Infrastructure Enhancement Strategies

ICM Functional Area / Tactic	ICM Category	ICM High-Level Benefits								
		Safety / Response	Mobility / Accessibility	Demand Reduction / Shift	Travel choice / Decision Making	Return on / Use of Existing Investment	Efficiency / Productivity	Institutional Cooperation	Environmental Impact	Customer Experience / DOT Perception
Infrastructure Enhancement										
Park and Ride Lots	Fundamental		•	•	•				•	•
Acceleration / Deceleration Lanes	System Modification	•	•				•		•	
Access Control	System Modification	•	•	•			•		•	
Bottleneck Removal	System Modification	•	•			•	•		•	•
Freight-Rail Improvements	System Modification	•	•				•	•	•	
Cycle Tracks	Active and Advanced	•	•		•		•		•	•
Crash Investigation Sites	System Modification	•	•				•		•	•
Connected and Automated Vehicles	Emerging	•	•	•	•	•	•		•	•
Smart Cities	Emerging				•	•	•	•	•	•

Park and Ride Lots

	Park and Ride Lots
Description	Park and ride lots are parking facilities located at transit stations, bus stops and highway on-ramps, particularly at the urban fringe, to facilitate transit and rideshare use. Parking is generally free or significantly less expensive than in urban centers. ITS elements can accompany and be deployed in conjunction with park and ride lots to enhance traveler information needs regarding parking capacity, transit vehicle arrival and other information that can improve decision making.
ICM Category	• Fundamental strategy
Anticipated Benefits	• Improved accessibility and mobility • Reduced or shifted demand • Enhanced traveler choice and decision making • Reduced environmental impact • Improved customer experience and perception
Provided Functionality	• Provides additional parking capacity • Improves public transportation accessibility
Prerequisite Functionality Required	• Dependent on complementary strategies implemented. Could include communications to enable en-route and pre-trip traveler information as well as remote monitoring functions.
Complementary and/or Supported Strategies	• Surveillance (Cameras, occupancy sensors) • Information dissemination (dynamic / hybrid static and dynamic signs) • Carpooling/vanpooling • Transportation management associations • Connected and automated vehicles
Examples	Widely Implemented, including: • Milwaukee, WI • Chicago, IL • Seattle, WA

Acceleration/Deceleration Lanes

	Acceleration/Deceleration Lanes
Description	Acceleration/deceleration lanes allow drivers to speed up or slow down in a space not used by high-speed through traffic. Incorporating speed change lanes into the roadway design can mitigate speed differences between vehicles and the resulting stop and go behavior that may be associated with this difference. Deceleration lanes allow traffic exiting a major street to slow down to a safer speed to make a left or right turn at an intersection without affecting the main flow of traffic. Dedicated acceleration lanes allow cars that are joining the main road to speed up to match the flow of traffic. The proper use of acceleration/deceleration lanes increases the average speed on freeways and major streets, reduces the delays on ramps, and increases safety by reducing the number of conflicts between slow speed and higher speed vehicles.
ICM Category	• System modification
Anticipated Benefits	• Improved safety and emergency response • Improved accessibility and mobility (reduces vehicle speed differentials) • Improved transportation efficiency and productivity • Reduced environmental impact
Provided Functionality	• Reduces speed variations in traffic • Improves traffic flow
Prerequisite Functionality Required	• None
Complementary and/or Supported Strategies	• Dynamic speed advisories / limits • Dynamic shoulder lanes / part-time shoulder use • Queue warning
Examples	• Austin, TX • Minneapolis, MN • I-81/I-70 Interchange (Maryland)

Access Control

	Access Control
Description	Access control is a term for a set of techniques that control several elements of a street, such as the spacing, design, and operation of driveways, turns, medians, and intersections. It serves as an effective congestion reduction technique because it controls where vehicles may enter and leave the road. Adequate access management improves safety on roads by limiting the number of locations where cars can slow down or speed up to exit or enter the road. In retrofit situations, public agencies must work with developers in a cooperative process to create the best solution.
ICM Category	• System modification
Anticipated Benefits	• Improved safety and emergency response (e.g., reduced conflict points) • Improved accessibility and mobility (e.g., improved traffic flow) • Reduced or shifted demand • Improved transportation efficiency and productivity • Reduced environmental impact
Provided Functionality	• Reduces potential vehicle conflict points • Improves traffic flow
Prerequisite Functionality Required	• None
Complementary and/or Supported Strategies	• Dynamic truck restrictions • Intersection improvements • Planned special event management • Bottleneck removal
Examples	• Colorado Access Control Demonstration Project • Iowa Access Management Research and Awareness Program

Bottleneck Removal

	Bottleneck Removal
Description	Recurring localized bottlenecks are encountered during everyday commutes and are characterized as being relatively predictable in cause, location, time of day and approximate duration. Some are "periodic problems" where volume surges temporarily exceed the roadway capacity. Common locations of bottlenecks include places where the number of lanes decreases, at ramps and interchanges, and where there are roadway alignment changes (sharp curves, steep hills, etc.). Innovative transportation agencies have realized that bottleneck removal is "low hanging fruit"—small projects that can result in big benefits. One or two corrections to inefficient locations may be all that is needed to improve the condition. Some of the typical low-cost solutions include restriping, adding travel lane(s) for a short section by reducing lane widths and converting shoulders, adding lanes to accommodate entering and exiting traffic, and modifying ramps
ICM Category	• System modification
Anticipated Benefits	• Improved safety and emergency response • Improved accessibility and mobility • Increased return on and use of existing investment • Improved transportation efficiency and productivity • Reduced environmental impact • Improved customer experience and perception
Provided Functionality	• Reduces chokepoints in traffic flow
Prerequisite Functionality Required	• None
Complementary and/or Supported Strategies	• Access control • Intersection improvements
Examples	• Dallas-Fort Worth Metro Area • Minneapolis, MN

Freight-Rail Improvements

	Freight-rail Improvements
Description	Freight rail improvements include strategies that encourage freight to move by rail or that make surface transportation infrastructure more efficient by reducing rail-related impacts. These include freight rail relocation or infrastructure improvements, intermodal transportation centers, rail crossing detection and warning Investment in freight rail relocation/ improvements or the construction of new intermodal centers can consolidate freight movement to rail corridors while removing some long-distance truck traffic from congested corridors. Improved train detection can allow railroads and local agencies to coordinate incident management and improve crossing safety.
ICM Category	• System modification
Anticipated Benefits	• Improved safety and emergency response • Improved accessibility and mobility • Improved transportation efficiency and productivity • Improved institutional cooperation • Reduced environmental impact
Provided Functionality	• Reduces truck and auto interaction and conflicts
Prerequisite Functionality Required	• None
Complementary and/or Supported Strategies	• Traffic signal improvements • Adaptive traffic signals
Examples	• Seattle, WA (At grade rail crossings in the industrial area)

Cycle Tracks

	Cycle Tracks
Description	A cycle track is an exclusive bike facility that combines the user experience of a separated path with the on-street infrastructure of a conventional bike lane. A cycle track is physically separated from motor traffic and distinct from the sidewalk. Cycle tracks have different forms but all share common elements—they provide space that is intended to be exclusively or primarily used for bicycles, and are separated from motor vehicle travel lanes, parking lanes, and sidewalks. In situations where on-street parking is allowed cycle tracks are located to the curb-side of the parking (in contrast to bike lanes).
ICM Category	• Active and advanced strategy
Anticipated Benefits	• Improved safety and emergency response • Improved accessibility and mobility • Enhanced traveler choice and decision making • Improved transportation efficiency and productivity • Reduced environmental impact • Improved customer experience and perception
Provided Functionality	• Reduces bicycle and vehicle interaction and conflicts
Prerequisite Functionality Required	• None
Complementary and/or Supported Strategies	• Bike sharing • Special event management
Examples	• 15th Street, Washington D.C • Vassar Street, Cambridge, MA • 9th Avenue, New York City, NY • Madison, WI

Crash Investigation Sites

	Crash Investigation Sites
Description	Traffic incidents located either on the freeway mainlines or shoulder can greatly reduce the capacity of a roadway. Furthermore, the safety of individuals involved in crashes can be jeopardized when getting out of their vehicles along the mainline. Crash investigation sites are specifically designated and signed to provide a safe area where motorists with partially disabled vehicles, law enforcement, fire-rescue and other public service vehicles can be temporarily relocated. Generally, these sites are identified by signs and sometimes pavement markings, have sufficient space to park multiple vehicles and lighting to ensure personal safety, and often have access to phone service.
ICM Category	• System modification
Anticipated Benefits	• Improved safety and emergency response (e.g., reduced potential for secondary incidents and reduces responder exposure) • Improved accessibility and mobility (e.g., reduced incident impacts on traffic flow) • Improved transportation efficiency and productivity • Reduced environmental impact • Improved customer experience and perception
Provided Functionality	• Reduces duration and impact of incidents on traffic flow
Prerequisite Functionality Required	• None
Complementary and/or Supported Strategies	• Incident management • Work zone management • Park and ride lots • Ramp configurations
Examples	• I-88 and I-90 (Illinois Tollway) • I-94 (Milwaukee, WI) • I-94 (Michigan)

Connected and Automated Vehicles

	Connected and Automated Vehicles
Description	Automated vehicles are those in which at least some aspect of a safety-critical control function (e.g., steering, throttle, or braking) occurs without direct driver input. Automated vehicles may be autonomous (i.e., use only vehicle sensors) or may be connected (i.e., use communications systems such as connected vehicle technology, in which cars and roadside infrastructure communicate wirelessly). Connected vehicles use communication technology to allow on-board system to communicate with other vehicles, the roadside infrastructure, or other devices or systems (including the "cloud"). Connected vehicle technology enables a variety of safety and mobility services, such as intersection collision avoidance and enhanced in-vehicle traveler information systems. Connectivity is also an important input to realizing the full potential benefits and broad-scale implementation of automated vehicles. Connected and automated vehicles have the potential to bring about transformative safety, mobility, energy, and environmental benefits to our nation's surface transportation system. These benefits could include crash avoidance, reduced energy consumption and vehicle emissions, reduced travel times, improved travel time reliability and multi-modal connectivity, and improved transportation system efficiency and accessibility, particularly for persons with disabilities and the growing aging population.
ICM Category	• Emerging strategy
Anticipated Benefits	• Improved safety and emergency response • Improved accessibility and mobility • Reduced or shifted demand • Enhanced traveler choice and decision making • Increased return on and use of existing investment (e.g., potential for shorter vehicle headways) • Improved transportation efficiency and productivity • Reduced environmental impact (e.g., vehicle platooning and adaptive cruise control) • Improved customer experience and perception • Increased transportation accessibility and efficiency • Improved parking efficiency
Provided Functionality	Dependent on specific CAV application, but could include: • In-vehicle communications and signing • Vehicle control automation • Vehicle safety monitoring • Automated vehicle operations • Vehicle collision warnings
Prerequisite Functionality Required	• Dependent on specific CAV application • Connected vehicle on-board system • Connected vehicle roadside units • Communications (Dedicated short range communications or 5G)

Complementary and/or Supported Strategies	• Dependent on specific CAV application
Examples	• Ann Arbor, MI • Columbus, OH • Madison, WI • Tampa, FL • New York City, NY

Smart Cities

	Smart Cities
Description	A system of interconnected systems, including employment, health care, retail/entertainment, public services, residences, energy distribution, and not least, transportation. This 'system of systems' is tied together by information and communications technologies (ICT) that transmit and process data about all sorts of activities within the city. The goal of the smart city concept is to improve quality of life for the citizens and to improve efficiency of government by using technology to better serve the public. A fundamental aspect vital to the success of a smart city is ICT. The advent of "big data" and improved communications due to smart phone applications and social media have allowed ICT to power smart cities and simultaneously make ICM viable.
ICM Category	• Emerging strategy
Anticipated Benefits	• Enhanced traveler choice and decision making • Increased return on and use of existing investment • Improved transportation efficiency and productivity • Improved institutional cooperation • Reduced environmental impact (e.g., reduced or sustainable energy) • Improved customer experience and perception
Provided Functionality	Dependent on smart cities initiatives implemented, but could include: • Improved efficiency in infrastructure monitoring • Improved data capture, sensing and processing • Travel information and planning
Prerequisite Functionality Required	• Data management and analytics • Information and communications technologies
Complementary and/or Supported Strategies	Dependent on smart city initiatives, but could include: • Connected and automated vehicles • Network surveillance
Examples	• Smart Columbus (Columbus, OH) • Austin CityUP (Austin, TX) • Kansas City, MO