Plocinski, Samuel	PennDOT
Porter, Damon	Global Automakers
Potutschnig, Daniel	Mifflin Co Academy
Prestash, Denny	PennDOT
Prestash, Thomas	PennDOT
Prisk, Chris	Langan
Puchalsky, Christopher	City of Philadelphia
Purdy, Diane	Urban Engineers
Rainey, Mavis	Oakland TMA
Rajkumar, Raj	CMU
Reed, Daniel	CC of Philadelphia
Reedy, Jenna	rabbittransit
Rensel, Eric	Gannett Fleming
Richards, Leslie	PennDOT
Richter, Patrick	SPK Engineering
Rimer, Mike	PennDOT
Ritchie, Nolan	Commonwealth of PA
Ritter, Stacia	PTC
Roberts, George	PennDOT 4-0
Rodgers, Victor	HACC
Rosica, Megan	Jacobs
Rousenberger, Todd	RK&K
Rowe, Glenn	PennDOT
Ryerson, Megan	University of Pennsylvania

Sabatina, John	Commonwealth of PA	Swan, Peter	PSU-Hbg
Sabo, Jay	Buchart Horn	Szczur, Joseph	PennDOT
Sam, Alan	Borough of State College	Tartaglia, Kathryn	PennDOT
Sargent, Frederic	Great Service Forums	Taylor, John	Commonwealth of PA
Saxton, Richard	CC of Philadelphia	Templeton, Kara	PennDOT
Saylor, James	SEDA-COG	Thompson-Graves, Scott	WRA
Schaefer, Nicholas	Trans Associates	Toppen, Alan	Kimley-Horn
Sharp, Jason	PennDOT	Turton, Lauren	Delaware Co TMA
Shehatta, Mahmood	RK&K	Ulp, Greg	Gannett Fleming
Showers, April	JMT	Vandervoort, Karen	FHWA
Siddiquee, Fatema	Michael Baker	Varadarajan, Vijay	AECOM
Sigel, Renee	FHWA	Vilello, Richard	DCED
Sikora, Richard	Lehigh Career & technical Institute	Vulakovich, Randy	Commonwealth of PA
Singel, Mark	The Winter Group	Wagenmann, Ron	TAC
Slizofski, Allie	Drive	Wagner, Mike	Edge Case Research
Sloan, Barbara	Cambridge Systematics	Wagner, Jason	APC
Smith, Matthew	Michael Baker	Wagner, Andrew	Dauphin Co Technical School
Smith, Sue	Northwest Commission	Wahed, Mir	JMT
Snyder, Frank	AFL-CIO	Walker, Bryan	PennDOT
Stavoren, Christopher	PA Collge of Technology	Walsh, Jennifer	HDR Engineering
Stevens, Dave	General Highway Products	Watson, Angela	PennDOT
Stever, Anthony	PennDOT	Watts, Robert	McCormick Taylor
Stimely , Doug	Mifflin Co Academy	Watts, Andy	Jefferson Tech School
Stoner, Kirk	Cumberland County Planning	White, Victoria	
Streets, Nick	WRA	Williams, Christopher	McMahon Associates
Stuart, Steve	Michael Baker	Wills, Taylor	Royal Trucking
		Woessner, David	Local Motors
		Yeakel, Skip	Volvo Group
		Zapinski, Ken	AlleghenyConferenc e

Photos: 2017 Pennsylvania Automated Vehicle Summit



2017 Automated Vehicle Summit



White Papers: “Finding the Safety Innovation Equilibrium in Vehicle Automation Policy,” and “Pennsylvania: At the Forefront of the Transportation Technology Revolution.”

Finding The Safety-Innovation Equilibrium In Vehicle Automation Policy

By Leslie S. Richards, Secretary
Pennsylvania Department of Transportation

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Finding The Safety-Innovation Equilibrium In Vehicle Automation Policy

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The year 2016 will be notable in the transportation world as the date when vehicle automation burst out upon society. No longer a topic of interest just among industry professionals, these powerful technologies are increasingly understood by the general public as a force of gathering momentum that heralds profound changes in how we live.

For those who serve as transportation policymakers in the public sector, this acceleration of technical progress, in conjunction with the awakening of public attention, pose both significant responsibilities and challenging issues.

Our paramount duty as public officials is to ensure the safety of the transportation system and those who use it. Because highly automated vehicles (HAVs) portend vast safety improvements, transportation policy should foster its development and eventual deployment. But doing so effectively and properly means doing so mindful of public concerns and anxieties, as well as the real-world issues of safety that arise as HAVs are tested, improved and eventually introduced into general use.

In short, as public policymakers, transportation officials must find the delicate equilibrium that balances innovation and public safety. Here in Pennsylvania, that equilibrium has been our focus.

Background: gathering momentum

For decades now, vehicle automation has been at home in Pennsylvania. The state's world-class research universities, among them Carnegie Mellon University (CMU), University of Pennsylvania and Penn State, have been at the forefront of robotics innovation. Arguably, the world's very first autonomous vehicle was the "Terregator," a rugged, slow moving six-wheeler built by CMU in 1984 that was designed to navigate and map land mines.

In recent years, this best-in-class R&D capability has attracted major private-sector investment, notably in Pittsburgh, representing some of the biggest technology and automotive industry brands.

Simultaneously, the Pennsylvania Dept. of Transportation has been working for years with these centers of innovation on developing and deploying advanced traffic signalization and other Intelligent Transportation System applications.

PennDOT leadership has also been actively engaged with key national organizations, including AASHTO, AAMVA and TRB, on various initiatives to advise the federal government on the policy framework for advancing HAV development.

Late in 2015, it became clear that developments were quickly accelerating. On-road HAV testing in a wide variety of conditions was emerging as the necessary next step. Pittsburgh and its surrounding suburbs, already the location of closed-course test beds, gained recognition as an ideal setting. The region's variable weather, hilly terrain, complex urban street patterns and multitude of tunnels and bridges provide real-world test conditions unlike few other locations.

In fact, on-road testing was already well under way in the form of the Carnegie-Mellon fully autonomous Cadillac SUV that I have traveled in several times. Because the Pennsylvania Vehicle Code predates by several decades the advent of HAV technology, Commonwealth law is silent on the matter of on-road testing, and therefore permissive, provided one key condition is met: a licensed driver must be seated at the steering wheel. (In fact, as in most states, there is no legal provision in Pennsylvania that the driver's hands actually be holding the wheel.)

This legal silence is the basis for the on-road HAV testing that has been occurring in Pennsylvania, including the headline-making test in Pittsburgh announced last summer by Uber Technologies, in which (non-fare-paying) passengers could ride to their destination in an autonomous car in the company of two testers, one in the driver's seat and an observer riding shotgun.

However, PennDOT long recognized that the opportunities to test on the public roads under existing law would only get so far, before the legal limits would present an obstacle to Pennsylvania continuing to host further innovation and growth of the advancing technologies. What of the vision to take the human driver out from behind the steering wheel entirely; or to control the vehicle or a platoon of vehicles remotely; or to do away altogether with the steering wheel or various other operating equipment and components that may be superfluous at the highest levels of automation?

For PennDOT then, the project in 2016 became and continues to be one of supporting the necessary changes to the law that will enable development and testing of future innovations not yet ready – possibly those that we can scarcely imagine, much less prepare for – and to do so in a way that ensures public safety now and in the future.

The goal is to strike that sweet spot of equilibrium between innovation and safety.

Emphasis on flexibility

PennDOT's HAV team approached the task by framing out model legislation to permit a very broad scope for testing on Pennsylvania roadways, subject to PennDOT's oversight. Significantly, this proposed law will enable PennDOT to exercise its safety oversight not through the formal regulatory process, which is slow and cumbersome, but through the more agile mechanism of policy.

We know have seen enough and know enough to recognize that we do not know where innovation will lead, thus it is essential to have an oversight tool that is flexible and prompt enough to respond to future, unanticipated developments. Regulation, which in Pennsylvania takes a minimum of a year or more to adopt, and entails no less than two dozen distinct process check-offs, is not that tool. PennDOT believes policy will be.

Critically, by creating a flexible means of oversight, PennDOT will be able to adjust policies proactively to foster ongoing innovation and responsively to ensure that emerging safety issues are effectively addressed.

Policy by collaboration

Progress toward this goal would be impossible without ongoing collaboration with key partners. Recognizing the tremendous social and economic benefits,

particularly that of safety, that HAVs offer, Governor Wolf and his staff have been supportive from the outset. Early on, PennDOT engaged the majority and minority leadership and senior staff of the Transportation Committees of both houses of the General Assembly to begin the drafting and introduction of the necessary legislation.

And in order to have testing safety policies in place for the day when that enabling legislation is enacted and signed into law, we convened a task force of key stakeholders representing government, private industry, non-profits and academic institutions that are currently engaged or have a major stake in the process and direction of HAV development.

The mission of the Pennsylvania Autonomous Vehicles Testing Policy Task Force (familiarily referred to around PennDOT as the AV Task Force) is to explore, discuss and recommend policies for the safe testing of HAVs on the Commonwealth's public roadways.

The hope for the Task Force was that it would generate a rich discussion of key issues representing diverse perspectives reflective of the varied interests and concerns of the members. Membership included representatives from government: The Federal Highways Administration, the Pennsylvania State Police, Departments of Insurance and Community & Economic Development and Pennsylvania Turnpike Commission, and the Pittsburgh City Council; from industry: Uber and General Motors; from non-profits: AAA, SAE, the national and state trucking associations, the Pennsylvania trial lawyers and from academia, faculty from Carnegie-Mellon and UPenn. The Task Force was supported by a team of subject matter experts from PennDOT and the senior staff from the Transportation Committees of the General Assembly.

Meeting biweekly between last June and November, the Task Force was given a series of white papers representing draft policies developed by PennDOT staff that the members then reviewed, critiqued and revised. Topics covered the breadth of issues we identified as a necessary framework for basic HAV safety policies:

1. Establishing the minimum levels that HAVs must achieve to begin testing
2. Identifying "The 'Where, When, and How' of Testing"
3. Defining "Who is the Driver?"

4. Considering “Vehicle Characteristics, Capabilities, and Security”
5. Determining what data do we want/need to collect, and what do we do with it?
6. Examining how we approve and govern testing now and in the future.

Finding consensus, accommodating dissent

Nobody would expect such wide-ranging representation to agree on all these critical issues, and indeed, the AV Task Force did not do so. But the group was structured to find common ground to the maximum extent possible, and in that we achieved a high degree of success.

No votes were ever taken. Rather, the group went through the iterative process of revising and refining the draft policy recommendations until a point of general agreement was reached.

Moreover, for the purposes of transparency and collegiality, Task Force members were invited to submit written statements detailing differing viewpoints and disagreements with the general recommendations and these statements were published in the appendices of the Task Force report.

I strongly believe that by transparently accommodating differing viewpoints, PennDOT encouraged collaboration and agreement. In fact, it is remarkable, given the various interests at the table, how much everyone was able to find common ground. I believe that is due to the fact that whatever the particular perspective or interest represented, all the Task Force members grasp the huge opportunities to benefit society that HAV technology can bring, and all share a commitment to safely make those possibilities a reality.

Next steps: Legislation, citizen engagement

We entered 2017 at PennDOT with a solid foundation of policy recommendations to ensure safety on the roadways as HAV testing continues. The principal tasks ahead are two-fold: to support the General Assembly’s efforts to enact legislation that will authorize on-road HAV testing under PennDOT’s safety oversight; and to engage the people of Pennsylvania in an ongoing dialogue about HAVs so there is an informed public understanding both of the benefits and the challenges these transformative technologies will present.

As of this writing, the legislation is introduced and awaiting action in the new session. No one can predict for certain its outcome, but there is optimism it will receive support from both sides of the aisle (as the bipartisan sponsorship of the bills suggest it will). It may well be necessary to revise the recommended policies to conform with provisions of the enacted law that may differ from what was originally envisioned when the legislation was first drafted.

The flexible mechanism of policy enables such adjustments and revisions with relative ease.

In fact, PennDOT considers the [AV Task Force's policy recommendations](#) as the first installment in what will be a living, evolving process of policymaking to maintain that elusive equilibrium between safety and innovation. In late December, a public outreach effort was launched, beginning with a [webinar](#) and invited public comments and ideas.

Increasingly, PennDOT's leadership is speaking in public and in the media about the enormous opportunities and the key challenges that lie ahead.

As citizens begin to understand HAVs' huge potential to increase transportation safety and reduce crashes and fatalities to a vanishingly few; to expand mobility options for the aged, disabled and indigent; to maximize the efficiency and capacity of our infrastructure through increased through-out without costly, difficult physical build-outs; to expand transit services, and to generate new economic opportunities yet unimagined, public support for HAV development will grow.

But policymakers must also speak frankly and openly about the range of challenges: the complicated transition we face over the coming years and decades as we gradually move from human to automated control over vehicle operations; the changes to business models and workforce that are in store; the hard questions of data control and personal privacy; the endless effort to stay a step ahead of the bad actors in the realm of cyber-security, even the ethical framework for automated decision-making.

These and other questions will arise and, with a flexible policy framework that is collaborative, transparent and publicly engaged, will, I believe, ultimately be resolved to advance the development and deployment of HAVs.

Since the colonial days of Pennsylvania's greatest son, Benjamin Franklin, human ingenuity has been the most valuable asset in our Commonwealth. It remains the hallmark of what we aim to achieve by promoting safety and innovation in the coming era of vehicle automation.

Pennsylvania: At the Forefront of the Transportation Technology Revolution

By Roger J. Cohen, Policy Director
Pennsylvania Department of Transportation

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Pennsylvania: At the Forefront of the Transportation Technology Revolution

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Recent years have witnessed an explosion of activity – and of public interest – in the development of connected and autonomous vehicles, collectively known as Highly Automated Vehicles (HAVs). During this time, Pennsylvania has emerged as one of the premier locations where HAVs are being developed and tested.

As test HAVs have been introduced on Pennsylvania’s roadways, first in Pittsburgh and lately more widely across the Commonwealth, the Pennsylvania Department of Transportation (PennDOT) has been actively engaged in this process with the principal aim of balancing this rapid march of innovation with ensuring the safety of the traveling public.

If implemented in that balanced manner, HAVs offer the prospect of a transformative revolution in how the world travels and transports goods. First and foremost, this technology brings the promise of a much safer transportation system. Last year in our state, 1,188 people died in vehicular crashes and a great many more were gravely injured, often permanently. The vast preponderance of those crashes was the result of human error. So as automation reduces and eventually removes the human element from driving, that toll of carnage is expected to dramatically decrease.

Other prospective benefits include greater mobility for the elderly, disabled and indigent; new, expanded and more affordable transit services; greater fuel efficiency and reduced emissions; and increased throughput on our capacity-limited infrastructure.

Pennsylvania’s leading role in the vehicle automation arena does not come out of the blue. Our great research universities, notably Carnegie Mellon, University of Pennsylvania and Penn State, have been seed-beds of innovation.

In fact, the world's very first autonomous vehicle, a little six-wheeled character called the "Terregator," was built at Carnegie Mellon in the 1980s.

While PennDOT has been involved with these innovations for many years, 2016 marked a milestone with the formation of the Autonomous Vehicle Policy Taskforce. Comprised of diverse stakeholders from industry, government, academia and advocacy organizations, the Taskforce operates as a collaborative, consensus-seeking group of experts who make recommendations for proper HAV on-road testing to balance innovation and safety. PennDOT is also working closely with legislators and their staff on both sides of the aisle to craft new law that will safely promote HAV testing on Pennsylvania roadways.

Meanwhile, PennDOT has been out in the field, undertaking a range of development activities on several fronts:

- PennDOT spearheaded a coordinated proposal that led USDOT to name Penn State and the City of Pittsburgh as official HAV proving grounds, one of ten such designations in the country.
- Working with our academic partners and the PA Turnpike, we have joined with Ohio and Michigan to create the "Smart Belt Coalition" to promote coordinated, multi-state development and testing of HAV technology, particularly as it affects trucks and freight movements.
- Pittsburgh was a runner-up in USDOT's "Smart Cities Challenge" competition last year, leading to the award of about \$20 million in public and private funding primarily to deploy connected vehicle (CV) infrastructure to create "smart spines" along some of the city's critical corridors.
- CV infrastructure, including adaptive traffic signals and vehicle-to-infrastructure (V2I) two-way communications capability, has also been deployed at test-beds in Cranberry and Ross townships in Butler County, and in Harrisburg, with additional locations planned for future deployments.
- This past April, a delegation from Australia, representing their top public and private officials working on CV technology went on a worldwide fact-finding tour of brsdt-practices, with only two stops in North America, California and Pennsylvania, where the group met a senior PennDOT team led by Transportation Secretary Leslie S. Richards.

- On Philadelphia’s massively congested Schuylkill Expressway, an integrated corridor management is being developed that combines peak-period shoulder running with real-time communications, adaptive signalization and alternate route information to relieve incident-related congestion, and to divert traffic to transit-node parking, when it’s available.
- The new Amtrak station in Middletown now under construction is being evaluated for possible deployment of a fully autonomous people-mover to connect the busy station with the nearby Harrisburg International Airport passenger terminal and the campus of Penn State-Harrisburg.

Just as important as these initiatives, PennDOT officials are actively engaged in increasing public awareness and understanding of the potential benefits, as well as the critical challenges and issues the Commonwealth faces as HAV technology advances. These activities include scores of public speaking events, media interviews and participation in conferences, roundtables, webinars and peer exchanges with other leaders in this field.

As a firm believer in meaningful public participation in shaping the future of our transportation system, Secretary Richards places a high premium on ensuring that the process of developing and shaping our automated transportation future is transparent and responsive to the needs and will of the public.

In that spirit, PennDOT is convening an HAV Summit in State College this Sept. 11 and 12 to discuss regional and community planning efforts and workforce development needs and opportunities that all Pennsylvanians will have to work collaboratively if we are to reap the maximum future benefits of the HAV technology revolution.

HAVs will not only affect how we move and transport things, it will profoundly affect our lives, whether we are urban, rural or suburban Pennsylvanians. PennDOT is committed to remain at the forefront of this transportation revolution that is such an exciting opportunity for the entire Commonwealth to come together to improve the quality of life for all our citizens.

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Roger J. Cohen is Policy Director at PennDOT and co-chair of the Pennsylvania Autonomous Vehicles Policy Task Force.

Resources

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Presentations