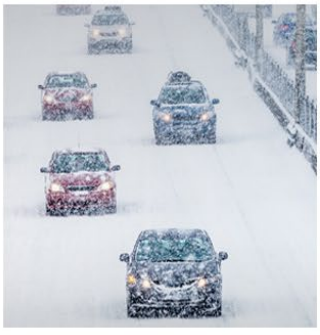
Every Day Counts

Request for Information

Summary of Innovation Suggestions
EDC 2019-2020
EDC 2021-2022




U.S. Department of Transportation
Federal Highway Administration

On-Ramp to Innovation
every day counts

Contents:

FOREWORD

The Federal Highway Administration (FHWA) published a Request for Information (RFI) in December 2017 for new innovations for the fifth round of Every Day Counts (EDC), deployed 2019–2020, and again in December 2019 for the next round of deployment in 2021–2022. The RFI is FHWA's opportunity to hear from State, Local, Academia, and Industry partners regarding ideas for accelerated deployment of proven, market-ready processes or technologies with the potential to provide efficiencies at all levels of the transportation system. FHWA staff also identified potential ideas for deployment. This report includes all of the ideas that were submitted externally.

Those responding to the requests were asked to consider the following:

- **National Impact:** Potential to benefit the transportation system nationally.
- **Readiness:** Whether the innovation is ready to be deployed nationally.
- **Game Changing:** How the innovation is transformative in saving time and money or improving quality.
- **Urgency and Scale:** Potential to shorten project delivery time, enhance safety, reduce traffic congestion, integrate automation, or positively impact freight movement, construction techniques, contracting methods, maintenance, preservation, emergency response.

FHWA received more than 100 suggestions and comments in response to each RFI. Ideas similar in content were combined for reporting in this document. Many ideas submitted need additional research or development, preventing deployment under the rapid process used by EDC. Some suggestions were not accepted due to small deployment markets. Some suggested innovations are proprietary, or require congressional action, and therefore were not considered under this process. All promising ideas remaining after the EDC selection will be considered by other programs within FHWA.

2017 EDC REQUEST FOR INFORMATION – SUMMARY OF RESPONSES

Asset Management & Planning

Decision-Support Tools – a toolkit containing rapid road rehabilitation applications, specifications, methods, materials, and costs that facilitates scheduling, traffic, and cost analyses for highway projects.

LiDAR Data Collection – the use of mobile LiDAR to collect, process, and analyze data to produce a three-dimensional digital terrain model that can be used for roadside asset management.

Negotiated Maintenance Contracts – a streamlined process used by the Minnesota Department of Transportation that allows direct negotiation of maintenance contracts if the estimated construction cost is under $150,000.

Asset Management for Local Transportation Agencies – a system that uses asset condition, performance models, and economic analysis to determine the benefit-cost ratio of different treatments to a roadway segment. Asset management systems generally move agencies from a "worst first" approach toward preservation and selecting treatments with a high return on investment.

Radio Frequency Identification (RFID) Tags – a class of technologies that can help track highway assets electronically, leading to the development of three-dimensional maps of new and existing utilities.

Construction

Accelerating Projects – the use of construction processes that reduce overall project duration to decrease impacts on the traveling public.

A+B Bidding Process – a construction bidding process where the low bid is determined by both construction cost and duration. This balances the overall construction cost with the user delay cost.

Project Budget Recovery Process – an aggressive administrative process that deobligates unused funds and quickly moves them into the next highest priority project.

Streamlining Delivery of Local Public Agency Projects – a system of simplifying and streamlining project contracting for local agency projects that would exempt them from Federal laws and regulations if their projects meet local and State requirements.

Progressive Design-Build Project Delivery – this alternative project delivery method combines the benefits of construction manager/general contractor and design-build delivery by simplifying the pre-award process, permitting the agency to get the design-builder under contract as early as practical while only being at risk for the cost of the preconstruction effort.

Federal Funds Exchange – a system enabling local agencies to exchange authorized Federal funding on a project for State funding at a discounted rate. This exchange would allow local agencies to implement projects under State and local requirements rather than Federal, State, and local requirements.

3D Modeling/Visualization Group – a strategy that uses an internal project group to build strategic visual communication content through 3D modeling, imagery, and video production.

Early Release of 3D Models – coordination and collaboration between an agency and contractors to facilitate release of the 3D model developed by the engineer to contractors during the pre-bid period to provide them with more accurate information for preparing bids.

Mobile LiDAR with Ground Penetrating Radar – a combination of technologies that collects accurate above-ground and below-ground assets and obstacles, reducing potential construction process conflicts.

Model-Based Design and Construction – an extension of the 3D design process, it provides for letting projects with the 3D model as the controlling document. This would facilitate using mobile devices in the field in lieu of plan sets and provide for populating existing condition data with mobile technologies.

Dynamic Roadway Design – a dynamic design software that links the separate design steps to allow for automatic revisions to all aspects of the design whenever revisions are necessary.

Reality Modeling for Transportation Projects – the process of capturing existing site conditions to provide real-world digital context for mapping, design, construction, operations, and inspection workflows.

Electronic Ticketing for Material Delivery – the use of electronic ticketing of construction materials (aggregate, asphalt, concrete, etc.) that includes the origin, destination, quantity, and associated quality measurements. These electronic tickets take the place of traditional paper tickets in the move toward a paperless construction process.

Blockchain Managing for Transportation Projects – a blockchain is a publicly distributed ledger of transactions that, in transportation projects, would allow data sharing and protection between agencies. The public ledger provides controlled access, reduces information silos, and improves sharing.

VDOT Job Books – a reference tool implemented by the Virginia Department of Transportation that uses an electronic "mentor" to support the transfer of relevant resources, job responsibilities, expectations, and guidance from subject matter experts to new and inexperienced staff.

Wiki-Scan Portable Laser Scanner Weld Inspection Tool – a handheld, portable weld inspection tool that replaces traditional gauges with a laser-measured weld analysis and database management system that can integrate with e-Construction systems.

Accurate Stockpile Measurement and Inventory Management – use of mobile phone applications for frequent measurement of construction material stockpiles to ascertain the quantity delivered to a project and determine if an adequate supply is available for project needs.

Intelligent Compaction Technology – an advancement in roller technology that allows the roller to measure the stiffness and quality of the soils and aggregates being compacted. It provides improvements in compaction uniformity and stiffness, and it identifies areas with compaction issues or low stiffness.

Hydraulics & Geotechnical

Bridge Scour Early Warning Detection System – a GIS-based system that displays bridge scour data on a map. The scour data is combined with additional sources of information on bridges that have the highest probability of experiencing scour-related damage.

Lithification Technology – a fast-curing process that accelerates lithification, turning soil into rock in a day rather than over many years.

Geofoam – the use of expanded polystyrene (EPS) geofoam blocks as an alternative embankment fill material to mitigate some differential settlements near bridge approach slabs.

Trenchless Culvert Replacement Methods – the installation of long-lasting, trenchless culvert pipes that reduce construction impacts.

Storm Water Flow Control and Grading – the use of enhanced grading and sizing of retention basins and storm water flow technology that allows high flow rates earlier during a storm to move water from retention basins to the storm water system.

Pavements

Precast Concrete Pavement – a system of specific details, materials, and associated installation methods used to rapidly create a fully functioning concrete pavement from precast pavement panels, which are most often used for rapid repair of in-service pavements.

Concrete Overlay Resurfacing – the placement of a relatively thin concrete layer on the surface of (or as an inlay in) any existing pavement to create a new, long-lasting driving surface. This is an alternative to removing and reconstructing an existing pavement or placing other types of overlays.

Long-Life (Perpetual) Pavements – a design method for asphalt pavements that attempts to eliminate structural, bottom-up pavement distress. This long-life pavement is then managed and maintained by addressing any top-down pavement distress through maintenance and rehabilitation.

Full-Depth Reclamation for Asphalt Pavement Rehabilitation – a rehabilitation technique that involves in-place recycling of an existing distressed asphalt pavement and its underlying aggregate layers into a new structural pavement base.

Interlocking Concrete Pavements – a pavement system that uses solid concrete paving units (blocks) assembled into a pattern to make a pavement wearing surface. These pavements have similar structural capacity to the equivalent asphalt thickness and resist deterioration under traffic or in hot temperatures.

Permanent Road Foundation – a pavement structural system where geotextiles and geogrids are used between the subgrade soil and the aggregate base to separate and reinforce the base. This reduces aggregate contamination and provides for a uniform and consistent performance of the pavement base.

Bender Elements to Quantify Aggregate Layer Stiffness – a measurement system for quantifying in situ stiffness characteristics of a pavement aggregate base/subbase layer.

Materials

Promotion of Patented and Proprietary Products – a program to encourage transportation agencies to use patented and proprietary technologies in highway construction that are allowed under Federal regulations.

Balanced Asphalt Mix Design – a system for asphalt mix design that uses performance tests to measure material properties that address different distress modes. This could allow the use of alternative mix designs and recycled materials and still provide a high-quality asphalt product.

Modified Binders in Asphalt Pavement – the use of polymer-modified asphalt binders to improve the long-term performance of hot mix asphalt and warm mix asphalt.

Low-Cost Additives for Performance – the use of readily available additive and recycled products, such as rubber, fibers, or shingles, to improve the performance of pavement materials.

Polymer-Modified and Highly Modified Binders – the use of high quantities of polymer-modified binders to enhance the long-term performance of asphalt materials. These highly modified binders are shown to increase cost by 5 percent and provide a performance improvement of 20 percent.

High Tensile Strength, Fiber-Reinforced Asphalt – a blend of synthetic fibers added to asphalt materials that controls and reduces thermal, fatigue, and reflective cracking and rutting.

Rip Rap Size and Shape Determination – a system for evaluating the size distribution of large-size rip rap aggregates based on analyzing images of the rip rap pile or project field application.

Lightweight Aggregates – the use of lightweight aggregates to reduce the density of concrete, to serve as a structural fill for embankments, to deliver water to the interior of concrete structural elements and pavements, and to provide long-lasting, skid-resistant pavement surfaces.

Nanotechnology in Concrete – the use of nanotechnology in concrete mixtures to improve permeability resistance, flexural strength, and abrasion resistance.

Structures

Folded Steel Plate Girder System – a prefabricated bridge superstructure using steel girders fabricated from plate steel with precast deck panels for use in accelerated bridge construction.

Smart Bridge Sensor Technology – the use of installed sensors to capture data on strain, out-of-plane bending, and crack changes that can be used to determine bridge condition and deterioration.

Stay-in-Place Precast Fascia Form – a method for accelerating the construction of bridge overhangs in which stay-in-place precast fascia elements are used as the formwork.

Ultra-High Performance Concrete (UHPC) for Bridge Deck Rehabilitation – the use of UHPC as a deck overlay material for rapid repair and rehabilitation to improve the performance, strength, and durability of existing structures.

Bridge Preservation Strategies Using UHPC – the use of ultra-high performance concrete to repair steel beam ends or to link bridge segments that would convert jointed bridge decks into jointless bridge decks.

Fiber-Reinforced Polymer Systems – the use of commercially available, fiber-reinforced polymer technologies with reinforced and prestressed concrete elements, such as pre-tensioning and post-tensioning of concrete beams, cast-in-place and precast concrete, composite tube arch structures, and other bridge elements.

Accelerated Bridge Construction Technologies – the use of construction acceleration techniques that use technologies such as precast concrete overhangs, full-depth precast bridge deck panels, and stay-in-place form systems to accelerate construction.

Orthotropic Steel Decks – the use of metal bridge decks that are up to 70 percent lighter than conventional reinforced-concrete decks.

Corrosion-Resistant Reinforcement (CRR) – the use of corrosion-resistant structural-reinforcement steel to reduce bridge deck maintenance by increasing the durability and extending the service life of the bridge decks and other key bridge elements.

Mobile Self-Propelled Tunnels – a large-scale mechanism of traveling gantries furnished with a crane, drilling machinery, and other equipment that carries out the construction process directly under the existing highway without impeding traffic flow.

Simplified Hydrostatic Pressure Relief for Bridge and Wall Preservation – the installation or retrofitting of a retaining wall's geotextile drainage and erosion-control system from behind the wall to the front face of the wall.

Seismic Design Using Shape Memory Alloy (SMA) and Engineered Cementitious Composites (ECC) – the use of SMA/ECC in the plastic-hinge regions of bridge columns to improve the seismic resiliency of bridges by dissipating energy during an earthquake without causing permanent damage.

Heated Bridge Technology – a technology that uses electricity generated from solar panels placed adjacent to bridges to help dry bridge surfaces during rain, snow, or ice events and slow down or eliminate bridge deck freezing following rain and snow events.

Safety

Intersection Control Evaluation Policy – a policy that allows agencies to make informed decisions on selecting the proper intersection form based on safety, operations, and cost and establishes guidelines for use based on the context of the project.

Channelization – the use of traffic safety products, typically orange plastic molded devices, to alert and direct traffic through roadwork or away from hazardous areas.

Guardrail Barrier System Using Rubber Roller Elements – a safety fixture on guard rails that absorbs impact energy and redirects the impacting vehicle back toward the road.

Rumble Strips – a road safety feature used at the edge of a road, or sometimes on the centerline, to alert inattentive drivers to potential danger by causing a tactile vibration and audible rumbling to be transmitted through the wheels into the vehicle interior.

Reduced Noise Rumble Strips – a class of non-traditional rumble strip designs aimed at reducing nuisance noise associated with their use.

Flashing Red Beacon – a fail-safe condition for traffic control signals that provides a flashing red condition during a power failure or other failure of the traffic signal.

Traffic Spot Eliminator – a roadway design modification that enhances visibility and reduces blind spots, resulting in fewer crashes.

Wider Pavement Edge Lines – the use of 6-inch edge lines to reduce run-off-the-road crashes on rural, two-lane highways when shoulder rumble strips are not feasible.

U.S. Road Assessment Program – a set of tools that allows for systemic data gathering, modeling, and prioritization of possible safety measures based on roadway physical characteristics.

Roundabouts – a safety countermeasure that reduces the potential conflict points in a typical intersection and reduces vehicle speeds.

Traffic Safety –a standard for traffic monitoring elements, such as loop detectors, closed-circuit television cameras, and electronic sign message boards, to inform and warn motorists of conditions.

Wrong-Way Driver Prevention – the placement of red on backside reflective pavement markers on arrows across limit lines and all freeway lane lines reduces the number of wrong-way driver reports.

Intersection Conflict Warning Systems – a collection of sensors and signage intended to warn vehicles on low-speed side streets of approaching vehicles on the intersecting high-speed mainline routes.

eTraffic GIS System of Engagement – an online, GIS-based data collection and sharing platform that integrates roadway characteristic data collected from multiple agencies with crash data to perform safety and operational analyses.

Job Site Practices to Improve Work Zone Safety – a series of approaches that includes increased use of positive-protection barriers, full road closures, project coordination by synchronizing projects at various levels, and the use of temporary rumble strips.

Environmental, Planning, and Realty

Improving Environmental Sustainability – the acquisition of ample right-of-way to allow for areas landscaped with trees and plants that offset CO_2 emissions and other pollutants and to provide flexibility for future right-of-way needs.

DOT Connects – a system of collaboration between State departments of transportation and local government to enhance understanding of community values and concerns. A clear understanding of local issues will provide more accurate scopes of work and budgets and minimize complications late in the design process.

Model for Accelerating Prosperity – a blueprint for stimulating economic vitality using transportation data that leverages federally funded data and staffing to support efforts to stimulate local economies.

Environmental Permitting – an automated system for calculating what is needed to determine if a plot is considered a wetland that reduces both QA/QC processes and permitting errors.

Promoting Environmental Streamlining Reform – a standard resource that helps disseminate national-level information on project streamlining reforms.

Digital Stakeholder Engagement Virtual Open House – the hosting of virtual, online public meetings communicating project concepts using 3D models and visualizations to expand the audience and range of public input for highway projects. It would include tools and social media that engage the public and point them to a virtual open house, where they can immerse themselves in 3D visualizations and provide feedback through comment forms, idea boards, and other interactive engagement tools.

Right-of-Way Acquisition Request for Proposals Process – a process that uses existing assets and develops operational improvements projects to reduce costs and improve mobility.

Accelerated Project Right-of-Way Acquisition – the use of separate contracts for preparation of right-of-way in advance of highway construction contracts that provides improved site access for geotechnical investigation, utility adjustments, supplemental surveying, and contractors bidding the highway construction project.

Environmental Compliance Monitoring and Tracking – the use of innovative methods for compliance tracking (e.g., databases and field technologies) that meet National Environmental Policy Act-derived goals for minimizing impacts to the human and natural environment.

Stormwater and Grading – a device that delivers superior discharges and efficient flows through small-volume ponds with additional localized collection of skimmed waste.

Operations

Crowdsourced Traveler Data – the use of crowdsourced, real-time traveler information from mobile phones and devices that can improve safety, operations, and maintenance.

Law Enforcement Cooperation – the use of police documentation and reporting to provide more immediate information on specific crash characteristics, leading to quicker implementation of countermeasures.

Autonomous Technology Improving Work Zone Safety – the use of autonomous crash trucks outfitted with truck-mounted attenuators that provide automated protection of workers in work zones.

Autonomous Vehicle Lanes – the use of smaller, dedicated autonomous vehicle lanes on interstates to allow more lanes for standard vehicles until autonomous vehicles are more widespread.

Portable Variable Speed Limits in Work Zones – the dynamic adjustment of speed limits in work zones to harmonize traffic while reducing the operating speeds of vehicles adjacent to workers.

Emergency Response/Traffic Congestion Mitigation – a program that utilizes both a mobile power inverter and quick-connect boxes at traffic signals to provide emergency backup power for signalized intersections during power loss or other emergencies.

Traffic Volume Control/Pre-Freeway Entrance Status – a meter or traffic management system that would allow drivers a non-commitment choice before they enter freeway approach ramps.

Narrow Track Vehicle Fleets with Optional Support Lane Markings – the use of single-width cars and lanes to mitigate congestion by allowing right-sized, width-efficient single and duo occupant driving.

Traffic System Management and Operations – a strategic approach to improving mobility for all modes of transportation by integrating planning and design with operations and maintenance to holistically manage the transportation network and optimize existing infrastructure.

Smart City Vehicle to Infrastructure Data Communication Platform – a communication platform that provides information, such as the number of vehicles, pedestrians, cyclists, and other objects in intersections and on the roadway, that enables predictive traffic analytics.

Data Access via Advanced Traffic Control Devices – the collecting, uploading, and storing of data captured at intersections and processed by smart technologies such as cameras and sensors.

Salt and Snow Management – a unified course that equips local public agency personnel with methods to optimize winter storm management activities.

Optimal Anti-Icing Strategies – a series of strategies and products intended to minimize the potential for ice to bond with pavements at the beginning of a storm, reducing the need for plowing and salting.

Efficient Use of Chlorides and Alternatives – the use of tools, such as on-board pavement temperature sensors, applicator control systems, forecast data, and application rate guidelines, to apply the right material, in the right amount, at the right place for snow and ice control.

Proactive Traffic Signal Timing – a proactive signal control system for optimizing signal phasing and timing plans by integrating data from traffic signals, loop detectors, and connected vehicles to reduce congestion on arterial roads and maximize the performance of intersections.

Consolidation of Autonomous Transportation Infrastructure – a network of continuously monitored stations that are evenly spaced along the traveled ways and used primarily for independent verification of autonomous vehicle data.

Freight Container Movements – the use of blockchain technology to record container shipping manifests at point of entry and point of delivery to move empty containers efficiently.

Flashing Yellow Arrow – the use of flashing yellow arrows at signalized left-turn lanes to reduce delay while not compromising the safety of the left-turning vehicles or opposing through vehicles.

Improving Agency Performance Management Using Automated Traffic Signal Performance Measures (ATSPM) – the continuation of the EDC-4 initiative with a change in the benchmark from ATSPM deployment to the use of ATSPM-driven decision-making for agency organization and business process improvement.

Speed/Distracted Driver Initiatives – a continuation of the EDC-3 Smarter Work Zones initiative to include additional approaches such as variable speed limits with automated enforcement, increased use of queue and speed management deployed through Intelligent Transportation Systems for dynamic management of work zone traffic, and partnering with Waze and other GPS navigation providers to share real-time road construction information.

Wireless Irrigation Valves – a secure wireless-integrated irrigation system for highway landscaping maintenance that provides a vandalism-resistant automated control system using off-the-shelf technologies.

2019 EDC REQUEST FOR INFORMATION – SUMMARY OF RESPONSES

Asset Management & Planning

Asset Life Cycle Utilization Tool – a web-based, big data software platform that allows users—with minimal training—to access, share, and utilize original infrastructure asset data by exact geolocation on a global Internet map. Virtually any type of file format (LiDAR, photo, video, aerial, CAD, BIM, GIS, CSV, etc.) can be processed and hosted on the platform for storage (with clear metadata), quick access, viewing, and use.

Asset Management for Low-Volume Roads – the use of transportation asset management principles to maximize investments on low-volume systems. Agencies implementing these practices on low-volume roads have seen improvements in network-wide condition as well as improved decision-making transparency and accountability for spending tax dollars in a way that builds public trust.

Construction

3D Engineered Models: Virtual Reality – a computer-generated simulation of a three-dimensional (3D) engineered model viewed through virtual reality holographic lenses. The technology can be used to communicate project details with stakeholders more effectively.

e-Ticketing Advancements – a technical solution for sharing ticket data from material producers. This new platform allows tickets to be reviewed, accepted or rejected, and appended with test data, pictures, and video via a mobile app in the field. This solution can be used with material producers' existing ticketing systems.

e-DOT Extension of e-Construction – collection, review, approval, and distribution of State department of transportation (DOT) documents in a paperless environment. e-DOT would extend the benefits realized through e-Construction to all aspects of State DOTs.

Raw Materials Supply Chain Management and Analytics – using a software tool to track the movement of raw materials to the jobsite, then using the same tool to collect and disseminate material test data. The result is increased accountability and better data management as all parties have access to compressive strength test data in real time.

Paperless Workflows – a cloud-based, electronic document markup solution for collaborative plan review. Traditional redlining is a multi-step, time-consuming process, and paper plan documents are subject to illegibility errors and printing time and costs. Available commercial off the shelf software can streamline the redlining process, improving accuracy and providing a comprehensive log of the review process. The electronic workflow facilitates cross-functional expertise during the design decision-making process, helping ensure the transportation asset can be built and maintained safely and efficiently throughout its life cycle.

Progressive Design-Build – using alternative contracting methods to streamline preconstruction activities and project design. Progressive design-build (PDB) is a contracting procurement method in which a design-build (D-B) team is selected solely on a qualification basis. PDB typically requires the contractor to team with a designer, forming a D-B team, to perform design and other pre-construction services.

Innovation in D-B-B Project Delivery – the use of new methods with traditional design-bid-build (D-B-B) contracting based on a project preview program, which provides contractors an "information only" look at preconstruction plans and specifications at various design milestones prior to project advertising. The contracting community then provides project teams with constructability comments and recommendations. This online RFI process carries into the project advertising phase for continued streamlining and transparency.

Earned Value Management – a project management technique for measuring project performance and progress. It has the ability to combine the measurements of the project management triangle: scope, schedule, and costs.

Digital Project Delivery Support – the use of digital project delivery to produce visualization models. Applying visualization to data-rich, as-built, three-dimensional (3D) models facilitates their easy consumption throughout the construction life cycle, along with querying and quality control applications. This helps provide a framework for innovation by producing a single source for shared information.

Hydraulics & Geotechnical

Advanced Geotechnical Methods in Exploration – an expansion of the current (round 5) initiative. The focus is on enhancing geotechnical site characterization by integrating data management and rapid subsurface visualization using the Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) standard schema.

LiDAR Data Collection – the use of mobile light detection and ranging (LiDAR) data collection and processing to generate a digital terrain model of surface elevations. Applications include drainage analysis, cross slope and superelevation evaluation, and height measurements for overpasses and other structures.

CPT Direct Design of Foundations – the use of cone penetration testing (CPT) to improve foundation design. CPT is fast and efficient, requiring hours rather than days per exploration, and gives direct, reliable measurements of soil strength and behavior. These measurements can be used directly in design with several models, saving time, reducing uncertainty through transformations, and improving quality with fewer sources of error. More efficient foundation designs with higher resistance factors and considerable cost savings are possible.

Scour Countermeasure for Bridge Piers – use of a sheath installed around bridge piers to reduce local scour, providing resilience and enhancing the safety of the structures. The sheath can be installed on new or existing piers and reduces scour, a main risk of failure to bridges, around and downstream of piers.

Pavements

Composite Shoulder and Roadside Ditch Stabilization – combining topsoil and/or rotomilling mix, turf reinforcement mats, seeding, and grading to disperse water runoff on pavement shoulders and stabilize the banks of roadside ditches adjacent to impervious surfaces.

Pavement Preservation / Recycling Technologies Training – building on EDC-4 pavement preservation to increase the impact and use of innovative technologies through development of best practices and training. This will enable State and local agencies to realize the benefits of pavement preservation, including increased resiliency, extended life, and decreased construction congestion.

Permanent Road Foundation – a strategy for using a competent unbound aggregate base and an effective geosynthetic separator to create a foundation that prevents the most common modes of bottom-up failure for road support layers. This will reduce the need for road reconstruction, promoting top-down rehabilitation in the future.

Continuous Friction Measurement – turns the reactive process of identifying areas with high risk for crashes into a proactive process of identifying and treating at-risk areas before crashes occur. With continuous friction measurement transportation authorities are empowered to choose the optimal countermeasures (engineering, enforcement, education, etc.) for addressing the root causes of crashes.

Development and Demonstration of Pavement Friction Management Programs – using continuous friction measuring equipment (CFME) to better support data collection for roadway safety. CFME is used with high-friction surfaces as part of a systemic and proactive pavement friction management program (PFMP). A demonstration project, conducted in collaboration with four States, confirmed a strong association between crashes and continuously measured frictional pavement properties (friction and macrotexture) and showed that a proactive PFMP can help reduce crashes and associated fatalities.

Concrete Pavement Overlays – the use of concrete overlays to increase pavement performance, including thin concrete overlays with fiber reinforcement and unbonded concrete overlays with a nonwoven geotextile fabric separation layer. Concrete overlay solutions have proven cost effective and had excellent performance results for the limited number of highway agencies that have used them.

Rolling Density Meter – a new technology for measuring density. The rolling density meter (RDM) uses ground penetrating radar to nondestructively measure the density of a recently placed lift of asphalt concrete (AC). Potential improvements include minimizing or eliminating destructive testing, real-time monitoring, and elimination of nuclear gauges, with an emphasis on more uniform compaction.

Using Spray Pavers to Place Tack Coat – use of asphalt paving machines with onboard tanks for tack coat. The benefits of using spray pavers include improved tack performance, because equipment is not driving over the tack coat; less risk of damage to the environment from rain that could cause tack coat runoff; and streamlined, quicker operations.

Diamond Road Smoother – an all-in-one grinding machine that removes bumps from roadways, helping agencies extend pavement life. Diamond grinding is a treatment strategy that removes a thin layer of the surface to reduce irregularities in concrete. It can also be used on localized roughness in asphalt. The process can improve ride quality, reduce road noise, and improve skid resistance.

High-Tensile-Strength, Fiber-Reinforced Asphalt Overlays – the use of high-tensile-strength fibers in Hot Mix Asphalt or Warm Mix Asphalt mixes increases the durability and longevity of asphalt overlays by 3 to 6 years.

Structures

Improved Sustainability and Durability with Calcined Clay – use of calcined kaolin clay as a supplementary cementitious material to improve concrete sustainability and durability at a lower cost.

Lightweight Aggregate – the use of lightweight aggregate to reduce concrete density. This improves design efficiency by extending span ranges and reduces the handling and transportation costs of the precast concrete elements commonly used to accelerate bridge construction. In rehabilitation projects, it is used to increase load ratings or allow reuse of existing substructure or superstructure elements.

Ultra High Performance Concrete (UHPC) Applications – Building on the advances in UHPC that were realized in EDC-3 and EDC-4, these uses of UHPC will continue the success of this versatile material:

- UHPC for Bridge Overhangs – Using UHPC precast panels to form bridge overhangs from the top side of the bridge shortens project delivery times.
- UHPC in Pre-Cast Structural Components – Using UHPC in the primary bridge structural components
- UHPC Overlays for Rehabilitation – Using UHPC as surface layers for bridge deck rehabilitation. Hydro-demolition can be used to remove a thin surface layer of the deteriorated concrete deck, then a thin-bonded UHPC overlay can be installed.

Carbon Rod Steel Bridge Reinforcing System – a fiber-reinforced polymer (FRP) strengthening system that may decrease the costs and time involved in repairing steel bridges while increasing safety. Bridges can often remain open during carbon rod reinforcement application, and sensors can be embedded for automated repair monitoring. Emergent structural defects can be fixed in weeks, rather than months or a year later.

Galvanizing and Coating H-piling – treatments to extend service life. Many of the concrete piling encasements on H-piling on bridges are deteriorating and require repair. The cost of galvanizing the pilings and coating them is largely offset by the cost of constructing coffer dams and pouring concrete.

Composite Beams – a lightweight, reinforced concrete beam strengthened and protected by a corrosion-resistant and resilient fiber-reinforced polymer (FRP) shell. The FRP materials offer corrosion resistance and the potential for extended service life.

Rapid Bridge Replacement Systems – the use of composite steel and concrete bridge systems that provides rapid construction with reduced traffic impact.

Galvanized Press-Brake-Formed Steel Tub Girder – a steel tub girder constructed from a single plate that is formed into a tub girder shape meeting the American Association of State Highway and Transportation Officials (AASHTO) requirements and galvanized. It increases durability and longevity of bridge superstructures.

Non-Destructive Evaluation Technologies – emerging non-destructive evaluation (NDE) technologies with improved capabilities and reliability compared to the conventional technologies currently in use. By more reliably imaging damage in decks, new NDE technologies allow for entirely different strategies for bridge construction, preservation, and maintenance.

Embedded Sensor Technology for Long-Term Monitoring – a new system for monitoring, measuring, and providing relevant infrastructure data to engineers and administrators in a timely manner. The embedded sensor technology enables proactive decision-making under routine and extreme event situations.

Accelerated Bridge Construction (ABC) – Seismic Isolation Joint – a class of newly developed, innovative connecting devices for use between the major structural components in a bridge. Its use in bridge joints between span and piers and between pier and footing can enable ABC while allowing the robustness of cast-in-place construction and the desired qualities for seismic isolation.

Sandwich Plate System – a system of two sheets of steel bonded together with a urethane core and a solid steel perimeter bar surrounding the panel. The bond between the steel and core creates composite action within the panel and structure when welded or bolted in place. The system can be mass-produced in pre-engineered sections or complete modules in various configurations using different beam types.

Using Ductility to Increase Bridge Resilience in Unpredictable Scenarios – methods used in the high-seismicity areas of the United States for allowing structural elements and materials to sustain large deformations without losing load capacity, thereby boosting structural stability and performance in extreme conditions. Approaches include ductile detailing, better structural continuity, and advanced devices and elements.

Spread Footings with Improved Design – a type of foundation that can be used to support highway bridges and, in many cases, leads to significant savings in construction costs and time when compared with other foundation types.

Safety

Buckle Up Phone Down – changing the behavior of drivers and passengers with a safety campaign based on active participation. The campaign aims to reduce unbuckled fatalities and distracted driving crashes by encouraging individuals to pledge to buckle their seat belt while riding in any seat and put their phones down while driving.

Roundabouts – a safety countermeasure that reduces the potential conflict points in a typical intersection and reduces vehicle speeds.

Speed Management Strategies for Design Manuals – a proactive approach to achieving desired roadway speeds. Speed management has the potential to save lives by reducing the total kinetic energy involved in crashes. It saves time by achieving the desired target speed prior to reconstruction, as opposed to constructing a project then applying traffic calming measures to achieve the desired operating speed.

Strategic Guardrail Management – a cloud-based guardrail inspection tool that allows agencies to track, in real time, teams inspecting guardrails. It allows agencies to overlay traffic data, pavement condition ratings, and crash history to target certain areas over others.

Flashing Yellow Arrow Omit – a signal adjustment to eliminate yellow arrow confusion. To eliminate conflicts between non-yielding vehicles and pedestrians crossing with right-of-way, traffic engineers can program signals to omit the permissive left turn with four-section signal heads when the pedestrian phase is activated.

Silver Zone for Elderly Pedestrian Safety – countermeasures for safer elderly pedestrian movements. Specifically designed countermeasures can improve elderly pedestrian safety and walkability in high senior population or high senior crash areas.

Motorcyclist Training Course – a mandatory motorcyclist training course with vehicle driving simulator to demonstrate the crash risk posed by motorcyclists from a vehicle driver's perspective.

Edge Lane Roads – a road configuration consisting of one center lane supporting two-way vehicle traffic and "edge lanes" on either side preferentially reserved for vulnerable road users, such as cyclists or pedestrians. When cars approach one another in the center lane, they merge into the edge lane after yielding to any vulnerable road users, accomplish the pass, and return to the center lane.

Local Road Safety Plans – a data-driven, risk-based approach to highlighting safety priorities. It prioritizes proactive safety efforts (rather than reactive) by identifying key risk factors on the roadway

network. This approach can be used both in rural locations (most common) or urban locations (including for pedestrian/bicycle crashes).

Separated Bike Lanes – one-way or two-way facilities reserved exclusively for bicycle use (and in some locations micro-mobility vehicles such as scooters) that physically separate bicycles and motor vehicles using both horizontal and vertical separation elements. Separated bike lanes are also referred to as protected bikeways, protected bike lanes, separated bikeways, or cycle tracks.

Highway Safety Improvement Program – a program providing for a data-driven process to systematically identify and equitably distribute funds toward the most critical safety projects.

High- and Low-Mast Lighting Retrofit for LEDs – use of energy-saving LED lighting systems. Retrofitting all high- and low-mast lighting with LED lighting reduces costs over time, produces benefits for the environment, and increases safety for highway workers and the traveling public.

Road Safety Assessments – an integrated approach that involves the 4 E's of highway safety: engineering, education, enforcement, and emergency response. Teaching traffic engineering principles and use of communication tools will improve highway safety by driving down fatalities and serious injuries.

Environmental, Planning, and Realty

Advanced Data Analytics for Project Planning – use of an algorithm-based analysis of traditional and non-traditional data sources that allows planners and designers to gain a more comprehensive view of their transportation networks. By analyzing diverse datasets the root cause for an issue is more accurately and easily identified, saving time and project funds and resulting in better overall project need identification and project quality.

Developing a Resilient Transportation System for the 21st Century – implementing a resiliency framework for transportation structures and communities for extreme weather events.

Project Priority Programming Process (4P) – an approach for vetting non-Project Development and Environment projects prior to programming funds with the objective of achieving work program stability in scheduling and accurate budgeting of design and construction cost estimates. The process includes development of comprehensive technical scopes for all projects entering the agency work program.

Land Value Return and Recycling – funding infrastructure through the return and recycling of infrastructure-created land values.

ADA Voluntary Curb Ramp Acquisition Pilot Planning – an approach to streamlining the process to acquire right-of-way needed to construct curb ramps that meet the requirements of the Americans with Disabilities Act (ADA). Permanent easements are acquired in place of fee simple property interests.

Enhanced Environmental Outcomes and Performance Products – an approach for considering social, economic, and environmental project-delivery benefits. By applying economic valuation concepts during project development, project benefits and the potential for recapturing a portion of their value can be measured.

Sustainable Transportation: FHWA INVEST – a web-based collection of voluntary best practices in sustainability. INVEST (Infrastructure Voluntary Evaluation Sustainability Tool) facilitates adoption of environmental stewardship from planning and programming through project development and operations.

Online Real Estate Auction Sales Program – an online auction platform that uses standardized contracts to enhance consistency in real estate sales transactions, which decreases risk to the agency. By increasing productivity and the number of surplus sales, a transportation department can return funds to be reprogrammed, which means more safety and mobility projects can be funded every year.

Human-Centered Design Process –a process focused on understanding the end user's needs and identifying potential solutions to address a defined problem. It is scalable from small, short-term needs to larger, long-term projects and can help keep the human experience in view while working on infrastructure solutions.

Virtual Public Involvement Videos – an effective way to explain complex issues to the public to generate stakeholder involvement. Videos also allow for a much larger audience to be reached.

Promotion of AASHTO Flexibility in Highway Design Guide – promotion and adoption of national flexibility in design guidance produced by the American Association of State Highway and Transportation Officials (AASHTO) and FHWA. It allows greater flexibility to achieve more comprehensive benefits and value in the overall context of projects. The ultimate goal is improved utilization of value and performance to support design flexibility and performance-based practical design.

River and Roads Connection – an approach to ensuring careful consideration of river processes, which is paramount for the safe, resilient, and ecologically sensitive design of transportation infrastructure in riverine environments. Promoting approaches to ensure understanding of river functions and processes are critical to the planning, design, and operation of transportation infrastructure, specifically highway encroachments (for example, bridge and culvert crossings and roadway embankments) on riverine systems.

Multi-Objective Decision Analysis Framework – a process for decision-making on very complex issues involving multiple criteria and multiple parties that may be deeply affected by the outcomes. The Multi-Objective Decision Analysis (MODA) Framework guides transportation agencies in structuring the set of objectives they are trying to achieve through their investment decisions and in measuring progress toward accomplishing these objectives through defining a utility function.

Performance-Based Practical Design – an approach to road and street engineering that right-sizes projects in order to achieve the best transportation system affordable.

Operations

Automated Traffic Signal Performance Measures (ATSPMs) – management of traffic signals based on high-resolution performance data. ATSPMs modernize signal systems by allowing agencies to measure performance, create better signal plans, and respond quickly to changing conditions.

Promoting Vehicle Hazard Light Use in Work Zones – encouraging drivers to use vehicle hazard lights in work zones as an effective and low-cost countermeasure for preventing rear-end collisions.

Crowd-Sourced Traffic Incident Management – a crowd-sourced video database of traffic incidents. This type of database has the potential to improve traffic safety on the same scale as the Waze™ GPS-based geographical navigation application and Google Maps™ have enabled drivers to dynamically re-route around traffic congestion.

Development of Multimodal Traffic Signal Control – a novel, real-time, adaptive, multimodal, decentralized traffic signal controller. The controller leverages connected vehicle data to optimize the total queue length. The framework has a flexible phasing sequence and free cycle length and can adapt to dynamic changes in traffic demand and operate independently of other traffic signal controllers.

Automated Enforcement – use of automated enforcement to reduce speeding in work zones. Most work zone fatalities and injuries can be attributed to speeding. Implementing automated enforcement systems in work zones is proven to slow drivers and reduce aggressive driving, fatalities, and injuries.

Reducing Snow Buildup in Traffic Signals – use of aerodynamic traffic signal design that keeps snow from building up in the signal head and reducing signal visibility.

Hitch Mount Changeable Message Sign – a digital sign used in addition to the standard signing sequence for maintenance operations. The sign is used to notify motorists that they are approaching roadwork and in what lane to expect workers. The sign is smaller and more portable than trailer-mounted changeable message signs.

GPS Control of Liquid De-icing Operations – Global Positioning System (GPS) technology that can be adapted easily by transportation agencies to control application of liquid brine for pre-treating bridge decks, hills, and adjacent turn lanes.

Mobile Productivity App for Roadway Workers – use of a mobile application that provides instant jobsite location, access to project documents and designs, and an instant messaging chat platform for team communication.

Reducing Congestion through Traffic Management – use of artificial intelligence software to autonomously manage an entire city grid based on actual demand, customizing service for every type of user to cut congestion, reduce emissions, and prevent accidents.

Digital Alerting and Collision Prevention Services – use of digital alerts to supplement existing lights and sirens by reaching drivers on their existing navigation apps or in-vehicle systems, allowing them more time to comply with State move-over laws that require drivers to move over and slow down to protect vulnerable roadside workers and emergency responders.

Temporary Traffic Control/Temporary Pavement Markings – use of an improved tape with a reinforced grid on the back that allows the tape to come up in one pull. Removal of older varieties of temporary pavement markings requires scrapers and heating tools and is labor intensive.

Calibration of Salt Spreaders – a process for managing application rates for deicing materials that reduces the cost for public agencies and is effective in reducing the chloride impact on the environment.

Transportation Systems Management and Operations (TSMO) Outreach for Rapid Institutionalization – a set of strategies focusing on operational improvements that can maintain and restore the performance of the existing transportation system. A nationwide outreach plan would encourage rapid institutionalization.

Predictive Analytics and Optimization for Roadway Weather – data provided by roadside sensors and national services used within data analysis frameworks to provide predictions on roadway conditions and optimizations for roadway management strategies.

Sustainable Data Formats and Standards for Traffic Operations – the use of open, standardized data formats and data handling practices allowing State departments of transportation flexibility, security, and ownership in incorporating new technologies into operations practices.

Visual Disruptor for Roadside Side Mirror – a durable, reflective device that hangs off a car mirror and increases visibility in low light.

Reducing Congestion on Freeways – allowing the nearly 2 million semi-trucks on the road today to safely bypass the ramp meters will increase the efficiency of the freeway and decrease pollution.

Integrated Mobility Tools to Support Predictive Transportation Systems Management – a bundled selection of innovations and proven processes to support integrated mobility, such as open source data hubs and coalition building.

Use of Probe Data for Traffic Studies and Model Building – use of new process data sources to support non-traffic analysis functions such as traffic information services, navigation services, and program transportation performance measures. They can be used to improve verification and validation of traditional transportation planning, corridor analysis, environmental studies, and traffic analysis tools.

Connectivity – expanding the use of sensors and wireless or fiber connectivity for real-time data submission to aid in bringing technologies such as connected and automated vehicles.

Saving Lives with Autonomous Work Zone Vehicles – use of autonomous technology to enable Truck Mounted Attenuator (TMA) vehicles to operate completely unmanned. Advanced automated vehicle technologies can increase worker safety by allowing TMA vehicles to be retrofit with vehicle automation kits that permit them to operate completely unmanned.

Other

Workforce Development for Local Transportation Agencies – development of a catalog of core competencies of several critical job classifications within local transportation agencies. Transportation agencies at all levels of government face a constant challenge to develop, recruit, and/or retain skilled workers and it can be especially difficult for small and rural local agencies.

Electric Account Bid Aggregation – a State practice to aggregate its electric utility accounts and bidding on the open market. This includes facilities accounts as well as highway lighting and traffic signals.

Utility Locating during Design Phase – an opportunity to reduce utility conflicts. Prior to excavating for construction, utilities are located and marked. Utility locating during the design phase provides opportunity for a better assessment of potential utility conflicts.