Developing Trends Facing the Transportation Profession

A Thought Leadership Report by the Coordinating Council of the Institute of Transportation Engineers
The Institute of Transportation Engineers would like to thank all the individuals who contributed to putting this document together. Developing Trending Report was only possible because of the invaluable input and cooperation from ITE Councils and Committees: Complete Street Council, Ethics Standing Committee, Joint Rail Grade Crossing Committee, Pedestrian Bicycle Standing Committee, Public Agency Council, Roundabout Standing Committee, Traffic Engineering Council, Transit Standing Committee, Transportation Consultants Council, Transportation, Education Council, Transportation Forensics and Risk Management Council, Transportation Safety Council, and TSMO Council.

ITE would like to specifically thank the Developing Trends Task Force Chair, Dr. Sogand Karbalaei, and ITE Coordinating Council Vice-Chair Mr. Eric Rensel, as well as Mr. Suresh Karre, and Mr. Mark Norman who volunteered to provide valued support for this report. We are also thankful for the support from the Coordinating Council Chair Mr. Jason Crawford, and the incredible assistance of ITE staff, especially Ms. Niloo Parvinashtiani for coordinating the project.
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Executive Summary

This Developing Trends Report is a collaborative effort of the ITE councils and committees to bring diverse, broad, and deep dialogue among professionals about the role of advanced technologies in transportation planning, engineering, management, and operation. The diverse range of topics covered in the Developing Trends report — led by the ITE Coordinating Council — is evidence of the change within the transportation culture. These topics are proving to be the most relevant to practitioners in the upcoming year.

The 2020 submissions for this report contain 34 topics cross-cut between eight major areas of safety, operation, design, data, workforce, Connected Automated Vehicle (CAV), ethics, and micromobility. The report shows how data analytics brings the public and private sectors and travel companies together to overcome challenges of cybersecurity and privacy by developing data-driven designs and practical implications of data in transportation systems.

This report includes a diverse range of topics that lay out the argument for current opportunities and challenges to integrating into next year’s action plans. This document also helps the ITE community dedicated resources and develop cases that benefit the industry’s leadership.
Introduction

Developing Trends Facing the Transportation Profession is a collaborative report developed with direct input from all councils and committees who identified several topics that would be important to ITE members in the near-term. Councils use these topics to develop their action plans for council products to provide value to ITE members. Publishing the Developing Trends Report is a success story of the ITE Coordinating Council and evidence of a change in culture.

The purpose of this effort is to support a healthy dialogue across all disciplines, leverage ITE’s collaborative spirit, make business cases for any potential council involvement, and push the boundaries in transportation society.

The first Developing Trends report was released in 2018. The process of the second Developing Trends report began in December 2018 by a SWOT analysis of the last report. A working group was established under the Coordinating Council in January 2019. The working group sent out a request for submissions to the ITE Councils and Committees in June 2019 and received the reports during September and October 2019. The progress report was presented to the ITE International Board of Direction in November 2019. The report was compiled and edited in November and December of 2019 and released in January 2020.

The developers of this report hope to reach a wide range of audiences from both the public and private sectors, as well as transportation practitioners and researchers, members of academia, and students from a diverse array of backgrounds and expertise such as transportation engineering and planning, data science, geography, industrial engineering, and more.

The document is organized by alphabetical order of councils and standing committees. Thirty-four submissions are included in this report. Among all the submissions, the topic of safety tended to recur most frequently, appearing in about 80 percent of what was received. Important topics such as equity and social justice made up a much lower 12 percent of submissions; data-related topics made up half of the total submissions. The publishing of the annual Developing Trends report helps shape our transportation society by focusing on significant concepts.
Role of Disruptive Technologies and Data Analytics in Swinging Transportation Equilibrium

Target Audiences: Public sectors DOTs; City MPOs; Private Consulting Companies and Contractors; Academia and Research Institutes; Tech App developers and Start Ups; Public health officials; TNCs; Data Scientists

Definition/Technology/Research:
In the modern world, different welfare systems compete with each other for a limited amount of human, capital and technical resources. This leads to a degradation of these systems over the years due to ever-increasing demand but static resources. Such status-quo in any welfare system persists until a disruptive technology is able to provide significant improvement in performance with lower resources. In the transportation sector, we are witnessing a slow degradation in the network's level of service. The current demand, as can be measured by vehicular miles of travel, increases at the rate of one to two percent annually. With nearly static gas-taxes and a shrinking highway trust fund, the level of investments in the transportation network either remains constant or declines gradually. This eventually results in an overall deterioration of the network level of service. As a result, the number of hours spent in congestion by commuters increases at the rate of one to two percent every year. There has been a gradual decline in fatality rates over the past few decades owing to the implementation of safety policies such as improvement in vehicle crash worthiness, seat belt regulations, stricter drinking and driving laws, etc. However, in recent years, there has been a slight increase in the national fatality rates as the economy is recovering from the slowdown. A triad of disruptive technologies shows a promise of breaking this status-quo and improve both safety and efficiency of the system and ITE can play a significant role in facilitating a meaningful dialogue between the private and public sector to understand the benefits of such technologies.

These technologies are namely the following:

- Availability of cheap/free crowd-sourced data through cell-phones and IoT devices
- Break-through in the field of machine learning models (deep-models) that can out-perform traditional models using massive training data
- Cheap cloud-based high-performance computing power to implement these models and thereby drive intelligent decision making

These triads of technologies can work in sync to provide an automated smart traffic solution that can simultaneously increase the safety and efficiency of the system, without the need for any significant capital investment.

Crowd-sourced/IoT data has already shown a great promise in the area of traffic incident detection. Most of the Traffic Management Centers now use Waze feeds to quickly identify traffic incidents. With the increased adoption of connected vehicles, such data streams will become more reliable. Agencies can then selectively choose to place infrastructure mounted sensors at specific locations thereby significantly reducing their installation and maintenance costs.

Exponential improvements have been made in the field of Artificial Intelligence with the capability of training and deploying deep neural network models for real-world scenarios. In areas like medical image classification, virtual games, and speech translations. these models have out-performed humans. In the transportation industry, these models show a significant promise in image processing, automatic incident detection, accurate speed and crash risk predictions, and driving adaptive traffic control. Currently, most agencies struggle to find skilled operators, and/or traffic engineers to manage their existing system. The ability to augment human decision making through artificial intelligence can significantly enhance efficiencies. This can result in manageable workloads for the current system operators/planners thus improving the quality of system performance.

High performance computing clusters are required for processing massive heterogeneous streams of crowd-sourced/IOT data in order to develop and deploy deep artificial intelligence models. Earlier such clusters required investment in computing resources and adept IT task forces to install and maintain these systems. This often resulted in hefty upfront costs and substantial recurring costs. Today, the ability to provide as-needed and on-demand access to high performance computing on the cloud makes it economical to use such systems for transportation management.

In essence, the implementation of the above three technologies in unison holds the key to improving the safety and efficiency of transportation networks simultaneously, without incurring any costs of capital investment. As an industry, we will see a significant increase in services offered that will be powered by the above-mentioned technologies, and ITE can provide the platform and policy guidance that would benefit both public and private sector members.

Current State of Practice/Example Projects:
Use of big data and its analytics is not being fully vetted yet, but there is an opportunity for pilot and test track implementation in near future that can reap the benefits of mobility, safety and congestion mitigation for end users.
Attracting and Retaining New Talent — A Workforce Development Challenge

Target Audience: Public sectors DOTs, City, MPOs; Private Consulting Companies, Contractors; Academia and Research Institutes; Tech, App developers, Start Ups

Definition/Technology/Research:
While we sometimes lament that the talent pool for new engineers to work in transportation engineering and planning is shrinking, we know that it isn’t necessarily a new issue. As workloads increase, the situation is certainly exacerbated, but we have had over the last decade or more, a diversion of talent to other professions that needed analytical thinkers and problem solvers. So, what can we do to attract and retain new talent to join our ranks and manage the workforce development challenge that we face in the civil and transportation engineering profession? This is an issue that many of our ITE members face both in public and private sectors and is of most relevance and importance to the member firms within our Transportation Consultants Council as the talent pool keeps on shrinking.

First, we need to recruit much earlier in the process, capturing the interest of future talent as they contemplate career choices. Our current efforts in the STEM programs are a fantastic step in the right direction. We need to “market/promote” our profession to our youth and stress the challenging, yet so rewarding opportunities to be involved in a profession that touches everyone almost every day. We need to stay in contact with this cadre of talent as they move through their elementary, junior and senior high school years. Our members being active in Math Counts, Science Clubs and career days are just a few ways of maintaining interest and showing support.

ITE needs to be visible as an organization on our college campuses and compete with our other professional organizations to engage and attract the best and the brightest to the ever evolving and innovative careers in the movement of people and goods. We need to make them feel wanted and needed.

We, as an organization, need to embrace and be a vocal and visible part of the transformation to an autonomous, connected and smart transportation world. We need to both manage the present but plan and build for a brighter and smarter future. Who would not want to have a career with such opportunities to be part of something so significant?!

We need to understand what motivates this new generation of talent. We might be surprised, at what we find, if we take the time to listen and hear. Times have certainly changed and they now change so much more rapidly than most of us are accustomed to experiencing. But how we deal with the changes, which are inevitable, will set the tone for attracting and retaining new talent! We need to accept such changes in a positive light and exude the thrill and excitement of being part of such a transformation. What is the magic solution to this issue? Is it money, is it work life balance, is it recognition (remember for years we have created the atmosphere of just showing up “earned” you a trophy), is it challenging work, is it working independently or as a team, is it the benefits, maybe training or further educational opportunities, and the list could go on for quite some time!

Current State of Practice/Example Projects:
Talent acquisition and workforce development is an ongoing challenge in our transportation industry and there is an opportunity for ITE to help recruit future talent through STEM programs before they make career choices.
Setting New Priorities and Policies to Make Streets Safer for All Users of All Abilities

**Target Audiences:** Planners & engineers in urban cities, traditional town centers, suburban, rural (Public sectors DOTs, City, County; Progressive jurisdictions implementing Complete Streets; Private Consulting Companies; Contractors)

**Definition/Technology/Research:**
Although transportation professionals have considered safety for decades, cities have been designed and operated to optimize mobility for vehicles since the invention of the automobile. Designing streets has shifted toward accommodating multiple modes and thinking about safety first for all street users.

Transportation professionals are now starting to designate a jurisdiction-wide modal hierarchy as well as craft transportation networks that designate modal priorities on individual streets to support the balanced network. Below is an example of the shift in the modal hierarchy from auto-oriented to pedestrian, bicycle, transit prioritization (from Minneapolis):

These steps in the planning process set the table for creating design standards reflecting the street's modal priority, improving safety, accessibility, and mobility. Clear steps in the planning process and setting clear design standards should reflect the equilibrium needed among modes.

The change in the purpose of street design and operations is a developing trend. The trend the CSC observes follows these steps:

- Prioritize safety for all users as the highest priority
- Ensure all modes of travel are accessible to all users in a transportation network.
- Once the network of streets is safe and accessible, optimize mobility for all modes.
- Apply an equity assessment to balance a data-driven process with a sensitivity to the under-served and special needs travelers.

**Current State of Practice/Example Projects:**
Limited guidance from industry leaders, recent Complete Streets manuals and comprehensive transportation plans recommended a source of new best practices.

Example Complete Streets Manuals and policies:
Seattle, Minneapolis, Chicago, Boston, and Vancouver, BC.
Prioritizing Space in Limited ROW

**Target Audiences:** Planners & engineers in urban cities, traditional town centers, suburban context, and Rural context (Public sectors DOTs, City, County; Progressive jurisdictions implementing complete streets; Private Consulting Companies, Contractors)

**Definition/Technology/Research:**
New emerging micromobility modes of transport, as well as the continued trend towards a multimodal environment, have added pressure to the already difficult decisions in designing streets in constrained rights-of-way. These trends require balancing priorities for various design elements. The developing trend is that street design standards should reflect the land use context and community vision. Establishing design priorities requires reviewing the steps of the design process and understanding the community’s vision for the context and street relationship.

Often the width of the public right-of-way varies along existing streets, making the job of the designer more challenging. When identifying priorities for design elements in the context of street segments with varying right-of-way widths, it is advisable to explore conceptual cross-section options that address the priorities for the typical range of widths available and to understand the issues that arise at the transition points from one cross-section to another.

New design standards provide flexibility to optimize the use of limited space, moving people safely and making our roads more accessible for all people and modes. Complete streets look at street widths to manage multiple modes and setting targets and maximum dimensions for each portion of the cross section. Complete street treatments can reduce high frequency crashes at targeted locations where vulnerable road users may be present or at a greater risk. Further, incorporating equity as part of Complete Streets policies can ensure networks are being designed for all users, all ages, all demographics, and added to roads in neighborhoods that increase access.

**Current State of Practice/Example Projects:**
- Limited guidance from industry leaders, shortlist of complete streets manuals include methods for ROW prioritization.
- Availability of data: Not a data driven process
- Tools: Cross section tools available for scenario illustration
- Research needs: Developing trends, minimal examples of success. Collect limited examples, funnel work through the CSC initiative for improved guidance on this topic.
The Transformation of the Mobility Space with On-Demand Services and Mobility as a Service

**Target Audiences:** Public Sector (FTA, MPO’s, Cities, Counties, Transit Agencies), Private sector (Operators, TNC’s, Consulting Firms), Academia and Research Institutes

**Definition/Technology/Research:**
It is a challenge to provide public transit efficiently and effectively in most of the United States and Canada: Out of 550 cities providing public transit, more than 250 transit providers are operating at less than 20 persons per revenue hour, and more than 60 at less than 10 passengers per hour. The hourly number of riders is a measure of efficiency and operational costs. Also, the mode share of public transit is less than 5% in most cities. This is why transit (read shared mobility) is not considered as a serious mode in impact analysis and road network design.

Low productivity and low mode share are typically a result of a low competitive service: better options are available and typically car traveling is factors faster than public transit.

The opportunity of the provision of more competitive service is recognized by the private industry (Uber, Lyft, VIA, and other Transit Network Companies). They can provide faster travel options than public transit services can, and also provide a higher quality of service (OnDemand, short wait times, door to door instead of stop to stop, service during the entire duration of the day).

However, the TNC’s also need high productivity to cover their operational costs. This means that they will need to subsidize trips when not enough demand is available. TNCs and other private parties are therefore making the case to replace bus transportation with OnDemand Services and be subsidized as bus services are. There is also a case to make to replace paratransit services with these on-demand services.

The cities and the private sector are evaluating a new offering of transportation solutions: Mobility as a Service. Will this new offer change the mode share of non-single occupant vehicles to higher percentages?

The challenges include:
- The Mobility space is transforming, and this is uncharted terrain. What are the required regulatory frameworks, what are expected mode shares and what is expected revenue- and business models? Getting an accurate network and demand data is a challenge. Travel demand models are often not granular enough and demand data is not easily provided by the private sector.
- Understanding the impact of new modes on travel behavior is also a challenge. When are people willing to change their current method of travel for an alternative.
- It is a challenge to having the right performance metrics in place.

ITE can set the standards, tools, and methods for integrated mobility design. ITE can provide standards for data sharing ensuring network and demand data is available to the public sector. The engineering methods enable the public sector in defining governance scenarios and understanding the impact of future changes.

The impact can be demonstrated on congestion, travel time to destination, emissions, impact on parking revenues, the required investment in public transit and configuration of the ideal fleets in composition and size. ITE can set the standards in common performance metrics.

**Current State of Practice/Example Projects:**
Some cities have evaluated the impact of TNC and On-demand Technology on a City-Wide scale:
- Lisbon Curbside impact
- Oslo: Congestion impact and travel time impact
- Hannover Mobil
Interregional Public Transit Service Design and Investment Decisions

**Target Audiences:** Public Sector (FTA, MPO’s, Cities, Counties, Transit Agencies), Private sector (Operators, TNC’s, Consulting Firms), Academia and Research Institutes

**Definition/Technology/Research:**
Public transit is often provided from jurisdictional areas. This means that some larger urban areas deal with 10-20 transit providers. The transit operator is often also the transit authority. The results of this approach are long travel times and extra connections for people traveling across jurisdictions, low mode share of shared services, leading to a reduction of transit services. This again leads to longer travel times and lower mode shares: a difficult position to get out of.

A regional and cross boundary engineering approach for designing service by a non-operating multi-modal authority will lead to an integrated, effective and efficient service. The regional authority can use traditional travel demand methods to understanding travel demand, categorize the travelers, identify trip purposes as is typically the case in demand planning. The new trend is that the authority can also include flexible routing, incorporating OnDemand, parking options, pricing options, biking, walking in a flexible mode choice model, simulate and predict mode choice and design transit networks in a more holistic and flexible manner.

The regional transportation authority can determine and evaluate whether the transit services can be operated by either the local transit authorities or outsourced to performance-based contracts with operating companies.

**Current State of Practice/Example Projects:**
This concept is common practice in The Netherlands, Sweden, France, Singapore, London (UK), and Australia.

ITE can evaluate FTA’s STEPS model and alternative methods to quantify which network designs and infrastructure investments lead to the highest benefits for the community, economy, and environment.
The Impact of Technology on the Workforce in the Public Transit Industry

Target Audiences:
Public Sector (Cities, Counties, Transit Agencies), Private sector (Operators, TNC’s, Consulting Firms)

Definition/Technology/Research:
The availability of bus and train operators is in many transit agencies at the crisis point. Also, the skill level of planners and schedulers is behind the levels of private sector companies. Is this a long-term, structural problem or will supply and demand balance out over time?

New technology requires adaptation of skills in the public sector. The public transit sector has difficulty attracting new drivers. Also, key competencies in service planning and IT are falling behind the private sector. Union regulation, lower pay and slow decision-making processes could be reasons for the lack of highly skilled resources.

Will driverless technology be a solution to the problem?

Current State of Practice/Example Projects:
ITE has highly skilled, young, multi-cultural and diverse members using proven engineering methods.

The public transit industry could be served by cooperation between traffic planners and transit planners, where Transit Agencies provide positions to Traffic Engineers for MultiModal transportation planning. A multi-modal approach to service planning and infrastructure design can attract a larger workforce.

Adapting to driverless vehicles will also attract a new set of skills. Should the public sector step in or leave this to the private sector?
5G and Continuous Internet Connectivity in the Public Transit Industry

Target Audiences: Public sector (Transit Agencies), Private sector (operators, TNCs, traffic signal providers, AVL, AFC, and other technology providers; consulting firms, road infrastructure providers), Academia and Research Institutes

Definition/Technology/Research:
Communication is very important in public transit. Vehicles communicate with the infrastructure for signal priority, drivers communicate with the control center for operations, and technology applications provide information about operational performance, fares, video imaging, and passenger information.

In the past, land mobile radio (LMR) systems were prevalent, but new cellular radio technologies, 2G developing toward 3G, 4G and now 5G seem to be replacing the existing LMR infrastructure. The benefits of LMR radio systems is that the systems are in full control of the transportation provider. Even in the event of an emergency, they have full operational control over voice and data communications. Operational costs are also fully in control of the operator. The disadvantage is that these systems are expensive and broadband frequencies are hard to obtain.

The benefits of the cellular radio systems are that they are lower in purchasing costs but require monthly fees. In case of emergencies, coverage is a point of discussion. However, it seems that 5G technology will be widely adopted by the private and automotive sectors. 5G will enable the streaming of various kinds of data, allowing the transit operator to operate their fleets in real time with the availability of high bandwidth.

The question is which technology will prevail: — 5G or wayside technology? Costs are significant if we take the large number of public transit vehicles into account.

Current State of Practice/Example Projects:
New York City is deploying Digital Short Range Communications (DSRC) on an extensive scale, documented as follows: Realizing Connect Vehicle Benefits — Now!, Alan Clelland, ITE International Meeting, Austin, TX, 2019; Challenges and Solutions for New York City Connected Vehicle Deployment, Robert Rausch, ITE International Meeting, Austin, TX, 2019). Additional research will reveal signature examples of cellular deployment.
Micromobility Design Considerations

Target Audiences: Public and Private Sector

Definition/Technology/Research:
Design solutions can improve the safety and convenience of micromobility in multimodal environments.

Micromobility devices have proliferated in both large cities and small towns, utilizing existing right-of-way and transportation infrastructure that was not explicitly designed with these devices in mind. Several organizations have addressed planning and policy considerations for micromobility devices (e.g., T4America, National League of Cities, NACTO, PBIC, Remix), but discussions of design considerations remain limited to acknowledgment that there is a need for more guidance regarding micromobility vehicles in the design of public space.

To effectively design infrastructure suitable for micromobility vehicles, there is a need to more concretely define micromobility. Micromobility Industries has advanced a “Micromobility Landscape” that includes vehicles weighing less than 500kg; additional vehicle attributes are needed to identify and design appropriate facilities for micromobility travel and storage. A working concept could include attributes such as the footprint, operating envelope, weight, speed, acceleration, and passenger and/or cargo capacity of microvehicles (e.g., e-bikes, e-scooters) that are relevant for infrastructure design in addition to Micromobility Industries’ subcategories of deck, handlebars, seat, and cover, which are more user-centric.

Case studies of micromobility challenges and/or innovative design treatments that are currently addressing micromobility needs can support the exchange of knowledge in this rapidly evolving space and help to identify problems that have not yet been solved and may require a more comprehensive design solution.

Identifying current and potential use cases and the role of micromobility throughout its lifecycle of use in the public realm can enable the identification of additional challenges for micromobility in the context of current infrastructure, including interactions with other users of the public right-of-way. Each micromobility/infrastructure challenge individually, and the combination of challenges in a given context that also includes other users and modes, then becomes a design problem that can inform the design of public space. Finally, evaluation programs are needed to understand whether design solutions support micromobility as a safe, convenient mobility option within a multimodal mobility environment.
Social Justice in Transportation

Target Audiences:
Target audience is anyone involved in the design, analysis, or operations of a transportation system.

Definition/Technology/Research:
The application of social justice to transportation is quickly coming to the forefront. There is a growing conversation focused on the intersectionality of social justice issues with transportation within the profession and the public. Lessons from the past, from the construction of the interstate system destroying many parks, natural areas, and minority communities, to the present day, where efficiency and throughput of vehicles is the primary focus (rather than vulnerable user safety), have led to a demand for change. The thought-provoking article “What does a traffic jam in Atlanta have to do with Segregation. Quite a lot.” Published in the New York Times as part of the 1619 Project by Historian Kevin Kruse illustrates the present-day impacts of past land use, public policy, and transportation decisions. The transportation profession is being asked to understand this history and to help to rectify past wrongs on present day projects. In a 2016 speech to the Transportation Research Board Annual Meeting, then-USDOT Secretary Anthony Foxx spoke at length about the mistakes of past infrastructure design that divided and segregated rather than united, using infrastructure as barriers rather than bridges.²

The dramatically increasing level of pedestrian fatalities and their relationship to inadequate or car-centric infrastructure, combined with concerns about climate change, are creating pressure to deliver multi-modal solutions. The general public has begun to demand that people have options for travel and that communities have a right to be safe when doing so. Social justice issues present themselves in the allocation of transportation resources and decisions for accommodating or resolving delays. Efforts to improve motorists’ delay in many cases have resulted in decreased quality of life for people who live and work in locations impacted by highway and road-widening projects. Likewise, development patterns and restrictions on housing have resulted in people feeling forced to live far from jobs in environments that are not conducive to multimodal travel. The balancing of these tensions is increasingly placed upon transportation agencies to resolve.

2 The Road to Opportunity https://www.vimeo.com/151957419
CAV: Implications on Workforce Development

**Target Audience:** Public Sector DOTs, City, and MPOs

**Definition/Technology/Research:**
Connected and automated vehicles (CAVs) have the potential to dramatically change the transportation industry and have a positive impact across the economy. Changes to the transportation industry have been found to have greater outside impacts than advances in almost any other industry. CAV technology is expected to create significant benefits in safety with reductions in crashes, energy independence by focusing on electric and hybrid fuel sources, traffic congestion through utilizing connectivity to optimize routing, and mobility and access for communities underserved by public transportation and those unable to drive themselves. The full impact of CAVs on the economy and society will only be realized after full deployment is achieved.

A recent study by the Workforce Intelligence Network for Southeast Michigan and the University of Michigan Transportation Research Institute found that the diversity of occupations and skillsets required for a complete CAV workforce has not been fully defined; therefore, educational and training requirements and programs have not been developed. Public transportation agencies must work with other industry stakeholders to ensure a trained and stable workforce is available. Public agencies can and should start preparing now for the workforce through investments in workforce development, occupational training, and educational partnerships.

**Current State of Practice/Example Projects:**
One example of current partnerships formed to address needed skills to address the future of CAVs in transportation can be found in the NHRCP partnership between the National Operations Center of Excellence (NOCoE), American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), the Intelligent Transportation Society of America (ITSA), and the Federal Highway Administration (FHWA). These partners are working to provide resources and services supporting transportation system management and operations (TSMO) communities through human resources support, professional staff education and training, and professional services to support the evolution of the TSMO workforce. CAVs are an important next step in TSMO development to improve capacity and communication between vehicles and infrastructure.

A second example is the partnership between ITE and the National Network for Transportation Workforce to prepare current and future employees for the transportation labor force. This partnership focuses on identifying strategies to attract new employees, especially from under-represented communities, to the transportation industry; developing strategies to meet workforce needs based on data-based predictions; and supporting the education industry through training and outreach programs. Five regional career pathway programs have launched focusing on planning, environment, operations, engineering, and safety to engage students in the transportation industry.

Finally, NOCoE has challenged state and local transportation agencies to achieve deployment of dedicated short range communication (DSRC) infrastructure with Signal Phasing and Timing (SPaT) in a corridor or network of approximately 20 signalized intersections, known as the SPaT Challenge. The SPaT Challenge exposes state and local agencies to vehicle-to-infrastructure (V2I) communication and provides experience in procurement, licensing, installation, and operation of infrastructure components that will be critical in CAV deployment. The SPaT Challenge also demonstrates a commitment from the public agencies to CAV manufacturers and application developers to work together to build the future of transportation.

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2. Workforce Intelligence Network for Southeast Michigan. Connected and Automated Vehicles Skills Gap Analysis, February 2017
Impacts of Small Cell Sites within Public Rights-of-Way

Target Audiences: Public Sector DOTs, City, and MPOs

Definition/Technology/Research:
Small cell sites are low powered cellular radio nodes used to add capacity to wireless communications areas.¹ They provide fill-in localized coverage, with a low amount of power and low antenna height. Small cells consist of small radio equipment and the dedicated directional antennas usually smaller than a shoebox that can be placed on structures such as buildings, signal poles, streetlights, and monopoles. Mobile operators use them to extend their service coverage, increase their network capacity, and cover a range of approximately 33 feet to 1.25 miles.

The exponential growth of mobile data traffic has been driven largely by the increase of streaming television and movie services, as well as video content on social media and instant messaging services. To meet these needs, wireless carriers are beginning to deploy network infrastructure upgrades to support the roll-out of 5G services. It is expected that 5G communication will consist of ultra-dense diverse small cell networks.

Fiber optic small cell infrastructure investment was initially projected to total a staggering $144.2B between 2014 and 2019; and, to date, it appears to have met, even possibly exceeded, this initial estimate. Fiber-based small cell is the preferred option, whenever and wherever possible, because the technology is scalable, secure, understood, and in many cases, the most cost-effective. It is for this reason, that state and local agencies are currently inundated with licensing and permitting requests to install underground fiber-optic runs within the rights-of-way. The brunt of actual small cell site applications will likely not be felt until the dedicated fiber optic infrastructure is in place.

Current State of Practice/Example Projects:
The number of wireless carrier companies looking to install fiber optic cabling and small cell sites within rights-of-way to meet the aspirational performance goals will impact municipalities through regulation of the facilities and management of the costs associated with the administration, inspections and permitting. In an effort to expedite the process and assure the nation’s dominant position on 5G deployment, the Federal Corporation Commission (FCC) released a wireless preemption order that went into effect on January 14, 2019. The rules limit local and state government authority in regulating the deployment of 5G small cells. They also force local governments to comply with guidelines designed to streamline some of the regulatory processes such as permitting that could slow down deployments. With the first wave of small cell wireless facilities now underway, opposition to the order is growing among local agencies across the U.S., some of whom have requested that the FCC reconsider the scope of the order.

In Arizona where the state legislature passed new language regulating small cell use of public rights-of-way and the permit application process and fees in 2017, state and local agencies have been working together to standardize application and permitting processes. These efforts have effectively streamlined the process of small cell installations across the state. Agencies hold regular meetings to address the use and management of the rights-of-way, discuss current and future matters/concerns, and actively review upcoming legislation. State and local agencies are likely to see future state and federal regulations around small cell sites. Creating working groups to address regulatory change is one way to streamline the administrative and implementation changes the public agencies must address.

² Brian Lavallee, 5G wireless needs fiber, and lots of it. Ciena.
Promoting Success of Student Chapters and Members

Target Audience: Public Sector; Private Sector; Academia

Definition/Technology/Research:
Promoting Student Chapter and Student Member success (leadership training, funding for activities, access to ITE international meetings)

One of the primary action items of the Institute of Transportation Engineers (ITE) Transportation Education Council (TEC) is to increase the involvement of academic/student chapter Faculty Advisors in the TEC, while a second area of focus has been to expand the presence of the ITE TEC at ITE District/International meetings. To begin to address this emerging issue, the TEC held a breakfast roundtable discussion at the Western District meeting for students and faculty advisors on “Student Chapter Best Practices” in 2017. A second meeting was held at the combined Western/Texas District meeting in 2018, and then a regular session was held at the Western District in 2019. In addition, the Southern District held a roundtable discussion, the Midwestern and Great Lakes Districts held a roundtable discussion in conjunction with their Student Leadership Summit (SLS), and the Canadian District has held sessions at their District meeting the past two years. The first such session at the International level was held in 2019 in Austin, Texas.

Although this has been a great start to help involve students at faculty at ITE meetings, to truly be successful in meeting the goals of the TEC, ITE needs to increase the promotion of student chapter and student member success through continued and ongoing leadership training, providing opportunities for funding for activities, and opening additional doors for student access to ITE international meetings. The TEC has begun this initiative, but it requires continual backing from ITE International to be truly successful. This is an emerging issue that will be ongoing for many years to come. The TEC will continue to organize activities and provide value for faculty to increase the involvement of academic/student chapter Faculty Advisors in the TEC by expanding the roundtable discussions and would request that ITE International continue to support this event at the international level.
Improving Transportation Engineering Education

Target Audience: Public Sector; Private Sector; Academia

Definition/Technology/Research:

Improving Transportation Engineering Education (evidence-based best practices in the classroom, contributing to improvements in the introductory course, building a community of transportation engineering professionals)

Raising awareness about and promoting the adoption of best practices in transportation engineering education is a critical need in secondary education. Although much is known about evidence-based instructional practices, they have been very slow to adoption in higher education, particularly in the STEM disciplines, and transportation engineering is no exception. Rather than adopting evidence-based practices, many educators lean towards extensive lecturing, which reduces the quality of student learning outcomes and retention in the transportation space. The Institute of Transportation Engineers (ITE) Transportation Education Council (TEC) can play a key role in improving the state of transportation engineering education.

To address this issue, the TEC has compiled a list of highly respected transportation educators from around the country to share their preferred learning activities and classroom strategies through webinars focused on evidence-based instructional practices. The first of these webinars took place in October of 2017 and the second in October of 2018. A third round is planned for October of 2019. The current goal is to expand these offerings to four webinars per year to assist faculty and students. This would include two webinars to assist faculty and two webinars to assist students, one each in the Fall and the Spring.
E-Scooters: Love Them or Hate Them, They Have Become a New Mode of Travel

Target Audiences: City and Municipal Governments; Private Consulting Companies; Academia and Research Institutes; Public health; TNCs; Data Scientists

Definition/Technology/Research:
If you’ve visited or lived in a city that has e-scooters, you probably have an opinion about them and in many cases, you have a strong opinion. Some see the scooters as a fun and practical mobility alternative and others see them as a nuisance (blocking the sidewalk, conflicts with pedestrians on sidewalks and vehicular traffic in the roadways and injuries just to name a few). But regardless of your opinion about this micro-mobility option the one thing that is difficult to argue — they have become a significant mobility option. Consider some examples. During a four-month pilot in Portland, OR there were just under 700,000 trips and just over 800,000 miles ridden on the approximately 2,050 scooters deployed on the city streets. In Austin, TX they are now averaging nearly 500,000 rides per month and had a peak in March of nearly 750,000 trips during South by Southwest. In 2018 (their inaugural year in cities across North America) they accounted for 38.5 million trips in the US which were just under half of all micro-mobility trips.

As e-scooters are being deployed in more and more cities, we see that each jurisdiction is taking a different approach. Some cities require helmets and others do not. Some cities allow them to be ridden on the roads, sidewalks, pathways, and others do not.

How do we best utilize this growing micro-mobility option? Is there guidance that can be provided to jurisdictions that have or are soon to adopt this new mode? How similar/different are the adoption and use of e-scooters vs. other micro-mobility options? Do e-scooters impact trip generation and mode split? If so, in what way (from transit, cycling, walking or vehicular trips)? Will their use continue to grow or will this turn out to just be a fad?
Open Data — How Do We Get There?

**Target Audiences:** Public sectors: DOTs, County, City, MPOs; Academia and Research Institutes; Data Scientists; Tech partners, App developers, and Start Ups

**Definition/Technology/Research:**
Public agencies provide a wealth of authoritative data related to the infrastructure they oversee. Real-time data sets include roadway geometries/base maps, closures/work zones, travel time, turn restrictions, signal timings, speed limits, warning speeds, etc. This data is often used internally for asset or operational management, but not released to a broader public audience. Providing open data for public consumption allows for better reaching of road users with accurate information through partners (e.g. Waze, Google Maps, Apple Maps) to ensure safe operations of the roadway. The Port Authority of NY & NJ has identified the accuracy of in-app navigation systems to be quality to the accuracy of field traffic control devices.

Through opening data sets, researchers and developers are able to conduct new and innovative analyses to gain new and powerful insights, as well as new start-ups and apps. Open data drives innovation. With the emergence of private-sector transportation network companies, such as Uber, Lyft, Bike Share and Electric Scooters — there is a desire through regulations for private company data to be shared with public agencies, if not more publicly.

There are many struggles in developing open data policies, including agencies willing to let go of control of the narrative, and allow for the outside use (and potential misuse) of their data; fear of cybersecurity breaches; and overall justification of the cost to launch. Additionally, in many areas, data sets lack a clear technical standard/structure, which creates a risk of released data not being incorporated in third party partner applications. Tech partners are seeking data to be released across the nation/world in a constant format to automate and allow for the scalability of their incorporation.

**Data Structure**
Currently, the largest limitation of scalability is the lack of a standard data structure for data exchange/APIs between public agencies and private platforms. As navigation apps replace 511 systems in terms of the user base, as they provide a better user experience which is integrated with other user services (e.g., suggesting restaurants with hours open), features well outside of any scope of a government developed 511 system. The impact of driver decision making based on information provided in these third-party navigation apps is well documented by agencies and research. However, all of the data behind the user experience is derived from various non-agency/owner authoritative sources and often are reduce the accuracy and timeliness of agency/owner knowledge.

Through a data structure that is advanced as a standard and meets the needs of both public agencies and navigation app platforms, is a key missing gap in the industry. ITE has historically filled this gap, in the 1980’s leading the development of the 511 data standards. With this gap filled, platforms will be able to develop an input to call all public agency APIs using one standard developed integration and obtain data from multiple cities, states and regions. Public agencies will be able to develop an API in a set format which they can have confidence in the data’s incorporation in map/app platforms, and ultimately reaching road users/customers, which in turn can justify the investment.

Through the development of a space of dialogue, ITE can facilitate a conversation that identified agency/member needs and desired in private traveler information systems (e.g. Waze/Google Maps/Apple Maps, etc.). Following the understanding of the desired data needs of the partners, this space can identify types of data desired for exchange and develop a technical standard to best communicate such. ITE’s publication of such a standard allows for a neutral group (e.g. not a specific competing map/app), nor a singular region (e.g., one city), with a quality brand of a long-standing engineering institution. Further, there is a precedence for ITE to engage in this space, as ITE originated the data standards for the legacy 511 system, the outdated data standards still used by many government agencies in an otherwise industry gap.
Making Advanced Traffic Signal Technologies, Operations, and Performance Measure Strategies More Scalable and Suitable for All of Our Communities

Target Audiences: City and Municipal Government Officials; City and Municipal Government Traffic Engineers; Private Consulting Engineers

Definition/Technology/Research:
Traffic signals are a vital piece of infrastructure in every community. Over the past several years, there has been an increased awareness of the various benefits of a well-designed and operated traffic signal especially as it relates to the overall mobility of a community. Operational concepts (like the development of Traffic Signal Management Plans or the use of high-resolution performance measures) and technology advancements (such as Adaptive Traffic Signal Control or Automated Traffic Signal Performance Measures) have revolutionized the way our traffic signals are planned, designed, maintained and operated.

While the FHWA has committed to educating the public on these initiatives (particularly through the Every Day Counts program), the early implementers of advanced traffic signal principles most often are the state DOTs. However, in many communities throughout North America, traffic signal infrastructure is owned, operated and maintained by the smaller governing bodies — the cities, counties, and municipalities.

The professionals representing these communities have not been as quick to take to some of these advanced signalization tools. In many situations, these individuals do not immediately see how the investment will provide immediate impacts on their day-to-day responsibilities. Often the money that does get invested is spent on technologies that are the wrong fit for their objectives.

Therefore, I think it is important for ITE to develop a program that helps to advance — and even modify — some of these concepts so that they can be better deployed at a local level. Our proposal would be to provide a series of sample projects from across the country that shows smaller governing bodies deploying these tools to their benefit. In addition, we would develop a series of “quick bite” white papers which builds off some of these sample projects to show a step by step approach to deploying some of these tools at the local level.

Current State of Practice/Example Projects:
In New Jersey, a county was designing a large traffic signal modernization and optimization project across a major corridor. After a presentation from a local traffic signal vendor, they decided to install a computerized traffic signal management system as part of the project. This included the installation of a hardened cabinet in a local park that housed the system’s servers. The county began using the new system primarily as a surveillance and incident management tool but had no qualified staff to maintain the servers. However, since software updates require a physical trip to the field, the system is now somewhat outdated and does not support some of the newer modules to monitor traffic conditions. The servers are now in very poor working conditions and beyond their useful life expectations.

As part of a new project, a consultant team is working with the county to develop a solution that is both more sustainable and useful to them. The new system will be hosted offsite on either a cloud-based or data center-based server so that the proper maintenance and upkeep is ensured for years to come. This will make it much easier for the county to push new software version releases and in turn have the most up to date tools at their disposal. In addition, some of the advanced performance measure modules will be added to the system so that the county can proactively monitor conditions and fine tune traffic signal timings remotely.

The original solution shows how some municipalities are trying to utilize these advanced traffic signal technologies but unfortunately deploy systems that are not suitable for their needs. The new solution shows a scaleable alternative that the county can build from moving forward.
Accelerating Growth of Roundabouts

Target Audiences:
Transportation educators; Engineers; Planners

Definition/Technology/Research:
Roundabouts are powerfully effective, becoming more affordable, and are gaining serious traction. Roundabouts eliminate 80 percent of severe injury and fatal crashes at intersections. That makes them an ideal component of every Vision Zero program, especially for vulnerable modes like pedestrians and cyclists. As we continue to learn which elements provide these safety benefits (and which can be compromised) costs are shrinking. This makes them cost-competitive with traffic signals, a must for many cash-strapped public agencies. And requirements for life-cycle cost/benefit alternative comparisons are becoming standard in many states, giving roundabouts a fair shake despite public agency structure designed to resist change.

The industry needs professionals to design and build these roundabouts. Not professionals who are unaware of the unique and counter-intuitive principles. Not professionals with seemingly related experience that gives them misplaced confidence. Professionals who need a discreet self-test to spot room for improvement. “The greatest enemy of knowledge is not ignorance, it is the illusion of knowledge.”
- Daniel J. Boorstin

Current State of Practice/Example Projects:
There are roundabouts in every US state. They are a fully scalable traffic signal alternative, dramatically improving safety and calming, while simultaneously improving mobility.

Call to action: ITE members would be wise to thoroughly prepare ourselves for roundabouts as we will undoubtedly encounter them professionally, and many aspects are unique or counter-intuitive.

Missed Opportunities for Roundabouts

Target Audiences: Elected officials; Developers; Transportation educators; Engineers; Planners

Definition/Technology/Research:
More locations are being considered for roundabouts these days, and that is a good thing. Unfortunately, after consideration, many are passed up because agencies and practitioners aren’t sure where they can be flexible and where they need to hold their ground to prevent poor design that causes opposition to roundabouts. Too often, those without sufficient roundabout experience aren’t flexible enough in the capacity analysis, design vehicles, or layout. Roundabouts are rejected because they are thought to take too much land and cost too much, but there are very few locations where a roundabout will not work.

Designing for the future is a must. But when we build interchanges that last 20 or 40 years, much of the capacity is still unused 10 or 20 years later. These are missed opportunities for a much smaller roundabout interchange. Single-lane roundabouts are overlooked because 20 more years of growth would require a multi-lane roundabout. It is less safe to build an oversized roundabout anyway because of higher speeds and lower driver compliance. But this is resolved in a cost-effective way by building a single-lane roundabout with room to expand when needed.

Roundabouts are also overlooked in constrained urban environments. Oval, peanut, compact, or mini roundabouts are too often overlooked as effective alternatives that often eliminate right of way impact. And in series, roundabout corridors reduce an entire project’s footprint by reducing the lanes needed between intersections. For example, instead of trying to maintain dense side-by-side platoons in rapid succession, traffic feeds continuously into a roundabout and merges like a zipper on both sides without drama. In another example, narrow medians replace wide center turn lanes, with U-turns handled easily by the roundabouts.

Current State of Practice/Example Projects:
An example of the missed opportunity is shown below. At this project location, a full standard interchange was built to accommodate future growth. The interchange footprint is shown in blue in the photo to the right. As you can see in the photo to the left, most of the roadway cross section is not utilized, even 10 years after construction. A roundabout interchange, as shown in maroon with the loop ramps would have saved $7M dollars in construction, not to mention right of way cost savings. The loop onramps provide the capacity needed for the 40-year design. The traffic analysis showed that the loop onramps would not be needed for 10 or more years, meaning they could have been constructed in a future phase and saved millions more in up-front construction costs.

ITE members would be wise to seek training that helps us recognize where we can be more flexible in roundabout analysis and design to save the roundabout option (and possibly millions), without winding up with a traffic circle.
Connected and Autonomous Vehicle Technologies Will Require Re-Thinking Highway-Rail Crossing Treatments

**Definition/Technology/Research:**
The current focus in CAV technology has addressed the system requirements for, as well as the design and systems integration of advanced technologies which provide navigation, warning and operational control of roadway vehicles connected to the roadside infrastructure and other vehicles and road users.

At a highway-rail crossing, CAVs need to interface with another mode — rail — which has different rules dictating assignment and management of right-of-way and which utilizes railroad-specific technologies for communication and activation of warning and traffic control devices.

Historically, the only direct communication between the highway mode and the rail mode at a crossing has been the provision of a preemption interconnection intended to provide warning to the highway users and harmonize the operation of railroad warning and traffic control devices such as flashing-lights, crossing bells and crossing gates with active roadway traffic control devices such as traffic signals and active warning signs.

As a minimum, CAV technologies need to respond to train detections transmitted via the traffic signal interconnect. This data could be used to provide various forms of enhanced warning to highway users such as activation of in-vehicle alerts, indications of crossing status provided by on-board navigation systems, and preventing vehicles from stopping on the tracks in the crossing zone.

The development of a more robust interface with the railroad subsystem, in conjunction with potential future generations of Positive Train Control (PTC) technologies, could provide added safety and operational benefits. For example, from the point of view of the road user, if reliable data on the direction, speed, and potential arrival “window” of approaching trains could be acquired, then areawide traffic management systems could use this data to manage traffic densities in the vicinity of crossings, road users could be warned of a “second train” arrival, and roadway network efficiency could be increased through navigational and speed control of highway vehicles in the vicinity of crossings. (A key technical issue to be addressed is the development of systems that meet the “fail safe” requirements associated with “vital circuitry” presently used by railroad systems.)

Another challenge for CAV’s involves the provision of safety at “passive crossings” which presently lack any form of train detection. There is no train arrival data or warning provided at such locations to which a CAV could respond. Although a smart highway vehicle should be able to detect such a crossing and to determine that there are no active warning systems available, such a vehicle would need to have the same capability as a human driver to scan the rail approaches and estimate the amount of time needed to safely cross. As most current research and development has been focused on requirements related to delineation of the highway, there has been little or no research or development of infrastructure requirements for CAVs at such crossings. This research may consider whether deploying train mounted transponders capable of communicating with highway ITS infrastructure and CAVs would be effective.

Practitioners knowledgeable about rail crossing treatments both from the highway side (primarily represented by ITE) and from the railroad side (primarily represented by the American Railway Engineering and Maintenance of Way Association (AREMA) should partner to enhance the visibility of these concerns so that CAVs can navigate and operate through rail crossings of all types safely.
Micromobility and Risk Management

Target Audiences: Public sector transportation practitioners (policymaking, transportation engineering, and transportation safety). The lack of academic research related to the effects of increased micromobility modal share may also induce research interest.

Definition/Technology/Research:
Micromobility refers to the short-distance mode of transportation, which is increasingly shorthand for the growing crop of electric scooters, electric skateboards, and dockless bicycles that are poised to reshape the urban landscape. Implementation of micromobility in practice arose in the late 2010s as a solution to the ‘last mile’ of personal transportation, particularly in congested urban areas. In the last couple of years, micromobility startups have emerged as a powerful alternative to the current transportation mix.

While the micromobility trend continues to grow worldwide, there are still several challenges hindering a complete adoption and assimilation of these new modes of transportation. One of the anticipated challenges is the lack of regulation which has led to increased tension among other road users, including pedestrians, over issues such as the right of way and their operating speed. The legality of riding e-scooters on sidewalks varies from one jurisdiction to the next, with some pedestrians suddenly sharing space with motorized vehicles and the associated safety and accessibility concerns. On the other hand, asking relatively unprotected micromobility users to co-occupy roads and/or bicycle facilities with vehicles traveling at a much higher rated of speed will increase risk, decrease ridership, or spur unwanted sidewalk riding.

The resulting conflicts between micromobility and some autonomous delivery vehicles and other road users will create issues for participating municipalities in setting policy for use in the current environment with limited and wildly varying precedents from other authorities around the world. Potential litigation concerning user safety related to the design, operations, and maintenance of the permitted facilities is an eminent conclusion.

To address the above-noted challenges and piecemeal implementation by many, ITE and its members should at the forefront leading the efforts in identifying the potential issues, promoting policy development uniformity and reducing the exposure of risk for the road authorities with micromobility vehicles in their transportation system.

Current State of Practice/Example Projects:
As early as 2008, docked bike-sharing municipal programs were launched in major Chinese cities to alleviate mobility issues. The dockless electric scooters first appeared on the streets of Santa Monica, California. In the past few years, e-scooters and other micromobility modes have continued to be introduced in several other cities in North America, including San Francisco, Atlanta, Austin, Denver, Washington DC, Montreal, Toronto, among others. With the speed and unpredictability of scooters zooming by on sidewalks or randomly placed in the streets, some European cities like Paris are banning them on sidewalks as cautionary steps to prevent scooter collisions with pedestrians. Some other cities such as Barcelona took an extra step to ban the use of shared electronic scooters completely. In terms of regulations, Denver allows scooters to use the sidewalk if no bike lane exists and the road speed limit exceeds 30 miles per hour (48 km/hr), but they are limited to a maximum speed of 6 miles per hour. In summary, many road authorities and transportation agencies are struggling with allowing and/or controlling the operations of these emerging modes in their systems; the current state of the practice is varied and diverse.
Vision Zero and Tort Liability

**Target Audiences:** This topic is of greatest interest to the public sector, especially for regions with goals for Vision Zero and High Exposure Liability Laws. The lack of academic research may also result in research interest. Advocacy and Public Health interests should also be aware of emerging issues.

**Definition/Technology/Research:**
Vision Zero (VZ) programs are being created and adopted in communities throughout the country, and many states are also showing interest. Liability laws vary considerably in determining agency exposure to litigation involving traffic collisions. But most state laws are written to protect agencies that allow for reasonable (tolerable, normal) collision rates. Vision Zero generally raises this bar above the historical level of tolerance and challenges that no fatal is acceptable if the agency can improve the situation.

Experts are being asked in courtroom settings to defend why an agency has not done all it can to try to prevent a collision or why a VZ improvement was not implemented sooner. Support for VZ programs can weaken through increased tort activity that increases defense costs and the potential for large awards. There may be a need for tort reform to ensure that agencies trying to do “Better than average” through VZ are not held to a higher standard of care. Public liability and VZ seek the same goals, fewer deaths and severe injuries, but the potential for public liability to increase while safety improves is a challenge.

The promise of crash reduction through autonomous vehicles may reverse this trend, but it will likely make a difference too late for Vision Zero to be hampered by increased tort activity.

VZ at the city level tends to focus on vulnerable users. These are the areas where tort activity is increasing, perhaps in line with the national rise in pedestrian fatalities. There is no known research on this subject, but TFARM members feel that this is increasing.

**Current State of Practice/Example Projects:**
A major Vision Zero city in California has already begun to see an increase in claims activity. Incidents that occur along its designated high injury network are being highlighted in claims. Press coverage of VZ is being presented as evidence. Many current claims are at sites on the VZ network, suggesting that the city may have known of a problem before the incident occurred. A major damage award was made against New York City due to the failure to implement a traffic calming/complete streets program to address collisions along the corridor. Similar issues are being heard in other cities.
Heading Toward Performance-Based Decision Making

**Target Audiences:** Public Sector and Private Sector Professionals involved in Planning and Project Development

**Definition/Technology/Research:**
With continued growth and interest related to performance-based decision-making, and serious interest within the AASHTO community related to greater evolution with the Green Book, the profession stands on the precipice of significant change in how we approach transportation design. Notably, NCHRP Report 837 examines how a future edition of the Green Book (beyond the current 7th Edition) could best support a performance-based design process, perhaps shepherding in a new era that has moved beyond our current nominal, standards-driven process. The current 7th Edition, Chapter 1 of the Green essentially opens the door for a significant professional shift from standards-based and nominal approaches to policies and action based on measurable and discernable estimates on performance.

New performance goals and measures have been promulgated in the data-driven approaches set forth by the Moving Ahead for Progress in the 21st Century (MAP-21) Act and further emphasized in the Fixing America's Surface Transportation (FAST) Act legislation. The next logical step in this evolution could be considered Performance-Based Design or Decision Making, which can be coined as Performance-Based Practical Design (PBPD). PBPD is a decision-making approach that helps agencies better manage transportation investments and serve system-level needs and performance priorities with limited resources. Through PBPD, agencies can weigh project-level results and associated trade-offs against systemwide performance needs and goals, with a specific need to reconcile competing for performance measures (i.e., operations, safety, environment, etc.) while consistently supporting all users, especially vulnerable road users.

**Current State of Practice/Example Projects:**
By focusing on system-wide performance, agencies can better manage the cumulative effectiveness of individual project investments and build upon the goals of Context Sensitive Solutions, flexibility in design, Practical Design, Asset Management, and Value Engineering. Numerous states and other jurisdictions from Minnesota to Kansas to Arizona have utilized a quantitative approach to understanding project performance while keeping system needs in mind. In addition, many states and localities have implemented and are moving toward institutionalization of Data-Driven Safety Analysis (DDSA), which employs newer, evidence-based models that provide state and local agencies with the means to quantify safety impacts similar to the way they do other impacts such as environmental effects, traffic operations, and pavement life, through predictive and systemic analysis techniques. States such as Missouri, Minnesota, Louisiana, and Ohio, and have implemented DDSA and created commensurate tools and policies. Arguably the implementation of DDSA and the use of the AASHTO Highway Safety Manual (HSM) are accelerating data-driven, science-based approaches that extend beyond nominal utilization of standards. It's conceivable, and potentially even ironic, that antiquation of AASHTO's leading design document may actually be led right now by its other best seller, the HSM; only history will know for sure. The legal, ethical, and professional implications of this change have yet to be resolved, and ITE stands in a position to lead our focused efforts in this paradigm shift.
Embracing a Safe Systems Approach

**Target Audiences:**
Public Sector and Private Sector Professionals

**Definition/Technology/Research:**
While safe mobility is not a new concept, Vision Zero requires a shift in how communities approach decisions, actions, and attitudes. A fundamental part of this shift is moving from a traditional approach to a Safe Systems approach. A traditional approach accepts that a certain number of traffic deaths and severe injuries will occur as unavoidable consequences of mobility, and it focuses largely on changing individual behavior to reduce the frequency of these incidents. In contrast, Vision Zero is built on the basis that traffic deaths and severe injuries are preventable. A Safe Systems approach seeks to improve safety through more aggressive use of vehicle or roadway design and operational changes rather than relying primarily on behavioral changes.

Safe Systems approaches are a way to advance safety roadway system wide for infrastructure planners, engineers, and designers. A Safe System approach could represent a fundamental shift in how transportation agencies consider, analyze, and make decisions. International experiences in Safe Systems include understandings that: (1) consequences of crashes should not result in a death or severe injury; (2) the human body has a limited tolerance to crash forces; and (3) system designers and system users share responsibility for managing crash forces to a level that does not result in death or severe injury. A change in our design practices to become principally focused on these understandings as well as the utilization of conflict points, impact angles, kinetic energy calculations, and maximum survivable speeds is needed.

**Current State of Practice/Example Projects:**
Speed management is a key component of a Safe Systems approach, and both efforts may be pursued with some degree of delineation or certainly together. Considered by many to be an international best practice, a Safe System is a proven approach toward achieving Vision Zero throughout the globe, including but not limited to the United Kingdom, Sweden, The Netherlands, Australia, and New Zealand. Generally, in the United States, the promulgation of Safe Systems approaches and the development of related tools is only just in its infancy. USDOT and FHWA have recently initiated projects to develop Safe Systems-focused models and frameworks for implementation stateside. ITE Leadership, staff and membership as a whole can: (1) Become educated on the principles of a Safe Systems Approach through technical training, information sharing, and review of available resources; and (2) Develop a Safe Systems approach as it could be applied in the US based on international practices that have worked. ITE, FHWA, and Road to Zero Coalition, among others, are actively working on technical products, tools, and resources related to the implementation of Safe Systems in the US.
Technological Advancements Impacting Safety Performance

**Target Audiences:** Public Sector and Private Sector Professionals; Operators; Maintenance Personnel

**Definition/Technology/Research:**
One of the greatest transportation safety opportunities (and challenge for that matter), is the continued advent and development of technologies that have the potential to revolutionize our lives and produce positive outcomes in safety performance. From automated / autonomous and connected vehicles to onboard safety features in many of the new and newer automobile and truck makes and models hitting the market today, we are witnessing and living through the rollout of the 4th industrial revolution and disruptive technologies are changing how we identify, perceive, and react to transportation safety challenges. We’re facing greater and more varied responsibilities in not only our traditional and enhanced approaches to improve road safety, but also in our abilities to keep up with the rapid expansion of the available technologies, from intelligent transportation systems, to artificial intelligence, to conflict measurement and detection systems. Many groups, councils, and committees have been addressing several of these challenges and this trend is just as cross-cutting as any other, but in an effort to be focused, we can identify specific technologies that exist today or are expected in the near future that are being used to change vehicle, driver, and roadway performance.

A key element in ITE's efforts related to Vision Zero (VZ), the National Safety Council’s Road to Zero (RTZ) Coalition, and the Toward Zero Deaths (TZD) National Strategy on Highway Safety is the transformation of traffic safety culture in the United States, among all users such that decision makers and the public at large would not only support decisions and norms that promote safe behavior, but also together would accept the strategies necessary to effect change and improve our basic level of support for the professional and societal strategies that increase safety and reduce risk.

One specific technology gaining popularity and continuing to develop involves the use of artificial intelligence in combination with video detection, observation, and recognition systems to identify potential conflicts along roadways and at intersections. During the ITE 2019 Annual meeting in Austin, Brisk Synergies, a company specializing in this type of technology, presented during the ITE Transportation Safety Council on the use of their on demand and real-time conflict identification systems. Traditional crash prediction and systemic safety techniques rely on professionals to have crash records and known and measured safety performance issues, whereas the use of surrogate safety and indirect safety measures such as those produced through conflict detection and near-miss calculations (either from field measurements or through simulations) can be used proactively and without the burden of establishing known relationships between certain roadway, traffic, driver, vehicle, and safety performance issues. Establishing crash prediction models associating these items through a scientific and statistically-sound approach is time-consuming, expensive, and not practical in many cases. The use of alternative tools and techniques is required to either fill a void or augment limitations.

**Current State of Practice/Example Projects:**
Several examples and case studies are available from the cities of Houston, Bellevue, Toronto, Atlanta, and Bogota. In an effort to learn more about this technology, both ITE, its councils and committees, and the broader safety community could consider the development of an introductory webinar or series of webinars on this technology.

Transportation Safety Council
Transforming Our Professional and Organizational Cultures to be Safety-Focused

Target Audiences: Public Sector and Private Sector Professionals; the Profession At Large

Definition/Technology/Research:
A key element in ITE's efforts related to Vision Zero (VZ), the National Safety Council's Road to Zero (RTZ) Coalition, and the Toward Zero Deaths (TZD) National Strategy on Highway Safety is the transformation of traffic safety culture in the United States, among all users such that decision makers and the public at large would not only support decisions and norms that promote safe behavior, but also together would accept the strategies necessary to effect change and improve our basic level of support for the professional and societal strategies that increase safety and reduce risk.

This is also clearly a major component and underpinning in so much of ITE's broader work, activities, priorities, and interests throughout the ranks of our membership, especially as captured through ITE's Vision Zero effort. The U.S. Department of Transportation's (USDOT) Safety Council has also identified safety culture as a top priority. The USDOT defines the safety culture as the shared values, actions, and behaviors that demonstrate a commitment to safety over competing goals and demands. The consensus among safety experts is that a safety culture exists in different forms, principally in terms of both an organizational safety culture and also a public safety culture, and significant progress is necessary on both of these simultaneous fronts. It is critical to organizational missions and values that we address and reconciles the competing interests and pessimism that dissuade many from viewing roadway safety as anything less than a public health emergency, costing the United States more than $200 billion in annual economic damages, irreparably harming families, communities, and businesses alike.

Current State of Practice/Example Projects:
Creating and sustaining a safety culture is integral to helping to move toward zero deaths. In addition, safety culture is one of the basic principles on which Vision Zero is based. The overall lack of a safety-focused culture in the United States and a continued perception of societal complacency poses a significant challenge to transportation programs and the profession as a whole. One may argue that ITE has an ethical and professional obligation to help lead in not just the United States, but throughout the globe in advancing professional and societal changes necessary to create a traffic safety-focused culture. In the immediate future, working to implement the results of NCHRP Project 17-69 (A Strategic Approach to Transforming Traffic Safety Culture to Reduce Deaths and Injuries) could be a logical step for ITE in advancing organizational safety culture changes with our membership and beyond.

“Creating a positive traffic safety culture is integral to helping our nation move toward a vision of a highway system with no fatalities.” (Towards Zero Deaths: A National Strategy on Highway Safety, 2012, page 61)
Ethical Implications with Increased Safety-Related Expertise

Target Audiences: Public Sector and Private Sector Professionals

Definition/Technology/Research:
The ITE Canon of Ethics for Members states, “… The member will have due regard for the safety, health, and welfare of the public in the performance of professional duties.” Similarly, licensure laws throughout the United States, ethical requirements of other professional societies and organizations, as well as among certain certification programs, all emphasize the need for our profession to regard safety and the safety of the traveling public as a key, if not paramount, obligation. Federal, state, and local laws codify our profession’s responsibilities towards realizing safety in many of our decisions and actions. Many of the governmental agency vision and mission statements follow suit and echo the prioritization of roadway safety, among other key values and amid other constituencies.

In May of 2010, the ITE Standing Committee on Ethics conducted a limited survey to select ITE members and leaders, mostly consultants, in order to identify ethical issues and challenges then faced by transportation professionals. The results of this survey were included in the May 2012 ITE Journal. Among other key findings, this survey noted that the most important training topic among several others pertained to the ethical considerations when dealing with the presumed tradeoffs between safety and mobility (i.e. operations). A central theme among most of the respondents was that a disregard for standard design practices, including placing a client’s interest ahead of other interests, was an area of primary concern. This last fact helps to illuminate the fact that safety is not the only consideration in project decision making, and despite many compelling obligations in the profession that seemingly prioritize safety over other factors, it’s clear that many projects are born from other interests and as the result of tradeoffs between safety, mobility, environment, project costs, and the like.

Current State of the Practice/Examples:
With greater usage of tools such as the AASHTO Highway Safety Manual (HSM), many organizations are moving towards data-driven approaches in planning and project development, placing specific estimates on safety performance. In some agencies, only specific program areas or project types are using predictive safety, introducing a potential inconsistency. We are moving away from traditional approaches and embracing the latest in roadway science and predictive capabilities now afforded by tools such as the HSM. But safety is not the only motivating factor for projects, we’re not overly-consistent with how safety is treated, and nor is it the only interest. Quantitatively-speaking, roadway safety was not seated at the analytical table, so to speak. That has changed. In fact, we now have safety performance legislation and target setting by agencies for all public roads; including those impacted by local projects and developers. We must begin to wrestle with the ethics of engineering decisions when the potential exists to witness or be involved in project decisions that can be expected to create additional harm to users.
Significant Advancements in Data-Driven Safety Analysis

Target Audiences: Public Sector and Private Sector Professionals

Definition/Technology/Research:
For the past four years, FHWA has been working with agencies and localities across the United States on the advancement of data-driven safety analysis (DDSA) tools, policies and techniques through the FHWA Every Day Counts program. ITE has the opportunity to help maintain the progress made and shepherd this program and foundational changes within our profession into its next stages of implementation. Data-driven safety analysis (DDSA) employs newer, evidence-based models that provide state and local agencies with the means to quantify safety impacts similar to the way they do other impacts such as environmental effects, traffic operations, and pavement life, through predictive and systemic analysis techniques.

Predictive and systemic analyses improve on traditional decision-making approaches that rely on subjective and limited quantitative measures of safety performance. Agencies use the analyses to optimize funding by selecting the most appropriate roadway features and project sites. DDSA offers a scientifically sound, data-driven approach to allocating resources that results in fewer fatal and serious injury crashes, a key element of our efforts in Vision Zero. The greater usage of tools such as the AASHTO Highway Safety Manual is helping to accelerate DDSA implementation. Traditional approaches that focus on automobile mobility and level of service (LOS) as driving performance indicators can be assisted by the latest in science and predictive capabilities now afforded by the HSM and policies and actions that embrace DDSA.

Current State of Practice/Example Projects:
Numerous agencies and states have either fully-adopted DDSA throughout its planning and project development activities or are in the process. States such as Missouri, Minnesota, Louisiana, and Ohio, and have implemented DDSA and created commensurate tools and policies. To date, approximately three quarters of U.S. state agencies are applying DDSA, but work remains, especially in promulgating DDSA with local agencies and in permitting. Many localities have adopted ICE policies and tools, including Kentucky, California, Georgia, and Wisconsin, but in other locations, they have either just started the process or have significant institutional barriers to overcome, for example in Pennsylvania.

ITE has the potential to help mainstream DDSA and infuse this emerging practice into our profession, especially with a concentrated effort by members connected to local, tribal, and county governments, as well as through our efforts in transportation safety education and outreach. ITE leadership, councils, and membership can: (1) promote DDSA and support the message that safety performance should and can be infused in all projects, not just state highways through training and conference activities; (2) support the national conversation on the evolving use of Level of Service (LOS) as a performance measure in transportation projects; (3) integrate DDSA into the ITE Multimodal Transportation Impact Study guidelines project (similar to the level of integration of mobility analysis techniques); and (4) encourage local ITE sections and chapters to partner with communities to leverage DDSA to augment and modify local zoning and land development ordinances to have greater support for roadway safety and through the development of local road safety plans.
Emerging Options and Including Safety Professionals in Mobility Dialogue

Target Audiences: Public Sector and Private Sector Professionals

Definition/Technology/Research: Emerging mobility options such as for-hail vehicles (Uber, Lyft), docked and dockless bike share, e-bikes, and e-scooters are disrupting the transportation landscape and bringing new challenges and opportunities for cities as they seek to further Vision Zero safety efforts.

Challenges include the following:
- Even more distracted walking, driving, and bicycling as users rely on their phones for navigation and vehicle/device locating
- Increased speed differential and conflict challenges between higher speed bikes and scooters on Bike facilities, sidewalks, and trails
- Increased curbside demand for loading, unloading, and vehicle/device parking
- Increased conflict between modes at the curb
- Increased vehicle miles traveled and associated exposure rates
- Additional crossing desire lines to mid-block access points
- The broader range of users on devices they have less familiarity with and/or using new facility types
- Equity and accessibility considerations with the new modes

Current State of Practice/Example Projects: Here are ways ITE members should consider the impact of emerging mobility for safety:
- Make use of significant origin, destination, and route choice data, particularly new and unique for active transportation
- Identify new revenue opportunities for cities who choose to permit or otherwise charge for new modes and/or curbside access
- Quantify potential for mode shift to “greener” alternatives
- Expect greater support for protected bikeways, protected intersections, trails, bicycle boulevards, and other low stress infrastructure
- Embrace bikeshare models that can work in lower density context, with dockless flexibility
- Enhance critical first/last mile connections in hilly topographies, with e-bike and e-scooter assistance
- Encourage active transportation commute choices with better emergency ride home options and child transportation alternatives (Hop Skip Jump, etc.).

Consider new funding availability for active transportation with transit services efficiencies and reduced paratransit costs.
Full Integration of Speed Management in Vision Zero

**Target Audiences:** Public Sector and Private Sector Professionals

**Definition/Technology/Research:**
The toolbox for Vision Zero is varied and extensive, but no tool is more important and readily-deployable than sound speed management practices. Speed is exponentially related to the severity of injuries and the chances for fatalities in roadway crashes. This is especially the case when vulnerable road users are involved.

In the Fall of 2017, the NTSB released a wide-ranging report on the impacts on public health due to traffic-related injuries. NTSB identified speed as the number one culprit and called for a national commitment to resolving this challenge through engineering, enforcement, education, and encouragement. A RAND Corporation Report followed, with a discussion of key strategies that national, state, and local agencies should consider for speed management. Even more recently, ITE and the Vision Zero Network received a grant to develop and conduct training on speed management. The grant funding is from the Road to Zero Coalition, a committee of the National Safety Council. ITE is an active member of the Coalition. A myriad of organizations and governmental agencies are working together to effect change within the profession, but precedent and longstanding traditions within the industry can stymie progress on this front. Broad teaming and consensus building to change how projects are designed and how roadways operate may be considered, in this regard, rather unconventional and arguably necessary to change existing tenets and policies.

**Current State of the Practice/Examples:**
States and cities throughout the United States have launched traffic calming campaigns and speed management action plans, including jurisdictions from Alabama to New Jersey, and from New York City to Seattle. Greater deployment of innovations in speed management and utilization of the myriad of tools and resources available is possible and should be an area of primary focus for ITE.

ITE and its membership can: (1) Support the core recommendations from the NTSB and RAND reports through advocacy, implementation, and removal of roadblocks; (2) Support efforts with the National Committee on Uniform Traffic Control Devices (NCTUCD) and several states to move beyond rote utilization of the 85th percentile speed of automobile traffic for setting speed limits; (3) Attend a speed management training course to better understand the role of speed in traffic injuries and the tools available; (4) Develop area- and city-wide traffic calming programs, using traffic calming resources such as those available from ITE Traffic Calming factsheets and FHWA; (5) Review agency design standards and other policies that may favor mobility over speed, such as level of service, corner radii dimensions, and lane widths; (6) Use “big data” to identify areas with key speeding concerns and to evaluate the effectiveness of speed interventions; (7) Partner with local law enforcement and the legal community and work together to ensure complementary enforcement and adjudication; (8) Consider on and off board detection technology to monitor vehicle speeds and near misses; and (9) Investigate and suggest opportunities to implement road diets and roundabouts and other countermeasures that specifically target speed.
Implementation of Core Principles of Vision Zero

**Target Audiences:** Public Sector and Private Sector Professionals

**Definition/Technology/Research:**
Vision Zero — the strategy to eliminate traffic fatalities and severe injuries — is being adopted by a growing number of communities across North America and beyond. While safe mobility is not a new concept, Vision Zero requires a shift in how communities approach decisions, actions, and attitudes around safe mobility. A fundamental part of this shift is moving from a traditional approach to a Safe Systems approach toward traffic safety. A traditional approach accepts that a certain number of traffic deaths and severe injuries will occur as unavoidable consequences of mobility, and it focuses largely on changing individual behavior to reduce the frequency of these incidents.

Vision Zero is built on the basis that traffic deaths and severe injuries are preventable. It emphasizes a Safe Systems approach, which acknowledges that people make mistakes, and it focuses on influencing system-wide practices, policies, and designs to lessen the severity of crashes. Approaching the issue of safe mobility in a new way can be challenging, even when everyone agrees on the ultimate goal — in this case, safety for all road users. One limitation of the success and proliferation of Vision Zero at this moment is the lack of a unifying definition and “best practice benchmark.” While an increasing number of jurisdictions may call themselves Vision Zero communities, the authentic and ongoing commitment to the fundamental shift in safety perspective can be uneven.

**Current State of Practice/Example Projects:**
The Vision Zero Network and Institute of Transportation Engineers have partnered to develop a set of Vision Zero Core Elements to help communities set priorities, work toward tangible results in promoting safety, and benchmark their progress relative to best practices. This resource encourages leaders to focus on the most impactful actions and helps hold them accountable to their Vision Zero commitments. Equity and Engagement play a critical role in each of the Core Elements. Elevating equity and meaningful community engagement, particularly in low-income communities and communities of color, should be a priority in all stages of Vision Zero work.

Here are ways ITE members should consider the core principles of Vision Zero in support of increased safety by ensuring all Vision Zero plans developed by agency or consultant staff have all core principles in place:

1. Leadership and Commitment (Public, High-Level, and Ongoing Commitment, Authentic Engagement, Strategic Planning, Project Delivery);
2. Safe Roadways and Safe Speeds (Complete Streets for All, Context-Appropriate Speeds);

To learn more about the Vision Zero Core Elements, see the Vision Zero Network’s full [Vision Zero Core Elements document](http://www.visionzeronetwork.org), which includes further details and links to examples and related resources. In addition, the Vision Zero Network [website](http://www.visionzeronetwork.org) and [ITE Safety Resources Toolbox](http://www.ite.org) offer useful information on Vision Zero principles, recommended practices, and analysis strategies.
Deployment of Proven Safety Countermeasures

**Target Audiences:** Public Sector and Private Sector Professionals

**Definition/Technology/Research:**
Back in 2008, FHWA began promoting certain infrastructure-oriented safety treatments, countermeasures, and strategies, chosen based on proven effectiveness and benefits, in order to encourage widespread implementation by state, county, tribal, and local transportation agencies to reduce serious injuries and fatalities. This became known as the Proven Safety Countermeasures initiative. The original list developed in 2008 was updated in 2012 and then again in 2017 to include now more than 20 treatments and strategies to address roadway departure, intersection, and vulnerable user crashes. Some of the latest additions to this list include reduced-left turn conflict intersections, roadside improvements along horizontal curves, and local road safety plans.

State and local government agencies throughout the world have utilized this list to help support safety planning and project development, and arguably the strategies and solutions therein comprise many of the infrastructure and engineering solutions needed to achieve Vision Zero. This list can help to serve as the basis for establishing the tangible, infrastructure-oriented engineering solutions to help advance Vision Zero and a resource that ITE membership can put to work today, if they aren’t already.

**Current State of Practice/Example Projects:**
Many of the treatments and strategies identified as Proven Safety Countermeasures are broadly used and considered, but many are not, and altogether this list would not be considered a mainstreamed resource in the same way that initial consultation with design standards and requirements of the MUTCD or AASHTO Green Book would be viewed. Typically, we start project decisions with the regulations and standards and then work to identify the feasible and desirable engineering outcomes that work within the boundaries set by those standards. If we reversed this approach to first consider the needed outcomes and consulted a list like the Proven Safety Countermeasures, the flexibilities within existing rules and regulations may become more evident and a greater number of the desired outcomes could be achieved, and different avenues and opportunities may become more evident. Also, notably, several countermeasures are the subject of ongoing NCHRP research and are being recognized through inclusion on the CMF clearinghouse.

ITE leadership, staff as well as the membership particularly at the section and chapter levels could: (1) market the concepts and strategies on the list of Proven Safety Countermeasures to both internal and external partners, including local elected officials, law enforcement and emergency service providers, and educators such as those involved in driver education; and (2) advocate for the consideration of reduced-left turn conflict intersections and the development of local road safety plans (which are two of the newest proven safety countermeasures identified by FHWA) within the engineering profession through an awareness campaign within local communities. The inter-relationships between this emerging practice and the others identified here are complementary and together can help to reduce crashes and save lives.
Cybersecurity in Transportation Infrastructure

Target Audiences: Public Sector and Private Sector Professionals

Definition/ Technology/ Research:
Understanding the Cyber-Physical edge keeps the infrastructure safer. Many modern transportation projects have elements of ITS incorporated into them for reasons including project longevity, improving traffic management, and to ease the burden of continuous maintenance through technology, to name just a few. All of the benefits wrought by the inclusion of ITS systems are at risk when basic cybersecurity and the cyber-physical edge are not properly considered.

The network edge is a term used to define the edge of an area in cyberspace where a boundary of the system’s reach ends. This boundary is often formed as a network encounters another network. Assume Network A is managed by Municipality A, and Network B is managed by Municipality B. Where Network A and Network B meet, and the rules by which they interact or exchange data across, is considered the network edge. The security, logic, and function of the network edge are defined by whatever agreement exists between the two municipalities regarding the sharing of data, users, video streams, etc.

The cyber-physical edge is the term used to describe the physical hardware that maintains and creates the network edge: the routers, modems, firewalls, switches, and devices — as well as their configured settings and parameters. In essence, the cyber-physical edge is the part of the ITS network that defines its interaction with other networks, devices, or users not native to the network.

As ITS deployments become more common for smaller municipalities, the creation of network edges between neighboring areas will become more common and more granular as the smaller entities seek to create their own networks, to host their own devices, and be managed by their own users and traffic management initiatives. In Florida, several local agencies have mandated by upper management that the Information Technology “Divisions,” within an agency, are now being tasked to manage the transportation infrastructure (instead of traditionally the Public Works or Traffic Engineering Departments). Many of these “Divisions” are not familiar with the transportation network and/or devices. Therefore, there is a huge gap or learning curve identified here.

When ITS projects seek to cooperate with each other, a small amount of planning can go a long way — or not far enough. Best practices documents should be drafted by local and state agencies to protect themselves from outside threats or hacks. Often the network aspects of inter-municipal coordination are overlooked or left as minutia to deal with in the details. The careful planning of your network edge to work with your neighboring municipalities’ methods of connection, variants of video streaming, security protocols, and access controls will save all partners time. An expert driven, thoughtful, long-term, high-level, and vendor-neutral network topography development plan allows for the opportunity to maximize the gain from the tremendous effort of sharing access and resources across agencies and municipal boundaries.

The goals of cybersecurity are to keep data confidential, accessible, and with its integrity intact. By ensuring the cyber-physical edge of ITS networks is secured against unauthorized access, the confidentiality of the data is protected. The ITS/traffic engineering professionals who calibrate and maintain the devices will ensure the data has its integrity. It is through diligent planning and coordination of network teams that the network edges will function together and ensure the data remains available to all stakeholders in the ITS municipal mesh.
Traffic Incident Management for Arterials

Target Audiences: Public sector (DOTs, Counties, Cities, MPOs); Private sector (Consulting Companies, Contractors, Suppliers)

Definition/Technology/Research:
Traffic Incident Management (TIM) for freeways and other limited access facilities has long been a proven tool for reducing secondary crashes, providing a higher level of safety to first responders, and for improving the time needed to clear a roadway and restore normal traffic flow. However, TIM applications on arterial highways have not historically been used, for a variety of reasons, including generally lower volumes, the availability of alternate routes, and lack of video and other instrumentation coverage along the corridors.

Recently, there has been an interest in the deployment of some TIM functions along arterials. Likely fueled by interest in Integrated Corridor Management (ICM) concepts and the growing availability and affordability of arterial-oriented technology (travel time monitoring, throughput detection, video monitoring, and more powerful intersection controllers), TIM is becoming a significant component of Active Arterial Management.

The benefits of arterial TIM can be significant. Arterials that serve as alternative routes to freeways need to be kept clear in case of a freeway incident resulting in the diversion of traffic. Major arterial corridors often serve as primary commuter routes where freeway facilities are not available. And, rural arterials may not have convenient alternative routes in case of an incident.

Two traditional freeway TIM functions — road service patrols and Rapid Incident Scene Clearance (RISC) — are increasingly being applied to arterial corridors. Previously, a disabled vehicle’s owner needed to attempt to move out of traffic flow or call a private towing company for assistance — raising concerns about safety and delays. And, for major incidents, emergency responders often had problems securing the appropriate scene clearance resources in a timely manner. Applying TIM functions to arterials helps address these past issues.

Arterial TIM may require a much higher level of inter-agency coordination. Where freeways generally fall under a state transportation organization, arterials often involve the local jurisdictions for operations and/or maintenance of control devices, communications facilities, and other TIM elements. A team approach to incident response would help address some of these inter-agency coordination issues.

And, getting the word to motorists about arterial incidents is important. Arterial Dynamic Message Signs are expensive to deploy; broadcast radio often involves delays and inaccuracies in getting the word out. The evolving connected vehicle programs allow an opportunity to get real-time guidance to arterial drivers. Unfortunately, there has been little information documented about successful arterial TIM programs. An on-line search identified only past presentations and updates about arterial expansions to TIM programs, as noted below.

Current State of Practice/Example Projects:
Perhaps the most extensive deployment, and likely the best documented, is the Maricopa County, Arizona, REACT program1 which has been in existence for several years. The Florida Department of Transportation has two programs; in the Jacksonville area, the “Safe Tow” program for arterials is provided for critical corridors to remove vehicles blocking a lane in the peak direction during the peak periods2. In the Miami area, an arterial RISC program has been established for arterials with heavy truck traffic3.

As there appears to be a growing interest in providing TIM services along arterials, and with the limited information available on how best to implement arterial TIM, the development of an informational package is proposed as an emerging trend topic.

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1 https://www.westernite.org/annualmeetings/13_Phoenix/Presentations/Session%203B%20-%20Hauser.pdf
2 http://www.jax511.com/D2TIMwp/initiative-arterial-safe-tow-program/
3 https://sunguide.info/arterial-management-service/