



**Federal Highway Administration (FHWA) Research and Technology Agenda**

**Meeting the Challenge: Operations**

Highway reliability affects our ability to visit family, get to work, deliver products to customers, live our lives, and grow the economy. FHWA's operations and freight research is developing innovative technology and processes that lead to system-wide improvements in how FHWA and its State and local partners manage and increase the reliability of the National Highway System and the National Highway Freight Network.

These innovations target the daily operations of transportation agencies, including demand management strategies, work-zone planning guidance, and improved traffic and freight analysis techniques. Research into new technologies and noteworthy management practices provides State and local agencies with additional tools to implement the institutional changes that will allow them to meet operational challenges.

Improved, real-time management of unexpected disruptions, such as adverse weather conditions and crashes, enables transportation agencies to improve the reliability of the highway system during times of unexpected stress. FHWA is exploring technologies such as traffic and weather sensors, wirelessly connected vehicles, and remote management of traffic signals, to provide better information and highway management options during disruptive events.

By deploying innovative transportation technologies to better manage congestion and freight movement, FHWA is helping transportation agencies embrace 21st-century system policies and tools that can deliver a reliable highway system for individuals and businesses nationwide.

**Objective: 1: Managing congestion by improving reliability and operating the system at peak performance.**

**Strategies**

- Develop and deploy traffic incident detection technologies and management processes.
- Promote efficient work-zone management processes.
- Develop and deploy road-weather maintenance technologies and management processes.
- Develop and deploy enhanced traffic signal technologies and arterial roadway management processes.
- Promote a corridor approach to freeway traffic management including the use of managed lanes and alternate routing to make more efficient use of existing roadway capacity.
- Develop and deploy integrated freeway operations systems to enable more proactive traffic management.
- Promote travel demand management programs that enable better route, mode, time, and location choices for travel, to reduce travel demand during peak periods.
- Develop congestion-pricing programs to manage the demand for limited transportation facilities in severely congested areas.
- Develop and deploy tools, guidance, and training for State and local roadway operators on the management of nonrecurring events that interrupt or overwhelm transportation operations.
- Develop and deploy real-time traveler information systems, which enable travelers to make choices that are more efficient.

**Showcase Activities**

- Active Transportation and Demand Management (ATDM)
- Traffic Incident Management (TIM) Program
- Adaptive Signal Control Technologies
- Road Weather Management
- Work Zone Management Program
- Congestion Pricing

**Active Transportation and Demand Management (ATDM)**

Rising congestion rates increase the potential for crashes, delays, and air pollution, and impose adverse costs to society. FHWA promotes Active Transportation and Demand Management (ATDM) strategies to help transportation agencies address the problem of congestion more effectively. These strategies include a variety of real-time and predictive tools, approaches, and methods to dynamically manage and control traffic demand and transportation facility capacity, based on prevailing traffic conditions. FHWA also provides resources, such as the ATDM toolbox, which helps agencies to

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implement the ATDM approach. By applying these tools and strategies, transportation agencies can better address traffic flow issues, improve travel time reliability, and optimize capacity throughout their transportation networks.

## Additional Resources

- [Active Transportation and Demand Management Web Site](#)

## Traffic Incident Management (TIM) Program

Traffic incident response involves effective coordination among multiple stakeholder agencies such as transportation, law enforcement, fire and rescue, and emergency medical services. FHWA developed the Traffic Incident Management (TIM) Program to promote a comprehensive and multidisciplinary approach to restoring traffic capacity as quickly and safely as possible. Through the TIM Program, FHWA provides guidance, doctrine, training, peer-to-peer, and other knowledge exchanges. Research, outreach, and other resources help transportation agencies, such as safety service patrols and traffic management center personnel, better understand, plan for, and implement traffic incident response operations. TIM Program resources assist agency stakeholders in improving traffic incident response; reducing the duration and impacts of traffic incidents; and improving the safety of motorists, crash victims, and responders. The program also builds capacity among local transportation and other first responders engaged in traffic incident planning and operations. This enhanced capacity enables communities to better prepare for and manage special events and larger scale incidents that affect their communities, such as flooding, hurricanes, hazardous materials incidents, and other technological and manmade events.

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## Additional Resources

- [Traffic Incident Management Program Web Site](#)

## Adaptive Signal Control Technologies

Poor traffic signal timing contributes to traffic congestion and delay. Conventional signal systems use preprogrammed, daily signal timing schedules. Adaptive signal control technology adjusts the timing of red, yellow, and green lights to accommodate changing traffic patterns and ease traffic congestion. The main benefits of adaptive signal control technology over conventional signal systems are that it can distribute green light time continuously and equitably for all traffic movements; improve travel time reliability by progressively moving vehicles through green lights; reduce congestion by creating smoother flow; and prolong the effectiveness of traffic signal timing.

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## Additional Resources

- [Adaptive Signal Control](#)
- [Traffic Signal Timing and Operations Strategies](#)
- [Traffic Signal System Management](#)

## Road Weather Management

Road Weather Management consists of the proactive operations and maintenance of the highway system under all weather conditions. The process begins with measurements and monitoring of weather conditions on or near the road surface, either through fixed (e.g., roadside) or mobile (e.g., vehicle) sensors. Observations are entered into weather and road condition models and then incorporated into advanced decision support tools that enable both road users and operators to make safer and more efficient decisions. These decisions cover a broad spectrum, ranging from the application of winter road maintenance materials, to traffic management strategies such as signal timing and variable speed limits, and eventually, to the provision of information so that road travelers can make decisions such as altering departure times or changing routes to avoid unsafe driving conditions. In addition, work is underway to look at how transportation, maintenance, and emergency managers can best incorporate emerging changes in climate and extreme weather events into their planning and ongoing activities.

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## Additional Resources

- [Road Weather Management Program](#)

## Work Zone Management Program

Work zones are a necessary part of maintaining and upgrading our highway system. The combination of more work zones and heavier traffic volumes has resulted in work zones having a greater effect on roadway systems in recent years. The American public has cited work zones as second only to poor traffic flow in causing dissatisfaction with the roadway system. FHWA's Work Zone Management Program will "make work zones work better." The program provides transportation practitioners with high-quality products, tools, and information, which can be of value in planning, designing, and implementing safer, more efficient, and less congested work zones.

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## Additional Resources

- [Work Zone Management Program](#)

## Congestion Pricing

Congestion pricing can act as a tool for demand management. The variability of pricing depending on traffic conditions and policies capitalizes on market forces to manage the utility of finite roadway capacity. An emerging form of congestion pricing that does not involve tolls includes several concepts and strategies, such as pay-as-you-drive car insurance, car sharing, variably priced metered parking, and variable port access charges for trucks.

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## Additional Resources

- [Tolling and Pricing Program](#)

## Objective: 2: Building a strong foundation for proactive operations.

### Strategies

- Update and maintain the Manual on Uniform Traffic Control Devices.
- Develop and deploy traffic analysis tools to assist roadway owners in designing and implementing more efficient operations strategies.
- Integrate operations into the multimodal transportation planning process at State and regional levels using an objectives-driven and performance-based approach.
- Promote the systematic use of quantitative and qualitative roadway performance metrics in the assessment of roadway operations.
- Deploy intelligent transportation systems to advance the state of the practice for operations.

### Showcase Activities

- Traffic Analysis Tools Program
- Planning for Operations Program
- Operations Performance Measures and Management
- Regional Intelligent Transportation Systems (ITS) Architecture Maintenance

## Traffic Analysis Tools Program

Traffic analysis tools, such as travel demand models or sketch planning tools, help assess proposed roadway improvements and their effects on traffic flows. By using these tools, transportation decision makers are better able to implement operational improvements that may enhance mobility and improve safety. However, with a wide range of options at hand, it can be difficult for decision makers to identify and deploy specific tools that are appropriate for their State, region, or community. Through its Traffic Analysis Tools Program, FHWA provides technical assistance and training, shares guidance and noteworthy practices, and disseminates other resources to help transportation professionals select, evaluate, and implement effective traffic analysis tools.

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## Additional Resources

- [Traffic Analysis Tools Program](#)

### Planning for Operations Program

A lack of communication and coordination between transportation agency planning staff and operations personnel can often lead to ineffective decisions, poor planning processes, and an underperforming transportation system. Linking these disciplines by bringing together professionals in both fields to discuss mutual concerns and priority issues can help to address these problems. FHWA developed the Planning for Operations Program to provide technical assistance and tools, guidance, and other resources to aid transportation professionals in integrating their planning and operations processes. These efforts help transportation agencies adopt strategies, techniques, and methods that consider both planning and operations viewpoints. The program has produced tangible results, such as an increase in the proportion of statewide long-range transportation plans that also address regional needs in transportation operations.

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### Additional Resources

- [Planning for Operations](#)

### Operations Performance Measures and Management

Operations performance measurement gauges progress toward meeting the objectives of transportation system management and operations. Although the specific objectives of management and operations activities vary among organizations, most relate to the overall goals of transportation mobility, productivity, and safety. FHWA is leading numerous activities to advance the implementation and practice of operations performance measurement at the Federal, State, and local levels, including the production of urban congestion reports, which are quarterly snapshots of traffic congestion and reliability trends at the national and city levels, developed using archived traffic operations data.

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### Additional Resources

- [Operations Performance Measurement Program](#)

### Regional Intelligent Transportation Systems (ITS) Architecture Maintenance

FHWA's Regional Intelligent Transportation Systems Architecture Guidance Document describes a process for creating regional intelligent transportation systems (ITS) architecture, discusses the uses for ITS architecture, and provides an approach for mainstreaming ITS into transportation planning and project development processes. FHWA also produced a more detailed guide for the development of a regional ITS architecture maintenance plan, and the activities involved in maintaining a regional ITS architecture were developed in a white paper. Together, these resources provide guidance for transportation professionals who are involved in the development, use, and maintenance of regional ITS architectures.

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### Additional Resources

- [Intelligent Transportation Systems \(ITS\) Architecture Implementation Program](#)
- [FHWA Regional ITS Architecture Maintenance White Paper](#)

**Objective: 3: Improving reliability through efficient movement of freight.**

## Strategies

- Improve reliability through the efficient movement of freight.
- Promote the development of cost-effective freight infrastructure to meet the changing demands of freight distribution and logistics.
- Deploy technology and processes to facilitate the smooth flow of goods on the Nation's roads, across international borders, and through intermodal transfers.
- Develop and deploy professional capacity-building opportunities for freight specialists at regional, State, and local transportation agencies.
- Maintain and enforce Federal vehicle size and weight standards for the movement of freight on the Nation's interstates.

## Showcase Activities

- Freight Analysis Framework (FAF)
- Freight Performance Measures Program (FMP)

## Freight Analysis Framework (FAF)

Freight professionals need accurate, current, and comprehensive information to plan and make decisions effectively. To address these needs, FHWA developed the Freight Analysis Framework (FAF), an inventory that compiles data from a variety of sources to create a comprehensive picture of freight movement for all modes of transportation, within and between States and major metropolitan areas. By using the FAF, freight stakeholders can better understand complex freight movements and make cost-effective, timely decisions that improve freight flows and safety, reduce environmental impacts, and support better integration of freight into transportation system operations.

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## Additional Resources

- [Freight Analysis Framework](#)

## Freight Performance Measures Program (FMP)

The Freight Performance Measures Program (FMP) is a mechanism for collecting and analyzing data to assist national, State, regional, and local transportation agencies in better measuring and managing highway transportation system performance. Unlike other U.S. Department of Transportation efforts, the focus of the FMP is on major freight-significant corridors, intercity pairs along those corridors, and major United States-international land border crossings. The availability of FMP data has the potential to inform future investment decisions that produce benefits of regional and national significance. When coupled with other sources, FMP data can provide a better understanding of travel time, reliability, congestion, and delay. In turn, this information assists decision makers in targeting infrastructure and operational improvements to maximize freight efficiency in the transportation system operation.

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## Additional Resources

- [Performance Measurement](#)

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