U.S. Department of Transportation
Federal Highway Administration

Dissemination Tools and Strategies of the Federal Highway Administration's Office of International Programs

Synthesis Report: Federal Highway Administration, Office of International Programs Successes of International Exchange from the 1990s to 2020

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This synthesis report is part of an OIP project that seeks to identify and disseminate information on some of the most useful and effective best practices, technologies, and lessons learned through OIP's programs from the mid-1990s through the present. This report is a summary of the project to date. It also describes, in greater detail, ten selected technologies and practices that have been adopted in the U.S. transportation community as a result of international exchange. The report also summarizes the benefits that have resulted from the implementation of these ten selected practices and technologies. The selected technologies and practices are: 1) Bridge Technologies; 2) Congestion Management; 3) Infrastructure Contracting; 4) Modern Roundabouts; 5) Pavement Materials; 6) Risk Management; 7) Safety; 8) Traffic Incident Management; 9) Truck Size and Weight; and 10) Winter Operations.</td></tr>
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Executive Summary

The Office of International Programs (OIP) works to access, promote, and disseminate global best practices and technical innovations to ensure a safe and efficient U.S. highway transportation system. The three main program elements of the office include Multinational Relations, Binational Relations, and International Visitors.

This synthesis report is part of an OIP project that seeks to identify and disseminate information on some of the most useful and effective best practices, technologies, and lessons learned through OIP's programs from the mid-1990s through the present. The research team conducted a literature review based on key reports, brochures, and presentations from OIP's past and current programs. The literature review was complemented by a series of discussions with OIP staff and current/former program participants. These foundational data collection efforts focused on a selected list of Multilateral and Bilateral programs, including:

- Australia
- Brazil
- Canada
- Chile
- Israel
- Japan
- Korea
- Mexico
- The Netherlands
- Sweden
- Switzerland
- Global Benchmarking Program (GBP)
- International Technology Scan Program
- World Road Association (PIARC)

The information collected was used to select a representative list of technologies and best practices that were learned through international exchanges and have been successfully implemented in the U.S. and integrated into the U.S. transportation system. The selected technologies fall into ten broader categories, as shown below in Figure 1. The report describes OIP's work in these ten topic areas and the benefits gained from their implementation in the U.S.

Bridge Technologies
- Cable-Stayed Bridges
- Accelerated Bridge Construction
  - Movement Systems for Prefabricated Bridge
  - Self-Propelled Modular Transporters
  - Prefabricated Bridge System

Congestion Management
- Active Traffic Management (ATM)
  - Automated Queue Detection
  - Lane Control Signals
  - Variable Speed Control

Innovative Contracting
- Design-Build Contracting
- Warranties
- Public-Private Partnerships (PPP)

Modern Roundabouts

Pavement Materials
- Pavement Recycling
- Warm-Mix Asphalt
- Stone-Matrix Asphalt

Risk Management

Safety
- Vision Zero
- Safety Planning
- Road Safety Audits

Traffic Incident Management
- ATM – Incident Management
- Traffic Incident Response

Truck Size and Weight
- Weigh-in-Motion (WIM)
- High-Speed Weigh-in-Motion
- WIM Database Management

Winter Operations
- Removable Legs on Trucks
- Anti-icing
- Fixed Automated Spray Technology
- Roadway Weather Information Systems
- Snow and Ice Cooperative Pool Program

Figure 1. List of selected technologies and best practices.

Many other technologies and practices that have been learned through international exchange have not yet been fully integrated into the U.S. transportation system. This report also recommends a set of technologies for future dissemination, with the hope that these are considered for future targeted outreach efforts. These technologies are listed below.

- Bikeway selection and design methods
- Bikeway design methods for safely integrating bikeways in roundabouts
- Practices for enhancing bicycle and pedestrian safety at intersections and other crossing locations
- Complete Streets and Complete Trips methodology
- Electrically isolated tendons
- Flexible adaptation pathways for climate change adaptation
- Integration of public transport and cycling
- Traffic signalization methods for bicycle and pedestrian safety
- Roads for Today Adapted for Tomorrow, a climate adaptation framework
- Tsunami design guidelines
- Turbo roundabouts
- Ultra-High Performance Concrete
- Wave attenuation devices

Finally, the report highlights the fact that OIP's successes go beyond the dissemination of specific technologies and practices. Through its decades of work in fostering international relationships, OIP:

- Shares and exchanges technology and information
- Promotes the use of highway standards that are compatible across the world
- Yields information to improve the safety, durability, and efficiency of transportation systems
- Provides assistance so that other countries can benefit from U.S. experiences and expertise to improve their roads

1 Introduction

1.1 Background

The Office of International Programs (OIP) leads the Agency to provide access to international sources of information, best practices, and road-related technologies and innovations. There are three main international program components: Global Benchmarking, Binational Relations, and Multinational Relations. Through collaboration with international and domestic partners, the three elements address the Secretary's and FHWA's priorities. They work together and cross-pollinate, with developments in one area sometimes leading to opportunities in others. For example, a one-time visit to a country for Global Benchmarking may lead to a long-term exchange as part of a bilateral relationship. A successful bilateral exchange may lead to a multilateral research project. Information or developments gleaned during a multilateral meeting may attract the interest of FHWA subject matter experts and lead to a Global Benchmarking study. In this way, the programs work in complementary ways to address distinct aspects of FHWA's international efforts, all while focusing on U.S. priorities and the objectives of the Agency.

This project seeks to identify and disseminate information on some of the most useful and effective best practices, technologies, and lessons learned through OIP's programs from the mid-1990s through the present. Many innovative practices have been studied through OIP programs. This report presents practices and technologies that were learned through international exchange and integrated into the U.S. transportation sector. This report also identifies specific technologies and practices that have the potential for greater dissemination.

1.2 Research Process

To achieve the project's objective, the research team undertook a research process that encompassed a review of available literature (see Appendix A) and discussions with FHWA staff. The data collection effort focused on a selected list of Multilateral and Bilateral programs, including:

- Australia
- Brazil
- Canada
- Chile
- Israel
- Japan
- Korea
- Mexico
- The Netherlands
- Sweden
- Switzerland
- Global Benchmarking Program (GBP)
- International Technology Scan Program
- World Road Association (PIARC)

The first step of the process was to develop a literature review, which included International Technology Scan reports, GBP reports, bilateral reports, PIARC reports, brochures, presentations, and more. The literature review provided important context and background on OIP programs, which informed the next step of the research process; discussions with OIP staff and current and former program participants. These discussions helped fill in gaps in the literature review and provided additional context on the many technologies identified. The final product of this effort is a list that provides an itemized summary of selected outcomes from OIP programs. This list includes ten categories of technologies and best practices that are mature and have been successfully implemented in the U.S.

1.3 Document Objective

The purpose of this document is to highlight best practices and provide dissemination recommendations by presenting a prioritized list of 30 technologies intended to demonstrate the breadth and variety of benefits of OIP programs. This document provides an overview of each selected technology and best practice and summarizes the benefits that have resulted from their implementation.

The research team also reviewed technologies that were learned through international exchange but have not yet been widely disseminated in the U.S. During the participant discussions, OIP staff and participants helped refine this list of technologies, identifying those that have the potential for further U.S. implementation. This document includes the prioritized list of recommendations for further dissemination. OIP will promote some of these technologies through webinars, brochures, and other promotional materials.

2 Office of International Programs Work and Outcomes

The FHWA and transportation agencies across the country are tasked with a challenging mission: promoting “safety, mobility, and economic growth, while enhancing the quality of life of all Americans.”[1] With over 4 million miles of roads in the U.S., over 610,000 bridges, and many other assets, transportation agencies must figure out how to maintain a state of good repair while also balancing other objectives such as efficiency, equity, and environmental concerns.[2] Therefore, it is critical that transportation agencies are equipped with the most successful, cost-effective technologies and best practices.

OIP has helped advance the state of the U.S. transportation system by facilitating the exchange of information on a wide range of technologies and practices from across the world. The following subsections describe in more detail the programs supported by OIP, the topics covered, and examples of the benefits from international exchanges.

2.1 Programs Supported

Through OIP, FHWA works to improve the technological and institutional base of highway transportation system performance and program delivery in the United States and abroad. It does so through three core programs:[3]

- **Bilateral Relations Programs** (BRP) – The BRP focuses on government-to-government relations and activities designed to exchange information regarding best practices and technologies on high-priority topics. Endeavors are closely coordinated with FHWA Leadership and Program Offices, as well as with the Office of the Secretary (OST), and focus on facilitating exchanges that are practical and implementable. BRP programs tend to be long-term relationships that develop over time, providing benefits over an extended period on a variety of subjects. BRP currently has active partnerships in the Asia-Pacific Region, Europe, and Western Hemisphere regions and has held relationships in Africa and the Middle East. BRP also provides support to OST initiatives in different regions of the world.[4] For current country programs, see Figure 2.[5]

Asia-Pacific Region	Europe	Western Hemisphere
•Australia •India •Japan •Republic of Korea	•The Netherlands •Switzerland •Sweden	•Brazil •Canada •Chile •Mexico

Figure 2. OIP Bilateral Relations Programs.

- **Multilateral Relations Programs** – The FHWA's involvement in multilateral relations includes global organizations such as PIARC, which provides information on the most recent technical and policy developments in road transportation abroad and is also a significant channel for communicating U.S. developments. Multinational programs also include the GBP, which supports FHWA's strategic priorities by seeking out and adapting foreign innovations that could significantly improve highways and highway transportation services in the U.S. Through

[1] Federal Highway Administration. 2012. “Who We Are.” https://www.fhwa.dot.gov/about/
[2] American Road & Transportation Builders Association. “Frequently Asked Questions.” https://www.artba.org/about/faq/
[3] FHWA. 2019. “Programs and Activities.” https://international.fhwa.dot.gov/programs/
[4] FHWA. 2020. “Binational Relations Programs.” https://international.fhwa.dot.gov/programs/brp/index.cfm
[5] Ibid.

the GBP and the former International Technology Scan Program, U.S. practitioners have participated in 94 multinational studies.

- **International Visitors Program** – This program facilitates the sharing of information regarding U.S. roads and technologies between FHWA experts and their international counterparts. It supports information sharing through specific topic meetings, study tours by foreign delegations with FHWA Program Offices, State Departments of Transportation, transportation agencies, and associations nationwide. The International Visitors Program has hosted visitors from all regions of the world, with a variety of interests related to U.S. roads and technologies.

2.2 Examples of Benefits from the Programs

The multinational and binational programs have uncovered valuable insights on an extensive list of study areas and specific technologies, see Figure 3. Within each of these broad categories, the U.S. has exchanged knowledge on many additional subcategories and specific topics. A few examples of OIP successes include:

Study Areas

- Bridges and structures
- Pavement and materials
- Planning, environment, and right-of-way
- Operations and intelligent transportation systems
- Agency organization and management
- Policy
- Safety
- Contract administration and financing
- Geotechnology
- Freight Management

Figure 3. Study areas supported by OIP.

- **Advanced Pavements**: On several scans, including the 1991 "European Asphalt Study Tour" in Sweden, Denmark, Germany, Italy, France, and the United Kingdom (U.K.).; the 2002 European Asphalt Warranties Scan," in Spain, Germany, Denmark, Sweden, and Great Britain; and the 2004 "Quiet Pavement Systems in Europe" scan in Denmark, the Netherlands, France, Italy, and the U.K., U.S. practitioners observed advanced pavement technologies and methods. U.S. practitioners learned about innovative methods for making pavement, testing pavement quality, and creating contracts that ensure long-term pavement quality. As a result of OIP programs, the U.S. uses life-long stone-matrix asphalt, warm-mix asphalt, two-lift pavement, and quiet pavement techniques. In 1997, 39 percent of National Highway System roads were in a state of good repair. That number had increased to 57 percent by 2006; some of that improvement can be attributed to the technologies and practices that the U.S. learned abroad.[6]
- **Bridges**: Studying bridges internationally was especially productive because the U.S. could learn from other countries that faced similar issues. Many European countries had built certain types of bridges, such as pre-stressed concrete segmental bridges, one to two decades before the U.S., which allowed the U.S. to observe the lessons learned from aging infrastructure. Additionally, the U.S. has learned from other countries that face seismic hazards. For example, the binational relationship with Japan has influenced bridge seismic retrofitting innovations in high seismicity areas such as California.
- **Policy**: International study tours have influenced U.S. policy, including one of the most important pieces of transportation legislation in the last decade, the Moving Ahead for Progress in the 21st Century Act (MAP-21). Many of the key elements of MAP-21 were learned through international exchanges, including performance management, asset management, financial sustainability metrics, asset valuation, and risk management. These lessons came from the 2004 “Transportation Performance Measures” scan in Australia, Canada, Japan, and New Zealand; the 2005 “Transportation Asset Management” scan in Australia, Canada, England, and New Zealand; and the 2009 “Linking Transportation Performance and Accountability” scan in Sweden, the United Kingdom, and New Zealand.

[6] FHWA. 2008. “Conditions and Performance Report to Congress.” https://www.fhwa.dot.gov/policy/2008cpr/

- **Environment**: Many of OIP's scans and studies provoked changes in mindset and vision in the U.S. On the first International Highway Technology Scan in the early 1990s, U.S. practitioners noticed that international agencies placed a much greater emphasis on environmental sustainability, interweaving sustainability considerations throughout the decision-making process for a wide range of projects. This realization helped U.S. agencies begin to see sustainability as a key part of transportation planning, design, and construction processes. Sustainable practices learned abroad include recycling materials and strategies for protecting wildlife in highway corridors. The 1999 "Sustainable Transportation Practices in Europe" scan in Sweden, Germany, the Netherlands, and the United Kingdom; the 1999 "Recycled Materials in European Highway Environments" scan in Sweden, Denmark, Germany, the Netherlands, and France; and the 2001 "Wildlife Habitat Connectivity Across European Highways" scan in Slovenia, Switzerland, Germany, France, and the Netherlands laid important groundwork for many sustainable practices in the U.S.
- **Active transportation**: International exchanges have also influenced U.S. bicycle and pedestrian planning. The binational relationship with the Netherlands has been particularly influential. The U.S. has incorporated many Dutch bikeway design features as best practices in design manuals. For instance, FHWA's "Achieving Multimodal Networks" guide (2016) includes Dutch protected intersection design methods; "Small Town and Rural Multimodal Networks (2016) was influenced by the Dutch approach to multimodal networks; and "Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations" (2018) incorporates other Dutch safety lessons. Beyond these specific practices, the U.S. has also learned from the Dutch "Sustainable Safety" design principles, which are based on the idea that infrastructure should be designed to accommodate human error and place a strong emphasis on cyclist and pedestrian safety.

These are a small selection of the many technologies, best practices, and lessons learned through OIP programs. Section 3 provides additional examples of OIP outcomes, focusing on ten categories of technologies and practices learned through international exchanges.

3 Overview of Selected Technologies and Best Practices

OIP has covered a broad array of topics over the past three decades. This project reviewed technologies from the programs listed in Table 1. Many of these topics have been researched for many decades, while others are more recent. For instance, pavement materials were studied in the 1990s and have become a common practice in the U.S., while risk management was studied within the last decade and has had a major influence on U.S. transportation practices more recently.

Table 1. List of programs reviewed.

Program	Years of Exchange	Focus Areas
Australia	2010 – present	Freight, innovative financing, road safety, connected and autonomous vehicles, green procurement
Brazil	2010 – present	Public-private partnerships, traffic management, safety data and information management, work zone management
Canada	2000 – present	Border management, trade, commercial motor vehicle size and weight
Chile	2010 – present	Road maintenance, bridge design, seismic design
Israel	2007 – 2012	Asset management
Japan	1984 – present	Bridges, seismic technology
Korea	1995 – present	Bridges, asset management, tunnels, geohazards and resilience
Mexico	2002 – present	Border management and wait time systems, road safety assessments, traffic incident management, commercial freight
The Netherlands	2009 – present	Road safety, performance measurement, project acceleration, infrastructure resilience and adaptation, emergency/crisis management, cycling infrastructure and safety, connected and automated vehicles
Sweden	2010 – present	Livability, sustainability, pedestrian safety, mobility as a service, connected and automated vehicles, smart cities
Switzerland	2020 – present	Electrically isolated tendons, post-tensioning durability, ultra-high performance concrete
GBP	2014 – present	Safety, infrastructure, operations, policy, planning, environment
International Technology Scan Program	1990 – 2014	Safety, infrastructure, operations, policy, planning, environment
WRA (PIARC)	2008 – present	Mobility, safety, sustainability, road administration, resilient infrastructure

In order to provide a clearer picture of the impacts of the international exchanges, this section explores 30 practices and technologies in greater detail, as listed below. These were selected based on the current level of dissemination and integration in the U.S.

1. Bridge Technologies
   - Cable-Stayed Bridges
   - Accelerated Bridge Construction (ABC)
     - Movement Systems for Prefabricated Bridge
     - Self-Propelled Modular Transporters (SPMTs)
     - Prefabricated Bridge System
2. Congestion Management
   - Active Traffic Management (ATM)
     - Automated Queue Detection
     - Lane Control Signals
     - Variable Speed Control
3. Innovative Contracting
   - Design-Build Contracting
   - Warranties
   - Public-Private Partnerships (PPPs)
4. Modern Roundabouts
5. Pavement Materials
   - Pavement Recycling
   - Warm-Mix Asphalt (WMA)
   - Stone-Matrix Asphalt (SMA)
6. Risk Management
7. Safety
   - Vision Zero
   - Safety Planning
   - Road Safety Audits (RSAs)
8. Traffic Incident Management
   - ATM – Incident Management
   - Traffic Incident Response
9. Truck Size and Weight
   - Weigh-in-Motion (WIM)
   - High-Speed Weigh-in-Motion (HS-WIM)
   - WIM Database Management
10. Winter Operations
    - Removable Legs on Trucks
    - Anti-icing
    - Fixed Automated Spray Technology
    - Roadway Weather Information Systems (RWIS)
    - Snow and Ice Pooled Fund Cooperative Program (SICOP)

3.1 Bridge Technologies

In the United States, there are over 617,000 bridges, 42 percent of which are at least 50 years old.[7] Since the 1995 "Scanning Review of European Bridge Structures," OIP has been sending teams across the world to learn effective bridge design and construction methods. Some of the most impactful bridge scans have included the 1999 "Performance of Concrete Segmental and Cable-Stayed Bridges in Europe" (in Switzerland, Germany, Denmark, and France) and the 2004 "Prefabricated Bridge Elements and Systems" (in Japan, Belgium, France, Italy, the U.K., and the Netherlands), as well as bilateral exchanges with Japan.

Efficient, high-quality bridge construction and design methods are critical for ensuring our country's bridges are safe and cost-effective. These exchanges have helped promote and make common practice in the U.S. the use of cable-stayed bridges, as well as accelerated bridge construction methods and technologies. As Benjamin Graybeal, Team Leader on FHWA's Bridge Engineering team, noted, "being able to show bridge owners real stories of success" helps accelerate the adoption of new technologies. Specific outcomes of bridge scans and bilateral exchanges include:

- **Cable-Stayed Bridges**: These are an attractive and efficient bridge type with a large center tower and cables supporting the bridge deck on either side. At the time of the 1999 scan, few U.S. practitioners understood how to design and construct these bridges. As of 2010, cable-stayed bridges were the most widely used bridge type for major long-span bridges in the U.S. Ninety percent of long-span bridges in the U.S. are cable-stayed as of 2019.[8] By using cable-stayed bridges, transportation agencies have realized $73.5 million in cost savings from bridge projects in Massachusetts, West Virginia, and Louisiana (based on competitive bids against traditional bridge technologies).[9]

Gordie Howe International Bridge. Source: FHWA

- **Accelerated Bridge Construction** (ABC): ABC is a set of methods used in bridge construction that helps reduce onsite bridge construction time. The U.S. discussed this approach during bilateral events with Japan and learned specific approaches and technologies during multilateral studies. The workshops with Japan have helped develop and disseminate technologies that "directly impacted the safety of bridges along the West Coast," according to Binational Relations Team Leader Stephen Kern.
    - One ABC method is **Prefabricated Bridge Elements and Systems** (PBES), which the U.S. studied on the 2004 scan mentioned above. Prefabrication allows construction teams to build elements of bridges offsite and move them into place in less than eight hours, which minimizes impacts on travelers, lowers risks for construction workers, and reduces project costs. As of 2013, over 38 States had experience with prefabricated bridge systems.[10] There are many examples of projects that saved time and money by using

Prefabricated Bridge Construction. Source: FHWA

[7] Report Card for America's Infrastructure. 2021. Overview of Bridges. https://infrastructurereportcard.org/wp-content/uploads/2020/12/Bridges-2021.pdf
[8] FHWA. 2019. "FHWA Global Benchmarking Program Briefing."
[9] Ibid
[10] FHWA. 2013. "Benefits Report for the FHWA International Technology Scanning Program."

these methods. The Washington State Department of Transportation (DOT), for example, used prefabricated elements to replace 3,900 feet of bridge deck on the Lewis and Clark Bridge over a period of 124 nights, with three-weekend closures and little or no impact on rush-hour traffic. This project came in under budget, at a price lower than the engineer's estimate.[11] The 2004 scan also studied technologies that enable PBES, such as **Movement Systems** and **Self-Propelled Modular Transporters** (SPMTs).

- Movement systems include horizontal skidding methods, incremental launching methods, and methods for floating bridges into place.
- SPMTs are multi-axle platform vehicles that are operated through computer control systems. They can pivot in any direction, move prefabricated bridge spans weighing several thousand tons, and position objects with precision. The 2004 scan team developed an FHWA manual called "Manual on Use of Self-Propelled Modular Transporters to Remove and Replace Bridges - FHWA-HIF-07-022" (2007). The manual has served as a valuable tool for increasing the use of this technology in the U.S. As of 2019, SPMTs have been widely used across the country. Utah DOT saved $55 million on six projects using this technology.[12] In 2006, Florida DOT used SPMT technology to remove and replace a highway bridge crossing and saved $2.2 million in delay-related user costs.[13] Utah, Louisiana, Rhode Island, and other State DOTs have also successfully used this technology.[14]

SPMT. Source: FHWA

3.2 Congestion Management

The average American loses nearly 100 hours (about four days) to congestion each year, costing American drivers nearly $88 billion (about $270 per person in the U.S.).[15] In addition to time lost, other costs of congestion include increased emissions and a higher risk of rear-end collisions. OIP's scans of Sweden, Germany, France, England, and other countries have yielded information on several effective congestion management strategies and technologies that have influenced U.S. practices. Many of these strategies fall within the concept of **Active Traffic Management** (ATM), which is a bundle of strategies that measure and manage congestion and travel speeds in real-time. ATM strategies include informing motorists of current conditions, adjusting speed limits to match conditions, and adjusting toll prices dynamically. The 2006 scan "Active Traffic Management: The Next Step in Congestion Management" studied ATM in Greece, Germany, Denmark, the Netherlands, and England. At the time of the scan, the U.S. already used many of the techniques, but the scan helped practitioners see how Europeans consider both current and projected conditions to actively manage and control traffic.

As the U.S. vehicle stock continues to grow and disrupting events become more common, it is imperative to continuously deploy technologies that enable the proactive management of congestion. Below are some of the congestion management technologies learned through international exchanges and implemented in the U.S.

[11] Accelerated Bridge Construction University Transportation Center. "2004 – Lewis and Clark Bridge." http://utcdb.fiu.edu/bridgeitem?id=271
[12] FHWA. 2019. "FHWA Global Benchmarking Program Briefing."
[13] FHWA. 2013. "Benefits Report for the FHWA International Technology Scanning Program."
[14] Ibid.
[15] INRIX. 2020. "INRIX: Congestion Costs Each American Nearly 100 hours, $1,400 A Year." https://inrix.com/press-releases/2019-traffic-scorecard-us/

- **Automated Queue Detection**: This technology uses sensors, cameras, and software to monitor travel speeds. When congestion occurs, these systems alert operators and drivers. Queue warning signs warn drivers when backups are developing ahead and help motorists prepare to stop and avoid rear-end collisions. These systems have since been implemented across the U.S., in places such as Seattle and Minneapolis. Texas DOT deployed automated queue detection systems during a major construction project to warn drivers of lane closures and nighttime traffic. Crashes were estimated to be 18 to 45 percent lower than they would have been without these systems.[16]

Queue warning system. Source: FHWA

- **Lane Control Signals**: These are overhead signals placed over lanes to inform motorists if the lane they are in is open. If there is a crash or a stalled vehicle, operators can change the lane signals to alert motorists that they should change lanes. These signals can also be used to indicate the direction of a reversible lane or to provide direction for toll plazas. A downward green arrow indicates that drivers can use the lane; a yellow X means that drivers should prepare to vacate the lane; a red X means that drivers are not allowed in the lane. This practice has been implemented in places such as Atlanta, Las Vegas, and Northern Virginia.[17]

Lane control signals. Source: FHWA

- **Variable Speed Control**: Variable speed control, also known as speed harmonization, is the practice of adjusting speed limits based on real-time traffic speed and flow data.[18] The 1999 "Innovative Traffic Control" scan team observed that the British used a "Go Slower to Get There Faster" approach. That is, by reducing speed limits during more congested periods, traffic operators can create steady traffic flows rather than stop-and-go conditions that often cause rear-end crashes. Computer software uses congestion information from traffic sensors to calculate optimal speeds, gradually lowering speed limits in road segments approaching bottlenecks. These speed limits are displayed on dynamic signs.

Variable speed control. Source: FHWA

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[16] Work Zone Safety. "Innovative End-of-Queue Warning System Reduces Crashes Up to 45%." 2015. https://www.workzonesafety.org/files/documents/training/courses_programs/rsa_program/RSP_Guidance_Documents_Download/RSP_EndOfQueueWarning_Guidance_Download.pdf

[17] Texas A&M Transportation Institute. 2017. "Summary of Effective Practices." NCHRP 03-123 Technical Memorandum for Task 2. http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP03-123_Task2TechMemo.pdf

[18] Office of Operations Research and Development. 2014. "Speed Harmonization." https://www.fhwa.dot.gov/publications/research/operations/15012/15012.pdf

3.3 Innovative Contracting

U.S. transportation agencies primarily used one form of contracting, design-bid-build, until the 1990s. A 1993 innovative contracting scan in Austria, France, Germany, and Spain observed that European agencies used different contracting methods that reduced construction time, enhanced quality, minimized life-cycle costs, and even rewarded innovation. These methods included the selected use of warranties, use of public-private partnerships, more efficient means of inspection, acceptance of alternative bids, and contractor pre-qualification based on International Standards Organization certification.

The 1993 scan elevated U.S. interest in innovative contracting methods and led to research on U.S. adoption of these methods. Follow-up efforts and impacts include:

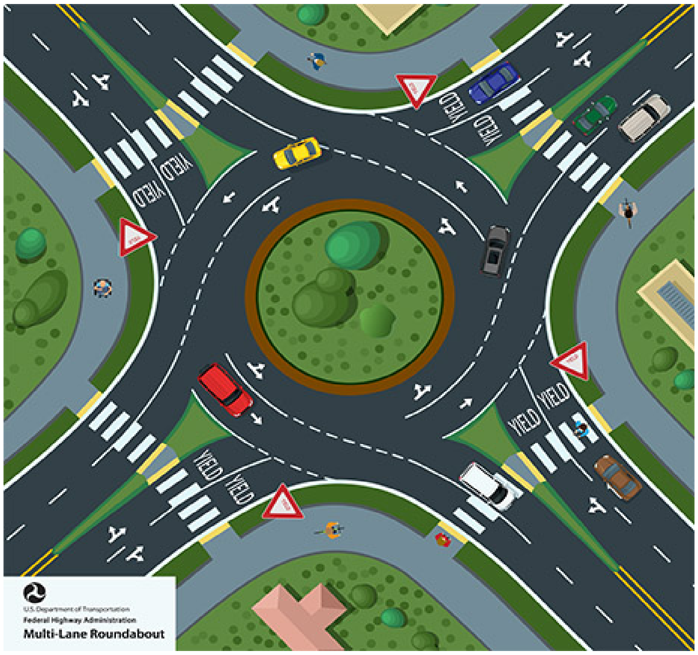
- **Pavement Warranties**: With pavement warranties, the contractor guarantees the performance of the pavement, which helps ensure the long-term performance of the pavement. The 2002 "Asphalt Pavement Warranties: Technology and Best Practices in Europe" scan in Denmark, Germany, Spain, Sweden, and the U.K. found that many of these methods were ready for widespread U.S. deployment. As of 2013, over 1,600 warranties have been used for Federal aid-funded State DOT projects. In the long term, pavement warranties are 70–90 percent more cost-effective based on service life.[19]
- **Public-Private Partnerships (P3s)**: Another scan team studied public-private partnerships during a 2008 scan in Australia, Portugal, Spain, and the U.K. called "Public-Private Partnerships for Highway Infrastructure: Capitalizing on International Experience." In P3s, private entities take on a variety of project roles, such as design, construction, finance, and/or operations.[20] Benefits include risk-sharing, accelerated project delivery, cost efficiency, and access to new sources of capital.[21] P3s have become more popular in the U.S. since this scan. For example, the North Tarrant Express (NTE) in Fort Worth, Texas, was built through partnerships with private entities. Two-thirds of the funds came from private sources. The project was completed nine months ahead of schedule.[22],[23] NTE Mobility Partners designed, built, and financed the project and oversees maintenance and operations. The private partner collects tolls on the facility's managed toll lanes.[24] On the U.S. 36 Express Lanes in Colorado, private debt and equity helped finance the project, accelerating the project delivery by at least ten years and shifting toll revenue risks and other risks to the private sector.[25]

Bilateral exchanges with the Netherlands in 2012 and 2013 also enhanced FHWA's understanding of the benefits and challenges of innovative contracting mechanisms such as design-build, design-build-finance-maintain, warranties, and performance-based maintenance contracting. These contracting methods studied through OIP programs are now much more common in the U.S. FHWA has promoted a variety of contracting methods through the Center for Innovative Finance Support and Every Day Counts.

[19] FHWA. 2013. "Benefits Report for the FHWA International Technology Scanning Program."
[20] Build America Bureau. 2018. "Public-Private Partnerships." https://www.transportation.gov/buildamerica/project-development/public-private-partnerships-p3/public-private-partnerships-p3
[21] Center for Innovative Finance Support. "P3 Defined." https://www.fhwa.dot.gov/ipd/p3/defined/new_build_facilities/
[22] Texas Department of Transportation. 2020. "North Tarrant Express." https://www.txdot.gov/government/partnerships/current-cda/north-tarrant-express.html
[23] Center for Innovative Finance Support. 2017. "Public-Private Partnerships." https://www.fhwa.dot.gov/ipd/pdfs/fact_sheets/techtools_P3s.pdf
[24] Wikipedia. "North Tarrant Express." https://en.wikipedia.org/wiki/North_Tarrant_Express
[25] Congressional Research Service. 2021. "Public-Private Partnerships in Transportation." https://fas.org/sgp/crs/misc/R45010.pdf

3.4 Modern Roundabouts

Modern roundabouts are circular intersections that are designed to calm traffic and reduce conflicts. At roundabouts, incoming drivers yield to circulating traffic. Design elements encourage vehicles to slow down. These features significantly reduce the frequency and severity of crashes compared to traditional intersections. The circular traffic flow minimizes head-on and side-impact crashes. Modern roundabouts are also more cost-effective than traditional intersections. During the 1994 International Technology Scan Program "Study Tour for Speed Management and Enforcement Technology" in the Netherlands, Germany, Sweden, and Australia, the scan team observed the practice of traffic calming, or the use of physical design to slow traffic and enhance safety. One particularly notable example was the roundabout; the scan team observed that European and Australian engineers had modernized roundabout designs to slow drivers and eliminate conflicting traffic situations.



Source: FHWA

Following the 1994 scan, FHWA developed a roundabout policy and planning procedures. Findings from the scan influenced FHWA guidance, such as "Roundabouts: An Informational Guide" (2000). FHWA also hosted a Roundabout Workshop and a Roundabout Showcase with several States in the Northeast. Research efforts and design standards have included: National Cooperative Highway Research Program's (NCHRP) 03-78: "Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities" (2005); NCHRP 03-65: "Applying Roundabouts in the United States" (2006); and NCHRP 03-65A: "Update of 'Roundabouts: An Informational Guide'" (2010).

At the time of the 1994 scan, there were fewer than 50 modern roundabouts in the U.S. As of 2013, there were over 2,000.[26] Roundabouts have helped improve safety at U.S. intersections. A single-lane roundabout has only eight conflict points, compared to 32 in a traditional four-way intersection.[27] A 2002 study by Maryland State Highway Administration found that at 15 locations where roundabouts replaced traditional intersections, the crash rate fell by 60 percent, and the injury crash rate fell by 82 percent.[28] Roundabouts also improve the efficiency of traffic flow, reducing fuel consumption by approximately 30 percent and reducing congestion.[29] Roundabouts are also cost-effective; by eliminating traffic signals, two-lane roundabouts can cost approximately $300,000 less than a conventional $1 million intersection.[30]

[26] FHWA. 2013. "Benefits Report for the FHWA International Technology Scanning Program."
[27] Ibid.
[28] Roundabouts Reduce Crashes and Congestion, FHWA Innovator, Vol 3, No 8, Aug/Sept 2008 Publication Number FHWA-HIF-08-028.
[29] Insurance Institute for Highway Safety http://www.iihs.org/research/qanda/roundabouts.html accessed March 7, 2011.
[30] FHWA. 2013. "Benefits Report for the FHWA International Technology Scanning Program."

3.5 Pavement Materials

There are over 2.6 million miles of paved roads in the U.S.[31] Pavement quality affects safety, vehicle longevity, the environment, and more. It typically costs hundreds of thousands of dollars to resurface just one lane mile.[32] Since the early 1990s, OIP has supported tours and scans through Europe and participation in international conferences with the purpose of identifying more cost-effective, high-quality, and environmentally friendly paving solutions that could be disseminated throughout the U.S.

Selected paving technologies and strategies that have been learned through international exchanges include:

- **Pavement Recycling**: During highway construction, materials such as asphalt and concrete pavements, industrial byproducts such as fly ash and steel slag, and reinforcing steel and beams can be recycled. The practice of recycling pavements is typically cost-effective, better for the environment, and can save time. On the 1992 “U.S. Tour of European Concrete Highways,” the U.S. observed that all pavement materials were recycled on Austrian highway construction projects. These observations led to a 1999 scan on recycling in Sweden, Denmark, Germany, the Netherlands, and France: “Recycled Materials in European Highway Environments: Uses, Technologies, and Policies.” Following the 1999 scan, FHWA formed the FHWA Recycling Team to promote these practices. The Recycling Team created a formal Recycled Materials Policy that has been adopted by FHWA and serves as a model for other Federal agencies. The 1999 scan also led to the creation of an American Association of State Highway and Transportation Officials (AASHTO) joint committee on recycling with FHWA, Environmental Protection Agency (EPA), and the Association of State and Territorial Solid Waste Management Officials.
- **Warm Mix Asphalt (WMA)**: WMA is one of the most common asphalt pavement mixes used in the U.S. as of 2021. Warm mix, as opposed to hot mix, permits mix production at lower temperatures, thus saving energy, making emissions less volatile, and allowing the mix to remain pliable at lower temperatures. WMA also creates safer working conditions, lowers costs, improves compaction and performance, and allows for a longer paving season.[33] This technology was introduced to the U.S. during a 2007 scan in Belgium, France, Germany, and Norway. The 2007 scan led to a 2008 WMA conference attended by 700 people, which was the largest single-subject conference ever held by the National Asphalt Pavement Association.[34] Following the scan, national research efforts were undertaken, including NCHRP 09-47: "Engineering Properties, Emissions, and Field Performance of Warm Mix Asphalt Technologies" (2009) and NCHRP 09-43: "Mix Design Practices for Warm Mix Asphalt" (2011). Additionally, a Warm Mix Technical Working Group was initiated by FHWA and the National American Pavement Association to guide education and research efforts. This group developed "WMA Guide Specification for Highway Construction" (2009). WMA had as much as 50 percent market share in some States by 2012.[35] As of 2012, 43 States had used it for projects, and 15 had developed specifications for its use.[36]

Warm-mix asphalt. Source: FHWA

[31] National Asphalt Pavement Association. 2014. “Fast Facts.” https://www.asphaltpavement.org/uploads/documents/GovAffairs/NAPA%20Fast%20Facts%2011-02-14%20Final.pdf
[32] Strong Towns. 2020. “How Much Does a Mile of Road Actually Cost?” https://www.strongtowns.org/journal/2020/1/27/how-much-does-a-mile-of-road-actually-cost
[33] FHWA. 2013. “Benefits Report for the FHWA International Technology Scanning Program.”
[34] Ibid.
[35] National Asphalt Pavement Association. 2013. “Annual Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2009–2012.” https://www.asphaltpavement.org/uploads/documents/IS138/IS138-2012_RAP-RAS-WMA_Survey_Final.pdf
[36] Office of International Programs. 2012. “International Technology Scanning Program: Bringing Global Innovations to U.S. Highways.”

- **Stone-Matrix Asphalt (SMA)**: SMA is a rut-resistant pavement with a strong stone-on-stone skeleton. The 1990 "European Asphalt Study Tour" in Denmark, France, Germany, Italy, Sweden, and the U.K. introduced SMA to the U.S., ultimately helping SMA become a staple pavement type. In 1997, the NCHRP “Designing Stone Matrix Asphalt Mixtures” (Report 9-08) identified guidelines for the design and construction of SMA. The report is the basis of the current AASHTO specification. FHWA estimated that approximately 45 million metric tons (50 million tons) of SMA were placed on U.S. highways by 2004. FHWA supported the construction of SMA test sections on U.S. highways to determine construction feasibility, performance, and cost-effectiveness. Staff from FHWA's Turner-Fairbank Highway Research Center assisted States by providing information on SMA mix design, while FHWA's Mobile Asphalt Pavement Mixture Laboratory provided materials analysis onsite and support for quality control and compliance. A report by the National Center for Asphalt Technology reviewed 140 projects in the U.S. and found that overall performance ranged from very good to excellent.[37]

3.6 Risk Management

Risk management is the practice of integrating risk considerations into the planning process. All transportation projects involve some degree of risk. Risks may include weather events that can damage assets, economic factors that can impact the ability of an agency to complete construction projects, and changes in legal requirements that add new costs.

The 2011 scan "Transportation Risk Management: International Practices for Program Development and Project Delivery" studied enterprise risk management practices in England, Australia, Germany, the Netherlands, and Scotland.[38] European countries were using private sector methods, such as weighing the risks and rewards of investments, to make well-informed decisions about risk. The study team focused on key risk management concepts, including:

- **Agency Risk Management**: This is a continuous, iterative process for managing risks that can affect the achievement of agency strategy objectives. Common agency risks relate to agency reputation, funding sources, and accuracy/adequacy of data.
- **Program Risk Management**: Agencies can apply risk management to specific programs, such as operations, safety, or asset management programs. Program-specific approaches that can facilitate effective program risk management include processes, systems analysis, stakeholder engagement, and leadership behaviors assessment.
- **Project Risk Management**: Risks can and should also be managed at the project level. Reducing risks can improve performance, cost control, safety, and environmental outcomes of the project.[39]

Many of these concepts had already been implemented in the U.S. However, OIP’s support in this field provided agencies with examples of more comprehensive approaches, concepts, and tools that align with stakeholder functions. These include frameworks for the risk management process, risk workshops, quantitative and qualitative analyses, risk management structures, risk registers, risk assessments, risk communication strategies, and risk management plans.

An outcome from the 2011 scan was a formal recommendation for U.S. agencies to formalize holistic risk management approaches and embed risk management into existing business processes. This led to five FHWA reports on how risk management can be applied to transportation assets. The five reports were also expanded upon in NCHRP 08-93: "Managing Risk Across the Enterprise: A Guide for State Departments of Transportation" (2016), which serves as a tool for the implementation of risk

[37] FHWA. 2013. “Benefits Report for the FHWA International Technology Scanning Program.”
[38] FHWA. 2012. “Transportation Risk Management: International Practices for Program Development and Project Delivery.” https://international.fhwa.dot.gov/scan/12029/12029_report.pdf
[39] Ibid.

management strategies. Additionally, workshops, brochures, case studies, and a spreadsheet tool have helped make these practices widespread in the U.S.

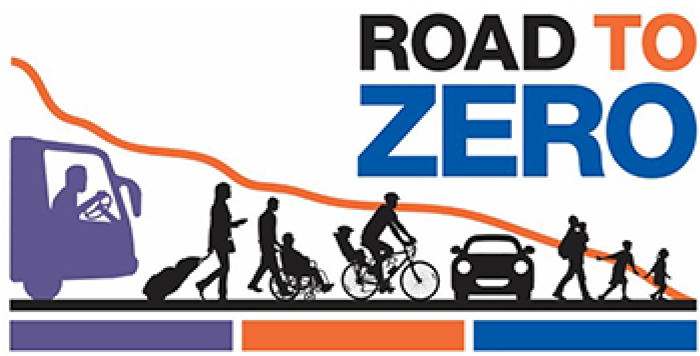
The 2011 scan and follow-up research had a considerable influence on MAP-21, which included many references to risk-based approaches in the areas of highway safety, managing assets, bridge inspection, and managing projects. States are now required to develop risk-based asset management plans that include risk management analyses.

3.7 Safety

A critical component of transportation agencies' work is maintaining safety for users. Drivers, pedestrians, and cyclists all face different safety risks. Transportation agencies throughout the world have developed technologies and strategies for protecting road users. OIP's international scans have not only helped the U.S. learn about specific infrastructure improvements but have helped the U.S. develop and advance holistic, ambitious safety frameworks.

Practices learned through international exchanges include:

- **Comprehensive, Multidisciplinary Safety Planning**: In the 1994 "FHWA Study Tour for Highway Safety Management Practices" scan in Japan, Australia, and New Zealand, the scan team observed a multidisciplinary, comprehensive approach to planning in Australia and New Zealand. The scan examined and recommended the adoption of comprehensive, goal-driven safety plans that involved all stakeholders, and not just highway officials. This multidisciplinary approach directly influenced AASHTO's 1997 Strategic Highway Safety Plan. The 1997 plan included 22 strategies that created formal, ongoing collaborations between the various highway safety partners as a primary component of safety strategies.[40] It called for a specific target for the national transportation community to have no more than one fatality per 100 million miles of vehicle travel. That goal was correspondingly adopted by the U.S. DOT and the Governors' Highway Safety Association.[41]
- **Vision Zero**: Following the 1994 safety scan, the U.S. continued to study international safety frameworks. The 2003 "Managing and Organizing Comprehensive Highway Safety in Europe" scan studied Vision Zero concepts in Sweden, the U.K., the Netherlands, and Germany. The driving idea behind Vision Zero is that working towards zero highway deaths is a worthy and achievable goal. It is worth noting that many countries use similar concepts with different names. For instance, the Dutch use a "Sustainable Safety" approach that focuses on human factors and designs the traffic system with human needs, competencies, limitations, and vulnerabilities in mind. The 2003 scan led the U.S. to focus more on ambitious safety targets with specific milestones. The scan influenced the 2005 "Safe Accountable Flexible Efficient Transportation Act - A Legacy for Users" (SAFETEA-LU), which required each State to develop a Strategic Highway Safety Plan that included numeric targets. The 2003 scan also influenced the "Zero Deaths" effort that started in 2009 in the U.S. Washington, Minnesota, Utah, and other States have adopted Zero Deaths as the long-term vision for highway safety programs. The U.S. has also discussed Vision Zero practices through the bilateral relationship with Sweden, which was established in 2010, and the bilateral relationship with the Netherlands, which focused on road safety in 2010 and 2011.



Road to Zero graphic. Source: FHWA

[40] FHWA. 2013. "Benefits Report for the FHWA International Technology Scanning Program."
[41] Ibid.

The bilateral relationship with the Dutch has helped establish peer-to-peer relationships “with safety experts in the Netherlands, providing quick access to Dutch expertise when new and unexpected questions arise,” according to Mike Griffith of the FHWA Office of Safety Integration. These relationships also “enabled rapid access to information regarding the larger European approaches to safety, and about details regarding the Dutch system in particular.”

- **Road Safety Audits**: On the 1994 safety study tour, the scan team also observed roadway safety audits (RSAs). RSAs are formal safety examinations of future roadway plans, projects, or service facilities that are conducted by independent, multidisciplinary teams. RSAs are considered to be a successful, low-cost measure to improve safety. FHWA has identified RSAs as a proven safety countermeasure and included RSAs in the Final Rule for the Highway Safety Improvement Program (23 CRF 924.9). Between 2004 and 2010, FHWA led more than 300 RSA workshops for representatives of local, Tribal, State, and Federal organizations. FHWA has also developed software called Interactive Highway Safety Design Model to assist practitioners in developing RSA reports. RSAs have become a successful, common practice in the U.S. because of international scans. Every State has established an RSA program, piloted or performed audits, and/or participated in related training.[42]

Road Safety Audits. Source: FHWA

3.8 Traffic Incident Management

In the U.S., three injury crashes occur every minute.[43] In addition to the direct consequences of incidents, crashes can also result in increased congestion, unsafe situations for incident responders, and secondary accidents. Traffic incident management falls within the concept of ATM, serving as an approach to ameliorate the impacts from incidents on the road.

It is important to clear crash scenes as quickly and safely as possible, as well as manage congestion that may occur from these incidents. OIP Programs have helped the U.S. learn about and disseminate effective traffic incident management strategies.

Examples of traffic incident management strategies learned through international exchanges include:

- **ATM – Incident Management:** From an incident perspective, ATM provides a set of best practices that help measure, manage, and reduce congestion; and the probability of incidents (primary and secondary) on the road. The 2006 scan "Active Traffic Management: The Next Step in Congestion Management" led to pilot projects in Minnesota and Washington. Both already used some of the ATM strategies, but the pilot projects—the Urban Partnership project in Minneapolis and the Smarter Highways Project in Puget Sound—implemented more comprehensive ATM approaches. As of 2013, the expected benefits of the Puget Sound project include 600 fewer collisions because of variable speed limit devices, saving $13.3 annually in accident costs; a 15–25 percent reduction in collisions because of traffic information signs, saving $392,000 in accident costs; and improved travel times and travel reliability.[44]

[42] FHWA. 2013. “Benefits Report for the FHWA International Technology Scanning Program.”
[43] SHRP2 Solutions. “Coordinated Training Program Builds Stronger Responder Corps for Safer Incident Recovery.” https://www.sheriffs.org/sites/default/files/SHRP2Solutions2.pdf
[44] FHWA. 2013. “Benefits Report for the FHWA International Technology Scanning Program.”

- **Traffic Incident Response**: The 2005 "Traffic Incident Response: Practices in Europe" scan studied practices for responding to traffic incidents. The scan team identified procedures, practices, and technologies in England, Germany, the Netherlands, and Sweden that could improve U.S. traffic incident response. These strategies include incident response training, coordinated traffic information centers, technologies for response vehicles, and coordinated communication practices.[45] This scan influenced action in the development of the second Strategic Highway Research Program (SHRP2) **Coordinated Traffic Incident Management Training Program**, which developed and delivered training at the U.S.-Mexico border through the Border Technology Program.
  - The Border Technology Exchange Program provided/supported training in methods for effectively **clearing crash scenes**. These trainings helped standardize procedures across borders, expand the understanding and practice of safe cross-border transportation, improve incident response in Mexico, and built capacity in the U.S. southern border States to ensure a more efficient movement of goods and services. Between 2013 and 2019, over 1,500 fire, law-enforcement, emergency management, and transportation officials from local Mexican entities attended workshops.[46]

3.9 Truck Size and Weight

In 2019, trucks moved over 11 billion tons of freight in the U.S.[47] Trucks traveled over 300 billion miles in 2018.[48] Given the scale of commercial trucking in the U.S., truck size and weight regulations have substantial effects on pavement quality and road safety. Larger trucks place greater strain on highway infrastructure and are more difficult to maneuver. Thus, setting and enforcing truck size and weight regulations has far-reaching impacts on U.S. roads, drivers, and the economy.

In order to enforce truck weight regulations, transportation agencies often used weigh-in-motion (WIM) technology. OIP programs have helped advance WIM practices in the U.S., including:

Weigh-in-Motion Systems. Source: FHWA

- **WIM**: A 2006 scan, "Commercial Motor Vehicle Size and Weight Enforcement in Europe," studied procedures and technologies for enforcing commercial motor vehicle size and weight laws in Belgium, France, Germany, the Netherlands, Slovenia, and Switzerland. In particular, the team studied WIM technology, which uses in-road sensors or scales to capture vehicle weights as they pass. Recognizing the effectiveness of this technology, FHWA engaged in many follow-up development and dissemination efforts. FHWA hosted a web-based strategic forum to support short-, medium-, and long-range strategic plan development for WIM technology use and deployment. Additionally, in 2010, six briefing papers and related PowerPoint presentations were prepared that describe various aspects of successful European practices and issues related to potential implementation in the United States. The 2010 efforts were part of NCHRP 20-07/Task 254: "Vehicle Size and Weight Management (VSW) Technology Transfer/Best Practices." Finally, as of 2013, FHWA had initiated efforts to integrate WIM technology into the National Institute of Standards and Technology's "Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices."

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[45] FHWA. 2006, "Traffic Incident Response: Practices in Europe." https://international.fhwa.dot.gov/tir_eu06/06002.pdf
[46] FHWA. 2019. "Traffic Incident Management Training at the U.S.-Mexico Border."
[47] American Trucking Associations. 2019. "Economics and Industry Data." https://www.trucking.org/economics-and-industry-data
[48] Ibid.

- **Bridge Weigh-in-Motion (BWIM)**: The 2006 scan team found that in Slovenia, highway officials were measuring the weight of trucks on bridges instead of building separate WIM scales in pavements. The bridges served as the structure incorporating the scales. Based on the technology seen in Slovenia, the scan team worked with the Alabama DOT and the University of Alabama-Birmingham to procure and install a BWIM pilot. The system screens for overweight trucks, reducing the costs of continuous weigh inspections. The Connecticut DOT also installed a similar system.
- **High-Speed Weigh-in-Motion (HS-WIM)**: On the 2006 scan, the scan team observed Switzerland's heavy goods vehicle control facilities, which simultaneously measure commercial vehicle size and weight at stationary enforcement locations. The system includes an HS-WIM and video (VID) technology component that is used to strategically select trucks requiring additional measurements. It also includes a user-friendly presentation of data for enforcement officers operating the system. After observing the effectiveness of the system, the scan team brought Swiss experts to the U.S. for a round of seminars in 2008. This peer exchange informed the development of the Kingman Enforcement site at Hoover Dam.
- **WIM Database Management**: The 2006 scan team observed the Netherlands' centralized WIM database management system. This system has many useful features, such as a report showing truck weight findings in tabular and graphical formats. The team developed a six-page report that, as of 2013, served as a framework for various States currently developing their WIM data collection systems.

3.10 Winter Operations

One of the greatest success stories of OIP programs is the impact of scan tours on winter operations. Through OIP programs, the U.S. learned about a variety of technologies for preparing for and responding to winter weather. Within a few years, many technologies learned abroad had become common practice in the U.S.

Practices learned through international exchanges have included:

- **Removable Legs on Trucks**: The U.S. learned through PIARC about the practice of attaching removable legs to trucks to apply sand to roads. As of 2016, this practice was common in Europe but not in the U.S. In the U.S., traditional sanding equipment requires sanders to be removed by winches, which is a laborious and dangerous practice. The removable legs are easier and safer to remove and take up less storage space. One U.S. delegate learned about this technology through PIARC's Winter Services Technical Committee and brought it to Nevada DOT, which has since implemented this practice.
- **Anti-icing**: Anti-icing quickly became a common U.S. practice following international scans. During the "Winter Road Maintenance Practices" scan (1994) in Japan and Europe and through Swedish and French World Road Association delegates on PIARC's Winter Services Technical Committee, the U.S. learned about anti-icing. Anti-icing is the practice of treating roads with a salt brine prior to snow and ice events. Previously, the U.S. had focused on deicing or treating roads with salt after weather incidents. Anti-icing is a more sustainable method because it uses significantly less labor, equipment, and materials than deicing. This technology was quickly implemented in the U.S. and became common practice within a few years. FHWA produced a "Manual of Practice for an Effective Anti-Icing Program: A Guide for Highway Winter Maintenance Personnel" in 1996. AASHTO's Snow and Ice Pooled Fund Cooperative Program (SICOP) learned about this practice through PIARC and produced the AASHTO "Guide for Snow and Ice Control" in 1998.

- **Fixed Automated Spray Technology**: Fixed Automated Spray Technology is a permanent installation of a pump, tank, and nozzles that dispense anti-icing chemicals directly on a predetermined area of pavement. During the "Winter Road Maintenance Practices" scan (1994) in Japan and Europe (countries not specified), the scan team observed Fixed Automated Spray Technology. This technology was quickly implemented in the U.S. and became common practice within a few years. After Minnesota deployed this system, there was a 68 percent reduction in non-dry crashes from 1996–1997 (31 non-dry crashes) to the 2000–2001 winter season (10 non-dry crashes).[49]

Fixed Automated Spray Technology. Source: FHWA

- **Roadway Weather Information Systems (RWIS)**: The U.S. learned about RWIS during the 1994 scan, "Winter Road Maintenance Practices," in Japan and Europe (countries not specified). These systems include in-road pavement sensors that can detect pavement conditions and inform snowplow operators how wet, cold, or icy roads are. Small, connected weather stations mounted to poles provide complementary information, such as wind speed and air temperature. The software can assimilate the air and roadway data to predict icing, drifting, and other conditions. Before the scan, the use of RWIS was not common in the U.S. Following the scan, RWIS quickly became a common practice. Maintenance managers in Idaho found that RWIS reduced crashes by 83 percent and labor hours by 62 percent.[50]
- **SICOP**: The "Winter Road Maintenance Practices" scan (1994) in Japan and Europe provided so much valuable information on winter technologies that AASHTO formed a permanent program in response, the SICOP. The program was formed in 1996 to further the testing and dissemination of snow and ice technology systems not already in use in the U.S. SICOP provides a common forum in which the nation's highway agencies can share research and testing on ways to cut costs, improve performance and reduce crashes. One of the outputs from this program was the RWIS training package developed in the early 2000s.

[49] FHWA. 2013. "Benefits Report for the FHWA International Technology Scanning Program."
[50] Ibid.

4 Conclusions and Dissemination Recommendations

4.1 Dissemination Recommendations

In addition to highlighting the benefits of OIP programs, a key objective of this project is to identify technologies that have not yet been disseminated widely throughout the U.S. This synthesis report highlights outcomes and benefits from OIP programs. Beyond the selected 30 technologies described in Section 3, OIP participants have observed many other innovative technologies and practices. Many of these could be used to support local, State, and National goals.

After flagging effective practices and technologies during the literature review, the research team asked discussion participants for input on the status of these technologies in the U.S. These experts and practitioners provided additional context on each technology, describing which technologies are already common practice in the U.S., which technologies are mature but have been implemented only by a handful of agencies, and which technologies could help fill an unmet need in the U.S.

The research team, in conjunction with OIP staff and practitioners, used these insights to develop a list of dissemination recommendations, detailed in Table 2. This list could inform future sets of targeted outreach efforts—e.g., webinars and marketing materials—that could help promote these technologies and create a national dialogue on these practices.

Table 2. List of technologies to consider for further dissemination.

Technology	Description
Bikeway selection/design	As implemented by the Dutch, this is an approach that focuses on simplification in the roadway design process. These include retrofitting roads and designing bikeways for target speeds and for specific contexts, as well as curb extensions and dashed bike lanes.
Bikeways in roundabouts	This consists of carrying bicycle facilities through and around roundabouts. This practice, used by the Dutch, has been implemented in some U.S. locations. For example, Massachusetts DOT has incorporated Dutch-style separated bike lanes through roundabouts as a design option in their “Separated Bike Lane Guide” (2015) and “Roundabouts Guidelines” (2020) publications.
Channelization of traffic **Observed raised crosswalks** **Protected intersections**	These are practices for enhancing bicycle and pedestrian safety at intersections and other crossing locations. Channelization provides definite paths for vehicles to follow through intersections. Raised crosswalks act as traffic-calming measures and allow pedestrians to cross at grade with sidewalks. Protected intersections preserve separated bike lanes up to and through intersections.
Complete Streets and Complete Trips	These are concepts used to enhance mobility for all travelers. Complete Streets are streets designed to enable safe use and mobility for all users. Complete Trips is the idea that individuals should be able to plan for and execute a trip from origin to destination without gaps in the travel chain.
Electrically isolated tendons (EIT)	EIT is a non-destructive evaluation technique for post-tensioning systems. EIT systems protect post-tensioning tendons from corrosion and enable long-term remote monitoring.
Flexible Adaptation Pathways	This is a framework to help practitioners choose flexible climate adaptation strategies with timeframes that allow for changing course as new information emerges. The decision tree or pathway is mapped out over a timeline. Transfers from one adaptation strategy to another can be made at various points in time.

Technology	Description
	Each of the pathways can be rated qualitatively for cost-effectiveness and possible unwanted side effects.
Integration of public transport and cycling	This is a planning approach that focuses on creating multimodal networks by integrating public transport and cycling, such as including bicycle parking facilities at stations.
Leading Pedestrian Interval (LPI) and Leading Bicycle Interval (LBI)	These are traffic signalization methods used to enhance bicycle and pedestrian safety by giving them head starts when entering intersections.
Roads for Today Adapted for Tomorrow (ROADAPT)	This is the Netherlands' climate adaptation framework that includes guidelines on the use of climate data, performing vulnerability assessments, performing socio-economic impact assessments, and selection adaptation strategies. The Dutch have "spent a long time developing a high-level approach to addressing climate change, including on cooperating across agencies on climate change," as Robert Kafalenos, an Environmental Program Specialist at FHWA, noted. "They have put out serious climate projections that cover the whole country."
Tsunami design guidelines	These are a set of refined bridge design and construction guidelines that focus on tsunamis. Examples of these include probabilistic tsunami hazard mapping, a methodology for providing site-specific tsunami hazard information for prescriptive bridge loading calculations, and numerical models for estimating tsunami risk.
Turbo roundabouts	These roundabouts have the same general operating characteristics as modern roundabouts but utilize different geometrics and applications of traffic control devices.
Ultra-High Performance Concrete (UHPC)	This is a cementitious composite material that is significantly more durable than conventional and high-performance concretes. UHPC can be used as an overlay for bridge deck rehabilitations. As Benjamin Graybeal pointed out, "it can be hard to predict how many years of life" bridge rehabilitation efforts add to a bridge. "The Swiss have been doing this for over a decade," he noted, so "we can use what they have learned and move forward much faster."
Wave attenuation devices (WADs)	This is a nature-based resilience strategy that makes holes in WADs to create habitats for aquatic species and eco dynamic engineering to use the forces of nature to provide protection.

4.2 Conclusion

OIP programs have helped to identify and disseminate an extensive list of transportation technologies and best practices in the U.S. Many of the technologies studied abroad have helped shape transportation planning and design practices throughout the U.S., advancing the state of the transportation system and enhancing safety.

The successes of OIP extend beyond specific technologies and practices. OIP has fostered a culture of collaboration among transportation agencies throughout the world. Participants in OIP programs often say that building relationships with international counterparts is one of the most valuable outcomes of the program. These connections facilitate ongoing collaboration and information-sharing.

Additionally, these programs help to create champions for specific technologies. OIP participants get first-hand experiences with technologies that may be unfamiliar in the U.S. They return to the U.S. with tangible examples of how these technologies can support agency goals and clearer ideas of how they could work in the U.S. In this way, OIP programs tend to have much greater impacts on U.S. practices than desktop reviews of international technology.

Through OIP, the U.S. has also supported knowledge-building and effective practices in other countries. For example, at the U.S.-Japan Bridge Engineering Workshops, the U.S. has shared information about ductile structure design with Japan. In turn, Japan has shared information on topics such as tsunami design procedures. Japan and the U.S. have also engaged in several cooperative research programs on topics such as experimental verification of seismic performance of bridges and numerical modeling of tsunami effects. This kind of information sharing improves the safety, durability, and efficiency of transportation systems.

OIP has contributed to major advances in transportation practices in the U.S. and throughout the world. It is OIP's expectation that this report, accompanied by other outreach efforts and materials developed as part of this project, will continue to promote technologies that improve the safety, effectiveness, and quality of the U.S. transportation system.

Appendix A. List of OIP Resources

The following is a list of reference materials developed by OIP and reviewed for this project.

- Cambridge Systematics, Inc. 2014. "Asset Management Exchanges: Georgia Department of Transportation and NETIVEI Israel Synthesis Report."
- Chuanbing Sun, Maher K. Tadros, Gang Shao. 2014. "Synthesis Report for United States-Japan Bridge Engineering Workshops."
- Connie Yew, Office of Program Administration (HIPA-40) and Nathaniel Coley, Office of Asset Management (HIAM-30). 2010. "Trip Report: United States/Japan Exchange on Performance Management and Benefit Cost Analysis - Shifting from Theory into Practice."
- David Geiger, Paul Wells, Patricia Bugas-Schramm, Lacy Love, Dr. Sue McNeil, Dennis Merida, Dr. Michael Meyer, Robert Ritter, Kirk Steudle, Donald Tuggle, Larry Velasquez. 2005. "Transportation Asset Management in Australia, Canada, England, and New Zealand."
- David Sanders and Sheila Rimal Duwadi (Editors). Hoda Azari, Bijan Khalegi, Bruce Johnson, Elmer Marx, and Tom Ostrom (Contributing authors). 2018. "U.S. – Japan Bridge Engineering Workshop-Innovative Bridge Design and Preservation - Summary Report."
- FHWA. 2019. "Traffic Incident Management Training at the U.S.-Mexico Border."
- FHWA. "Traffic Incident Management Workshops."
- FHWA. 2013. "Benefits Report for the FHWA International Technology Scanning Program."
- FHWA. 2016. "Leading on the International Stage: A Synthesis Report of the U.S. Participation in the World Road Association during the 2008–2011 and 2012–2015 Cycles."
- FHWA. 2019. "FHWA Global Benchmarking Program Briefing."
- FHWA. 2019. "Traffic Management Training at the U.S.-Mexico Border."
- FHWA. 2020. "FHWA Binational Program: Anchor Briefing."
- FHWA. 2018. "New Mexico 2018 Border Technology Exchange Program Event Summary."
- Hideaki Nishida (Editor). 2012. "Proceedings of the 27th U.S.-Japan Bridge Engineering Workshop."
- Ian Friedland, Wen-huei (Phil) Yen, Agnes Velez. 2015. "Considerations for Future U.S.-Japan Bridge Collaborations."
- Jackie Clark, Amanda Grate, Michelle Neuner, David Peshkin. 2019. "Synthesis Report of the FHWA and the MOLIT Knowledge Exchange Since 1995."
- John D'Angelo, Eric Harm, John Bartoszek, Gaylon Baumgardner, Matthew Corrigan, Jack Cowsert, Thomas Harman, Mostafa Jamshidi, Wayne Jones, Dave Newcomb, Brian Prowell, Ron Sines, and Bruce Yeaton. 2008. "Warm-Mix Asphalt: European Practice."
- Kees van Ommeren, Paolo Ruffino, Sara de Boer, Jeroen Buis. 2017. "The Dutch Approach to Bicycle Mobility: Retrofitting Street Design for Cycling."
- M. Gardner and A. Burde. 2013. "Procedures for Defining Management Strategies and Targets Associated with Transportation Goals."
- Maartje van Ravesteijn, Mark in't Veld, Kevin Vijftigschild, and Mike Woning. 2016. "Joint FHWA and Rijkswaterstaat Report 'Resilient Infrastructure' – Assessing vulnerabilities/risks to climate change and incorporating the results into planning, design and asset management."
- Mary Lou Ralls, Ben Tang, Shrinivas Bhidé, Barry Brecto, Eugene Calvert, Harry Capers, Dan Dorgan, Eric Matsumoto, Claude Napier, William Nickas, Henry Russell. 2005. "Prefabricated Bridge Elements and Systems in Japan and Europe."
- Matthew Dorfman. 2017. "Synthesis Report: Australia Program."
- OIP. 2011. "International Technology Scanning Program: Bringing Global Innovations to U.S. Highways."

- Rijkswaterstaat and Volpe National Transportation Systems Center. 2017. “Joint Research Workshop on Transportation: Shared Mobility: Its Concept, Trends, and Implications for Future Policy.”
- SHRP2 Solutions. 2019. “SHRP2 TIM Training Fact Sheet.”
- Steve Ernst (FHWA), Bill Bergeson (FHWA), Steve Harelson (Colorado DOT), Dan Williams (Maryland Transportation Authority), Matt Bilson (WSP). 2018. “Tunnel Fire Protection Using Fixed Firefighting Systems: Advanced Practices in Australia and New Zealand.”
- TxDOT. n.d. “TxDOT's Commercial Vehicle Training in Mexico to Improve Commercial Traffic.”
- Walter Podolny, William R. Cox, John M. Hooks, Maurice D. Miller, Alan J. Moreton, Mohsen A. Shahawy, Douglas Edwards, Majid Madani, R. Kent Montgomery, Brett Pielstick, Man-Chung Tan. 2001. “Performance of Concrete Segmental and Cable-Stayed Bridges in Europe.”

Appendix B. Transcripts of Discussions

Table 3 lists the discussion and respective participants held as part of this project. Table 4 through Table 8 provide the summaries of each discussion.

Table 3. List of participants in each group discussion.

OIP Staff	Japan	Korea
• Agnes Velez • Stephen Kern • Hana Maier	• Sheila Duwadi • Shrinivas Bhide • Jerry Jia-Dzwan Shen • Ken Leonard	• Robert Kafalenos • Khalid Mohamed • Al Logie • Christy Pook-Atkins • Barry Zimmer
The Netherlands	**Sweden**	**Switzerland**
• Dan Goodman • Govindarajan Vadakpat • Robert Kafalenos • Mike Culp • Amy Plovnick	• Mike Griffith • Shari Schaftlein • Shana Baker	• Reggie Holt • Benjamin Graybeal

Table 4. Summary of Key Findings from the Netherland Discussion.

Topic	Context
Climate stress tests/vulnerability assessments	Amy Plovnick mentioned “stress tests” as a key climate resilience takeaway. These tests are more direct than U.S. vulnerability assessments. Because stress tests are different than U.S. vulnerability assessments, transportation professionals may be interested in learning from differences. It is not clear how much this practice has been disseminated in the U.S.
How to plan regional bike networks across multiple jurisdictions	Dan Goodman suggested a webinar about Dutch intercity bicycle route planning, design, and implementation, including a discussion of interagency coordination.

Topic	Context
Signalization for bikes	Dan Goodman mentioned signalization as a topic that State DOTs might be interested in.
Speed approaches for bikes	Dan Goodman mentioned speed approaches as a topic that State DOTs might be interested in.
Multimodal network approaches and multimodal infrastructure design	Dan Goodman saw this as a key topic for dissemination and thought it would be especially useful for State DOTs.
Intersection design and protected intersections	Dan Goodman observed protected intersections when he visited. Dutch protected intersection design is incorporated in an FHWA manual on multimodal networks.
Systemic safety approaches	Dan Goodman identified system safety as a key potential webinar topic.
Simplification in the roadway design process	Identified by Dan Goodman as a potential webinar topic.
Water and permeable pavements	Amy Plovnick mentioned that permeable pavements were a focus on her site visit. There has been a webinar for subject matter experts to share information. The Dutch, Amy noted, are intentional about the "relationship between water management strategies and multimodal design."
Co-benefits of active transportation in relation to policy	Dan Goodman noted that the U.S. has "a lot to learn" from the Netherlands on the co-benefits of active transportation.
Transit station bike parking	Dan Goodman briefly mentioned as something we could learn from, and that has already been incorporated in FHWA materials.
Road Safety collaboration: • **Action prediction models** • **Highway Safety Model** • **Dutch investment scenarios for safety**	Mike Culp noted that several topics were discussed in a Road Safety collaboration, and there have been follow-up video conferences on several topics.

Topic	Context
• **Rumble bars** • **Barriers** • **Billboard distraction**	
Low-stress bike networks	Dan Goodman mentioned this topic as something we have learned from the Netherlands, and that has been included in FHWA design guides.
Adaptation pathways	Amy Plovnick and Robert Kafalenos mentioned this topic as something we have learned and incorporated in our approach to resilience. Amy Plovnick noted it is a concept that is interwoven into documents but may not be worth a standalone dissemination plan.
The use of climate data	Mike Culp noted that we have learned from the Dutch about how to use climate data.
Nature-based resilience strategies	Amy Plovnick mentioned this topic and noted that FHWA is working with North Carolina and Washington State DOTs.
Bikeway selection	Dan Goodman mentioned this as a topic we have learned and has been covered in FHWA guides.

Table 5. Summary of Key Findings from Japan Discussion.

Topic	Context
Seismic design	Seismic design knowledge exchanges have been a significant success of the program. Seismic design topics have been covered in the earliest workshops as well as the most recent ones. Ken Leonard suggested sending surveys out to State and local agencies to ask about their seismic technologies and then follow up with information that could help with addressing gaps. Many topics also fall into the seismic design category.

Topic	Context
Corrosion and durability	Infrastructure in Japan and the U.S. is starting to age. The countries were experiencing similar issues in corrosion and durability, so recently, the exchanges have focused on those topics. The participants identified this topic as a key success of the program.
Unmanned Aerial Systems, drones, and other advanced infrastructure monitoring systems	The participants identified this topic as an important takeaway that the U.S. is interested in.
Scorecards from design and retrofitting methods for seismic or hurricanes	Jerry Shen noted that this is a topic of interest that the U.S. would like to learn more about. This topic seems to be at an early stage of learning.
Accelerated Bridge Construction (ABC)	The most recent workshop with Japan emphasized ABC. Through that workshop and other exchanges with Japan, the U.S. has learned about Japan's ABC technologies and incorporation of seismic design in ABC. The U.S. has applied these methods in the development of seismic design guidelines in prefabricated bridge columns and piers. There have been many cooperative research efforts on seismic design, including "A Comparative Study of U.S.-Japan Seismic Design of Highway Bridges" (2003). (*This information comes from the Binational Brief*).
Fragility/performance data	Jerry Shen mentioned that it is difficult to find sufficient field data to validate existing fragility methods or to produce reliable empirical fragility curves. He identified this topic as a topic of interest. This topic seems to be at the early stages of learning.
Infrastructure resilience	The most recent workshop discussed infrastructure resilience. Participants identified resilience as a topic of interest.
Deterioration and maintenance	Jerry Shen identified this topic as a topic of interest.
Geo-seismic and landslides	Jerry Shen identified this topic as a topic of interest.
Bridge management and asset management	Jerry Shen identified this topic as a topic of interest. This topic has been covered in past workshops and will be covered in future workshops.

Topic	Context
Lessons from recovery efforts	This was identified as another potential dissemination opportunity. Through recovery efforts and reconnaissance missions, the U.S. has learned about isolation bearing, steel bridge piers, and emergency planning lessons (Binational Brief and Synthesis Report of U.S.-Japan Bridge Workshops).
Discussion summarizing what we do and do not know	Participants suggested a webinar that summarizes what we have learned about seismic design in bridges and what we do not know yet.
Connected and automated vehicles	OIP could follow up with Hannah Raikoff at Volpe, who would be able to share meeting notes on automated vehicles for the last five or ten years. OIP could also follow up with Jonathan Walker or Kate Hartman, who might be able to share some of their successes with pilot activities and deployment of connected vehicles – lessons we could learn for the deployment of international technologies.

Table 6. Summary of Key Findings from Korea Discussion.

Topic	Context
Unmanned aerial systems (UAS)/drones	Khalid Mohamed mentioned that past workshops had discussed drones. Christy Pook-Atkins noted that there is variation between States in applications of drones, and it is important to understand elements of privacy and the different uses of these technologies, like assisting with an inspection. Robert Kafalenos added that another related topic of interest is the use of UAS for geohazard data collection and surveying. Through a 2015 workshop with Korea, the U.S. learned about Korea's automated inspection and monitoring technology, which is used on expressway structures. Steve Kern noted that “remote inspection of bridges allows for more consistent reporting.” This technology includes the Ubiquitous Bridge Inspection Robot System. This remote monitoring system has now been adopted in the U.S. (Synthesis Report of the FHWA and the MOLIT Knowledge Exchange).

Topic	Context
	Lori Porreca noted that it is not clear what the U.S. can learn from Korea at the moment with regard to UAS.
Anchoring systems	Khalid Mohamed noted that past workshops had discussed anchoring systems, which are very different in the U.S. and Korea. Korea uses smaller systems with a cross profile.
Debris flow - design, construction, and assessment and analysis approach	Khalid Mohamed noted that the U.S. and Korea have similar debris flow issues. Korea uses custom, site-specific approaches for catching debris. Khalid also noted that the U.S. could benefit from evaluating other strategies used in Korea. It may be at an earlier learning stage.
The impact of climate change on infrastructure – design changes and ITS-AVs	Al Logie noted that Korea's work on climate change impacts, specifically design changes and intelligent transportation systems/autonomous vehicles (ITS-AV) (no further detail provided), could be worth dissemination.
Triangular compactor in pavement construction	Al Logie noted that it could be helpful to disseminate information about the use of triangular compactors in pavement construction. The technology did not originate in Korea, but Al noted that Korea uses it because it "uses less water and can reduce construction costs by 50 percent." It has not been disseminated widely in the U.S.
Segmental bridge construction	Al Logie noted that we have learned about segmental bridge construction from Korea.
Low-impact development	Khalid Mohamed identified low-impact development technologies as a topic the U.S. could benefit from exploring further. It does not seem ready for dissemination
Noise barriers	Khalid Mohamed identified noise barriers as a topic the U.S. could benefit from exploring further. Noise barriers are different in the U.S. and Korea. It does not seem ready for dissemination.
Pavement management systems and how to develop better models to estimate performance of pavements	Christy Pook-Atkins identified pavement management systems as a priority topic: discussing models for estimating the performance of pavements.

Topic	Context
Adaptation of Green Roads engineering	Khalid Mohamed said that this topic could be informative but is not yet at the dissemination stage.
Automated bridge/infrastructure health inspection + real-time monitoring technologies / strategies.	Khalid Mohamed and Robert Kafalenos both mentioned Korea's monitoring systems for bridge flooding and bridge joint repairs. Korea uses different technologies than the U.S. Some elements may be ready for dissemination. Binational Brief: Through the U.S.-Korea program, the U.S. has learned structural health monitoring (SHM) and nondestructive evaluation (NDE) technologies for bridges. SHM/NDE technologies support the U.S. in designing, constructing, and maintaining long-span bridges.
Strategies to prioritize projects, including social impacts	Christy Pook-Atkins identified this as a topic of interest but did not seem ready for dissemination.
UAS	OIP could track Khalid Mohamed's active work on UAS and expected webinars on this topic; investigate leveraging this effort.

Table 7. Summary of Key Findings from Sweden Discussion.

Topic	Context
Multimodal, integrated planning	Shari Schaftlein noted that the U.S. has learned a lot from Sweden about packaging and promoting integrated multimodal planning, rather than isolating one mode at a time. This topic includes Complete Streets and Complete Trips. This topic is potentially ready for dissemination.
Vision Zero, focusing on State DOTs and successful case studies	Multiple scans, including the 2003 "Managing and Organizing Comprehensive Highway Safety in Europe" scan in Sweden, the U.K., the Netherlands, and Germany, have shaped the United States Department of Transportation approach to safety (GBP Benefits Report).

Topic	Context
	At the moment, State DOTs are looking for examples of leadership to look to and enhance their safety policies. The participants shared a Sweden Vision Zero presentation that included topics such as: focusing on vulnerable road users, using automation and digitalization for safety, leadership, and coordination to achieve results, multisectoral approaches, integrating road safety with other relevant sustainability aspects, and road safety culture. This topic is ready for dissemination. Mike Griffith discussed the potential for a webinar with Sweden and other countries to share lessons learned, challenges, and successes with the Vision Zero approach.
Successful case studies of implementation of Swedish sustainability and mobility concepts	Shana Baker pointed out that it can be important to get local planners to see successful case studies of the lessons we have learned from Sweden on mobility and sustainability – such as the Atlanta Beltline or Navy Yard. The topic is potentially ready for dissemination but may have already been covered extensively.
Gender equity in the context of Complete Streets, bicycle mobility, etc.	Shari Schaftlein noted that the European Union as a whole is actively working to incorporate gender equity considerations into mobility planning.
Freight sustainability	Shari Schaftlein pointed out that there was a 2016 webinar about sustainability and freight. Sweden was trying to figure out how to efficiently locate and move their freight – integrating freight mobility, sustainability, and climate efforts. At that time, Sweden was very far ahead in terms of freight sustainability.
Multimodal transportation centers that serve biking, walking, mobility-on-demand, transit, etc.	Shari Schaftlein noted that this is a topic the U.S. could benefit from learning more about.

Table 8. Summary of Key Findings from Switzerland Discussion.

Topic	Context
Electrically isolated tendons (EIT)	Through a 2019 Global Benchmarking Program study, the U.S. learned of Switzerland's electrically isolated tendons (EIT) technological advances. A webinar is planned to disseminate some of those practices. The U.S. has implemented a demonstration project in Pennsylvania. This topic already has dissemination efforts planned for it. There is an upcoming webinar on EIT. February 25, 2021. https://connectdot.connectsolutions.com/sr500xglobal/
Ultra-high performance concrete	The Swiss have more advanced technologies for ultra-high performance concrete (UHPC) for bridge deck overlay. Benjamin Graybeal, FHWA Team Leader, Bridge Engineering Team, noted that the Swiss have been developing these technologies for over a decade, so the U.S. can learn from the Swiss on this topic. This topic is part of the U.S.-Swiss work plan.
Training for PT installers, non-destructive evaluation technologies for PT structures, and innovative connections for steel-concrete composite bridges	The work plan lists other innovations Switzerland has made advances in that the U.S. would like to learn more about. It is unclear if there would be enough information at this point for a webinar.
Workplan	The U.S.-Switzerland work plan has more details about the specific interests of the U.S. and the state of practice in Switzerland for these technologies.
Webinar	-

Table 9. Summary of Key Findings from OIP Discussion.

Topic	Context
Long-span bridges (Korea and Japan)	Steve Kern mentioned that there have been several exchanges related to long-span bridges with Korea and Japan. We have learned a lot from them, but Steve did not know the status of dissemination.
Remote inspection of bridges (Korea and Japan)	In the last 5–7 years, remote inspections of bridges have emerged as a key topic of interest. Steve Kern does not know how much this topic has been disseminated. This topic was covered in other discussions.
Advances in Intelligent Transportation Systems (Japan)	Agnes Velez noted that the U.S. was interested in ITS and developed a relationship to stay updated with Japan’s work. Now there are exchange personnel involved in this work, and the U.S. receives a report once per month on regulation updates, best practices updates, etc. Some elements may be ready for dissemination. *See Japan for contacts on this topic.*
Infrastructure performance (the Netherlands)	Steve Kern noted that for the past four to six years, the U.S. has been working with the Netherlands on the topic of infrastructure performance. Each country has been developing parallel tools, and there is now a pilot in each country. Steve Kern indicated that this topic has not been well disseminated. Michael Culp has been involved in this project.
Vision Zero (Sweden)	Participants identified Vision Zero as a key takeaway from OIP programs. *See Sweden discussion for more details.*
Freight topics – truck parking, managing freight on highways (Australia)	Steve Kern noted that Australia's freight topics, including truck parking and managing freight on the highways, have not been widely disseminated. The 2017 Australia Synthesis Report includes a lengthy list of topics that have been discussed through webinars.

Topic	Context
Approach to bridges and seismic issues (Japan)	Agnes Velez noted that the U.S. Geological Survey, not FHWA, has been working with Japan on Shake Alert technology. This information could be useful because it can bring a new perspective to people who are not in the immediate work environment.
Infrastructure resilience (the Netherlands)	Steve Kern noted that infrastructure resilience work in the Netherlands could be a useful topic to disseminate. As such, the topic is potentially ready for dissemination, but it would be important to determine if this is a priority among practitioners.
Fixed firefighting systems (Japan)	Steve Kern noted that fixed fire suppression in tunnels could be a useful topic to disseminate. These systems “have shown to have tremendous benefit,” according to Steve, but it would be important to determine if this is a priority among practitioners.
Asset recycling (Australia)	Steve Kern noted that asset recycling is an important topic that has not received much attention in the U.S. Australia has worked extensively on this topic. (Notes say Australia, but reports focus on Austria, so this may have been a typo).
Mobility (GBP)	Hana Maier noted that there was a recent GBP study on mobility. The findings were not widely disseminated because it was not a priority from the administration.

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