United States Department of Transportation
FY 2018
Annual Modal Research Plan

Federal Transit Administration
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Executive Summary

The Federal Transit Administration (FTA) is pleased to provide this FY 2018 annual research plan, which describes statutory requirements, research programs, sub-programs, program objectives, major activities, and, expected outputs, outcomes, impacts. FTA's mission is to improve public transportation for America's communities, and its vision is that America has a world-class public transportation system with access and mobility for all. In support of this mission and vision, FTA's research program drives public transportation innovation by funding projects in a four-phase research-to-practice pipeline process, as required in Public Transportation Law (49 U.S.C. § 5312):

1. **Research** – develop and deploy new and innovative ideas, practices, and approaches.
2. **Innovation and Development** – improve public transportation systems nationwide to provide more efficient and effective delivery of public transportation services, including through technology and technological capacity improvements.
3. **Demonstration and Deployment** – enable early deployment and demonstration of innovation in public transportation that has broad applicability, including low- or no-emission vehicle deployment.
4. **Evaluation and Implementation** – analyze project results and plans for broad-based implementation of innovative findings.

FTA's research vision is that innovative projects and partnerships promote mobility, enhance safety, improve infrastructure, and promote economic competitiveness. Thus, FTA's research mission is to advance public transportation innovation by leading research, development, demonstration, deployment, evaluation, and implementation practices and technologies that enhance effectiveness, increase efficiency, expand quality, promote safety, and, ultimately, improve the transit rider experience. This FY 2018 Annual Modal Research Plan (FTA-AMRP) builds upon ongoing strategic planning activities that will result in a four-year FTA Research Strategic Plan. The FTA-AMRP anchors FTA's activities within statutory and U.S. Department of Transportation (DOT) goals to promote safety, drive innovation, and improve infrastructure. Within these goals, FTA research includes three associated programs: Safety, Mobility Innovation, and Infrastructure. A fourth research program is statutory and cross-cutting; the Transit Cooperative Research Program (TCRP) is a public transportation cooperative research statutory program authorized at $5M annually with oversight through an independent governing board.

FTA's research programs directly enhance DOT's goals in the following ways:

- Safety – improve safety of the nation's transportation system.
- Infrastructure – develop better capital asset management, improve operational costs, and reduce congestion through asset innovation.
- Mobility Innovation – increase quality of life in communities through new service models that effectively and efficiently leverage public and private assets.

Each FTA research program has positive impacts across multiple DOT goals; however, each has a primary goal, as reflected in the table below, with TCRP activities crossing all DOT goals.

FTA Research Program Alignment with US DOT Goals

USDOT Goals	Promote Safety	Improve Infrastructure	Drive Innovation
FTA Research Programs			
Safety	✓		
Infrastructure		✓	
Mobility Innovation			✓
Transit Cooperative Research Program (TCRP)	✓	✓	✓

A significant component of FTA's research initiatives are partnerships, which are the major drivers for implementation of research findings. Key organizational research-to-practice partners include research institutions, training partners, non-profit partners, national transportation associations, university transportation centers, transit agencies, state agencies, technical assistance partners, and international partners. FTA's research implementation activities include collaboration with other US DOT modal administrations, including the Federal Highway Administration (FHWA), the Joint Program Office (JPO), the National Highway Traffic Safety Administration (NHTSA), and the Federal Motor Carrier Safety Administration (FMCSA). FTA works with the National Academies' Transit Research Board (TRB), the Volpe National Transportation Systems Center, and the American Public Transportation Association (APTA) to support various standards discussions. The National Academies provide assistance with strategic planning and research prioritization by hosting the Transit Research Analysis Committee (TRAC). To achieve an understanding of how promising research outcomes, translate into practice, demonstration grantees often are state and local agencies that test innovative approaches to public transportation capital investments, operational enhancements, rider mobility programs, and safety initiatives.

Cross-Modal Collaboration

Automation

Partnership activities may revolve around subject areas that cross modes in specific DOT areas of focus, such as Automation. FTA is engaged with other US DOT modal administrations in pursuing automated vehicle research via a weekly Automation Modal Coordination Meeting. This forum allows US DOT modes to communicate the status of current automation research activities and to coordinate and collaborate on future planned activities. A growing number of transit agencies are showing interest in automating some aspects of transit operations, with the goal of improving mobility and safety. The potential benefits of transit vehicle automation include avoiding collisions, lowering operational costs, improving service frequency and flexibility, and enabling new service models. Automated vehicles (AVs) are vehicles in which at least one element of vehicle control (e.g., steering, speed, braking) occurs without direct driver input. FTA is developing a comprehensive Strategic Transit Automation Research Plan with objectives to (1) define a research and demonstration framework for automation in transit, (2) offer a means for the transit industry to communicate its needs and concerns regarding automation to FTA, (3) identify a list of specific deliverables such as transit automation use cases, and (4) provide an instrument to capture issues relating to policy and program for FTA.

The focus of this AMRP is on transit bus operations, with "bus" defined broadly to consider a range of passenger capacities as well as traditional and novel rubber-tire vehicle designs. The plan is due for completion in Fall 2017; in the interim, FTA identified some early key research topics to pursue:

- Transit Bus Applications of Light and Commercial Automation Technology – "technology transfer" exercise examining existing technologies that could be transferred to transit applications.
- Knowledge Transfer – development of technical assistance materials for transit stakeholders interested in adopting automation.
- Transit Automation User Acceptance Study – examination of operator and passenger acceptance of automation in specific use cases.
- Automation Policy Review – review of federal, state, and local rules, regulations, and policies relating to automation affecting public transportation.
- Test Facility Requirements Development – as automation in transit will require testing in key areas such as safety and effectiveness, this element defines parameters to review and capabilities to be required. For instance, FTA will examine what changes might be needed in the statutory bus testing program and FTA-funded bus testing facility.
- Transit Automation High-Priority Use Case Demonstrations and Evaluations – support of demonstrations focusing on practical applications of a service model or technology.

Other Cross-modal Collaboration Areas of Focus

Other cross-modal collaboration areas are Intelligent Transportation Systems (ITS) research, Mobility on Demand, and the Accessible Transportation Technology Research Initiative

(ATTRI). Safety projects are coordinated closely with FTA's Office of Safety and NHTSA. FTA also connects with other Federal agencies and laboratories, providers of public transportation, private firms, non-profit organizations, and technical/community colleges to achieve FTA's research goals.

Appropriate Federal Role in Research

An essential element of the AMRP is FTA's appropriate Federal role in transit research. Although there are private, public, governmental and non-governmental industries and academic organizations that conduct transit research throughout the United States, FTA alone has the responsibility for addressing national public transportation research from a Federal perspective in accordance with Public Transportation Law. FTA's Federal role is to tackle issues that may be too complex and long-term for individual agencies or private sector companies to absorb the risk of testing new approaches. Federal research seed funding is often a catalyst to incentivize the research, demonstration, and deployment continuum across both public and private sources for key research areas. Federal research should respond to industry needs and anticipate beyond the industry to see how public transportation should evolve when the arena within which agencies operate is changing. Additionally, Federal research should assist the industry in managing positive change. As an operating administration of the US DOT, FTA commands the level of financial and technical resources necessary to assume the risks and uncertainties inherent in testing new approaches. FTA resources provide economic incentives to spur private investment.

Section 1 – Program Descriptions, FY 2018

FY 2018 RD&T Program Funding Details

FTA RD&T Program Name	FY 2018 Pres. Budget $000	FY 2018 Basic $000	FY 2018 Applied $000	FY 2018 Development $000	FY 2018 Technology $000
Mobility Innovation	9,000		1,000	8,000	
Infrastructure	8,000		1,000	7,000	
Safety	6,000		1,500	4,500	
TCRP	5,000		5,000	0	
Totals	28,000		8,500	19,500	

FY 2018 RD&T Program Budget Request by Critical Transportation Topic Area

RD&T Program Name	FY 2018 Pres. Budget $000	PROMOTING SAFETY $000	IMPROVING MOBILITY $000	IMPROVING INFRASTRUCTURE $000	PRESERVING THE ENVIRONMENT $000
Mobility Innovation	9,000		9,000		
Infrastructure	8,000			5,000	3,000
Safety	6,000	6,000			
TCRP	5,000	1,000	2,000	1,000	1,000
Totals	28,000	7,000	11,000	6,000	4,000

Mobility Innovation

$9,000,000

Program Description:
FTA's Mobility Innovation research seeks to strengthen the capacity of transit agencies and communities as they navigate the dynamic, evolving landscape of personal mobility. Demonstrations under the Mobility Innovation area will explore innovative business models and partnerships for enhanced mobility options, improve travel decision tools, and enable access to convenient and seamless travel and fare payment options and include many opportunities for important research. Beginning with FTA's Mobility on Demand Sandbox (2016), FTA will begin the process of clearly identifying many of these issues and paving the way for future innovative research and demonstration.

The definition of mobility continues to evolve dramatically with the rise of new multimodal concepts, traveler needs, and emerging technical capabilities. These fundamental changes in the way transportation services are offered also influence the form of our communities. Options such as mobile way-finding, bicycling (and bike-sharing), on-demand ridesharing, and autonomous vehicles mean that mobility options will alter the nature of public transportation. The traditional transportation split between public transit and the personal automobile will give way to a traveler-centric mobility portfolio offering seamless service through peer auto-sharing schemes, on-demand taxi trips, demand-responsive paratransit, and other innovative transportation methods.

Program Objectives:
The overarching objectives of FTA Mobility Innovation research is to engage in advanced research and innovation, encourage the development of complementary and supplemental mobility options, and improve the overall experience for public transportation travelers, all leading to the adoption of new, integrated, multimodal mobility options by public and private transportation providers. Mobility Innovation research will focus on the following objectives:

- Improve transit operations and reduce costs by leveraging public and private assets and technologies.
- Improve personal mobility by identifying and promoting seamless transportation models that engage all modes, public and private, for enhanced mobility for all travelers.

Anticipated Program Activities:

1. **Mobility on Demand (MOD)** – The goal of this effort is to provide travelers with enhanced mobility options, improved travel decision tools, and convenient and seamless travel and fare payment and develop innovative new operational models for transit agencies, such as solutions for first/last mile and transportation options that leverage private transportation investments/assets and improve service quality. FTA is working with MOD stakeholders to improve the transit industry's awareness and support readiness for MOD, and MOD research also seeks to identify and understand impediments to implementation. MOD projects help to increase the buy-in from local stakeholders and transportation companies/vendors needed for successful deployments of integrated public and private MOD solutions.

2. **Transit Automation Research** – This research will develop and employ automation use case scenario analysis to identify and review vehicle automation technologies, including a plan for future transit automation development and demonstration projects.
3. **Accessible Transportation Technologies Research Initiative (ATTRI)** – The purpose of this initiative is to improve the mobility of travelers with disabilities through the use of ITS and other advanced technologies and extend those benefits to improve accessible transportation for all travelers; the program leverages recent advances in vehicle, infrastructure, and pedestrian-based technologies, as well as accessible data, mobile computing, robotics, artificial intelligence, object detection, and navigation.
4. **Integrated Payment System** – This effort will integrate payment options for transit agency and other mobility providers at the regional and interregional levels to increase a seamless traveler experience, thus improving system wide mobility efficiency and performance.
5. **Small Business Innovation (SBIR)** – The aim of this effort is to stimulate technological innovation, use small business to meet federal research and development (R&D) needs, encourage participation by minority and disadvantaged businesses in technological innovation, and increase private sector commercialization of innovations derived from federal research and development objectives.

Expected Program Outcomes:
FTA's Mobility Innovation research is expected to:

1. Improve transportation efficiency by promoting agile, responsive, accessible, and seamless multimodal service inclusive of transit through enabling technologies and innovative partnerships.
2. Increase transportation effectiveness by ensuring that transit is fully integrated and a vital element of a regional transport network that provides consistent, reliable, and accessible service to every traveler.
3. Enhance the customer experience by providing each individual with equitable, accessible, traveler-centric service, leveraging public transportation's longstanding capability and traditional role in this respect.
4. Achieve greater personal mobility choices through a 10% annual increase in the number of public transit agencies that expand service coverage (geographic or temporal) by collaborating with alternative shared mobility solutions and public private partnerships.

Collaboration Partners:
FTA collaborates closely across the Department on mobility projects, especially with the Joint Program Office, the Volpe Center, and the FHWA's Turner-Fairbank Highway Research Center. External partners include the APTA, Transit Center, Booze-Allen-Hamilton, and the Community Transportation Association of America (CTAA).

How Program meets Statutory Requirements:
A Federal Public Transportation Law research goal is to improve the mobility of people and goods, and FTA's Mobility Innovation program is directly focused in this important area. In addition, the Public Transportation Innovation program (49 U.S.C. § 5312), FTA's research authorization, specifically notes that providing more effective and efficient public transportation

service and mobility management and improvements to travel management systems are eligible projects areas.

Describe how public and stakeholder input have been utilized in the development of this research program:
FTA is continuing the Mobility Innovation research program based on significant outreach activities such as internal FTA leadership briefings and staff discussions, a public online dialogue with 462 registrants and an accompanying webinar, a two-day meeting of TRAC and a resulting letter report, and feedback on trends from the Center for Urban Transportation Research (CUTR). TRAC noted that mobility is an important area of research and should be expanded.

Infrastructure (formerly Asset Innovation and Asset Management) ($8,000,000)

Program Description:
FTA has a long history of asset innovation work specifically related to vehicle technologies and supporting cleaner technologies and more efficient operations. A new statutorily-required low and no emissions component testing program will provide critical information to reduce negative environmental impacts and improve operational efficiencies. FTA conducts research on and demonstrations of zero-emission vehicles, facilities, and technologies to identify innovative and sustainable uses of transit vehicles and services. This program directly develops and deploys technologies that reduce the energy consumption and greenhouse gas (GHG) emissions of transit systems. Maintaining a diverse fleet infrastructure while also improving and understanding the effects of transportation activities on operations and the natural environment continues to require additional research.

Program Objectives:
FTA's focus on infrastructure to improve asset management and drive asset innovation is expected to:

- Improve lifecycle maintenance by evaluating methods, products, approaches, and practice to develop products or service more efficiently.
- Enhance the environment by providing mechanisms for mainstreaming and determining performance specifications for low- and no-emission transit bus components through university-based laboratory testing.
- Improve the build and project approval process.
- Stimulate economic growth.

Anticipated Program Activities:

1. **Asset Management and Asset Innovation** – FTA will demonstrate the "health" monitoring of transit assets using advanced technologies, including sensors and the use of innovative construction techniques and new materials such as nano-particles, recycled polymers, and composites. Major advances have occurred in sensor technology, including strain gauges and unmanned vehicles (drones), increased processing power, and data analytic tools such as hand-held field devices to make real-time health monitoring of fixed and moving infrastructure/assets a viable alternative or complementary to existing visual inspection.

2. **Advanced Propulsion Research** – With the goal of furthering the commercialization of zero-emission vehicles, FTA will evaluate its previously-funded low- and no-emission demonstration programs to better assist both grantees and the industry with capital equipment selection. In addition, FTA will begin a five-year program of testing and certifying a range of components specifically for use on low- and no-emission transit buses.

Expected Program Outcomes:
Expected outcomes of FTA's Infrastructure research will be the ability of transit agencies to:

1. Extend the useful life of infrastructure by 5% annually.
2. Reduce infrastructure lifecycle maintenance costs by 5% annually.
3. Reduce service time for electric buses by 5 percent annually.
4. Improve the cost/benefit for electric buses by 5% annually.

Collaboration Partners:
FTA collaborates closely with other agencies and external partners, including the private sector bus manufacturing industry. Key partners are the Volpe Center, APTA, and the National Renewable Energy Lab (NREL).

How Program meets Statutory Requirements:
This program directly focuses on the Federal Public Transportation Law research goal of improving infrastructure by improving the durability and extending the life of transportation assets and preserving the environment. In addition, its enabling statute specifically notes a number of eligible projects associated with infrastructure, including the deployment of low- and no-emission vehicles, zero-emission vehicles, or associated advanced technology.

The FTA Bus Testing Program is a statutorily-required program (49 USC § 5318) that provides independent evaluation of new transit bus models and previously-tested bus models being produced, with major changes in the areas of maintainability, reliability, safety, performance (including braking performance), structural integrity, fuel economy, noise, and emissions. It ensures that the highest-quality buses are procured annually, using more than $8B in Federal capital funds.

Describe how public and stakeholder input have been utilized in the development of this research program:
FTA prioritized its Infrastructure research based on significant outreach activities that included internal FTA leadership briefings and staff discussions, a public online dialogue with 462 registrants and an accompanying webinar, a two-day meeting of TRAC and a resulting letter report, and feedback on trends from CUTR. TRAC noted that FTA has invested heavily in this area and suggested harvesting the findings from the ~$100M in demonstration programs by focusing on research to practice and dissemination once projects are completed.

Safety
$6,000,000

Program Description:
The heightened statutory focus on the safety responsibilities of FTA, along with high-profile transit safety events, led to specific new and renewed research initiatives in areas such as increasing safety culture with transit workers, track monitoring through new technologies, advanced technologies to reduce vehicle collisions, improving safety through vehicle design of human/machine interfaces, and ways to support the development of safety management systems. The effective implementation and maturity of the Safety Management System (SMS) framework will depend upon a robust research strategy at the state and national levels. In addition to supporting FTA's SMS initiatives, research plays an important role in helping transit agencies function within the SMS structure and its functional components: safety management policy, safety assurance, safety risk management, and safety promotion. The type of research methods used in FTA's Safety research program and corresponding outcomes can support agencies in setting forth appropriate safety policies and procedures by identifying effective safety practices and principles, determining whether transit agencies are implementing recommended practices, and evaluating the impact of those practices on transit safety. Regarding safety risk management, research that identifies emerging hazards and evaluates their associated risks can help agencies formulate controls to reduce or eliminate hazards that present the highest level of risk. Safety is central to public transportation and to FTA's research mission.

Program Objectives:
As the steward of the nation's public transportation system, FTA is obligated to provide the resources necessary for safe, efficient, and effective operations for transit customers, employees, and others through safety regulation. The goals of FTA's Safety research program are to improve public transportation safety and support its regulatory role as well as its responsibility to develop a safety oversight framework. The safety program's objectives are to improve public safety by reducing transit-related injuries. and fatalities, increase safety events, and improve system reliability. Specific objectives of projects funded under the program are the following:

1. Operate systems in a safer manner through improved:
    a. Safety culture
    b. Human factors
    c. Application of advanced technologies and the accompanying practices
2. Reduce injuries and fatalities associated with:
    a. Improve worker safety
    b. Improve rider safety

Anticipated Program Activities:
1. **Safety Demonstration Program** – This program seeks to fill the gap in the current portfolio of safety demonstration projects started under the Innovative Safety, Resiliency, and All-Hazards Emergency Response and Recovery (SRER) Program. SRD builds upon a portfolio of demonstration projects that assist transit agencies to 1) improve operational safety, 2) strengthen infrastructure resiliency, and 3) improve the state of good repair for

transit assets. Key aspects of SRD focus on demonstrating innovative bus transit collision avoidance technologies and rail transit right-of-way worker safety technologies.

2. **FTA Standard Development Program** – This program focuses on safety standards development, working in concert with public transportation industry organizations, and is a follow-up to the FTA Safety Standards Strategic Plan project. Program tasks include a) conducting additional research on any standard determined to be inadequate and in need of modification or enhancement, b) conducting additional research on any standard that needs to be modified to be applicable to transit, c) developing standards for gaps identified by existing research, d) expanding and re-establishing partnerships with industry Standard Development Organizations (SDOs) or other standards development workgroups directed by FTA leadership, and e) conducting additional research, data collection, and economic impact analysis on possible safety standards for rulemaking or voluntary adoption.

Expected Program Outcomes:
Safety research demonstrates the feasibility of innovative solutions and technologies to improve the safety of transit operations. Through this program, agencies share their successes (reduction in number of crashes, fatalities, and injuries) to help other agencies adopt promising practices. Specific anticipated outcomes include the following:

1. Achieve a 2% annual increase in the demonstration and deployment of innovative practices or technologies at transit agencies.
2. Increase the adoption of a safety management systems approach by ensuring State Safety Oversight (SSO) Certification federal goals are met each year.
3. Promote the adoption of employee safety reporting systems across the US and the use of data to improve transit agency safety policies and practices.

Collaboration Partners:
FTA collaborates closely with external industry partners to promote safety. Key partners are the Volpe Center, APTA, and CUTR.

How Program meets Statutory Requirements:
A Federal Public Transportation Law research goal is to promote safety in a variety of ways, including using technology. In addition, the Public Transportation Innovation program statute specifies safety improvements as a project area.

Describe how public and stakeholder input have been utilized in the development of this research program:
FTA is continuing its Safety research program based on significant outreach activities that included internal FTA leadership briefings and staff discussions, a public online dialogue with 462 registrants and an accompanying webinar, a two-day meeting of TRAC and a resulting letter report, and feedback on trends from CUTR. TRAC noted that safety research should always be a significant area of focus due to the importance of ensuring the safety of public transit systems for employees and riders.

TCRP
$5,000,000

Program Description:
TCRP is a cooperative agreement through the National Academy of Sciences to carry out research activities in public transportation. TCRP selects research projects recommended by an independent governing board of public transportation stakeholders. TCRP's mission is to promote, select, and conduct research and disseminate research findings to improve the practice and performance of public transportation. Its governing board plays a critical role in suggesting public transportation research, development, and technology transfer activities that further the effectiveness, efficiency, and quality of public transportation.

Program Objectives:
TCRP research is conducted in a variety of transit fields, including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices. Key objectives include:

1. Lead and complete research that is consistent with and supportive of FTA's strategic research goals and TCRP strategic priorities through a process guided by a broad group of industry stakeholders.
2. Support the growth and continued excellence of the nation's public transportation infrastructure to meet the mobility, environmental, safety, and energy objectives of public transportation systems.
3. Solve operating problems, help public transportation adapt to new technologies, meet service area/frequency needs, and introduce innovations into the transit industry; field approaches to research that are local, problem-solving in nature, and able to easily transfer into useful practice in to public transit providers and to the broader transportation industry.

Anticipated Program Activities:

1. Twice yearly, requests are issued for research problems and synthesis statements. The TCRP Oversight and Project Selection (TOPS) committee meets twice annually to discuss, identify, and prioritize research needs and selects approximately 15 problem statements.
2. Selected statements are developed by TRB staff, the TCRP project panel, and FTA liaisons collaboratively into requests for proposals and are released to solicit bids to carry out the research. Proposal submissions are evaluated, winning proposals are selected, and a project panel oversees the applied research product to offer insights, guidance, and feedback. Publish final results on the TRCP website.
3. Expert technical panels are appointed and guide the research.
4. Research reports and findings are published, disseminated, and promoted.

Expected Program Outcomes:
Since its inception, TCRP has produced more than 600 publications for the public transportation industry. The engagement inherent in TCRP studies brings together the transit industry, interested stakeholders, and the public, thereby creating various communities of practice. This reinforces partnerships, promotes experience sharing, and strengthens relationships among transit

general managers and agency staff, who collaborate on project panels. TCRP is a trusted and enduring forum for the transit community to share ideas and best practices to improve public transportation in communities across the country. Key outcomes for TCRP are to:

1. Enhance the transit customer travel experience by identifying ways to increase customer satisfaction, improve access to transportation options, expand service time/geography, and connect to life activities.
2. Help transit take advantage of technology and integrate affordable and sustainable technology solutions that improve transit service quality in mobility, accessibility, operations, and community access.
3. Increase the effectiveness and efficiency of public transportation through identifying processes and methods that support continuous improvement in public transportation industry services, safety, asset management, and operations.

Collaboration Partners:
Hosted by the National Academies, TCRP engagement links closely across DOT and the transportation industry. Within the National Academies, TCRP also collaborates across with Academies, especially with the Transportation Research Board and the National Highway Cooperative Research Program. The Office of the Assistant Secretary for Research and Technology (OST-R) is a key partner, as TCRP research often relates to multimodal research issues that OST-R may be coordinating. Additionally, as the dissemination partner for TCRP, APTA play a critical role in supporting TCRP research to practice.

How Program meets statutory requirements:
The Public Transportation Innovation program statute requires that the program is carried out through a cooperative agreement with the National Academies to manage TCRP at $5 million per year from FY 2016–2020.

Describe how public and stakeholder input have been utilized in the development of this research program:
The TCRP TOPS committee selects research topics that are submitted by a transparent public process.

Section 2 – Program Descriptions, FY 2019

FY 2019 projects build upon the programs and activities of FY 2018. Public transportation innovation research take years to achieve, thus specific program outcomes remain the same. However, in some cases program objectives were modified to ensure alignment within the August 17, 2017 FY 2019 Administration Research and Development Budget priorities. s

Mobility Innovation

Program Description:
FTA's Mobility Innovation research for FY 2019 will build upon the findings of FY 2018 activities to strengthen the capacity of transit agencies and communities as they navigate the dynamic, evolving landscape of personal mobility. Demonstrations under the mobility innovation area will explore innovative business models, partnerships, and private-sector technological tools and solutions for enhanced and seamless mobility options for all travelers. Further, demonstrations will complement emerging private-sector advancement in autonomous vehicle and mobility technology, potentially leading to job creation in new businesses and technologies, aligning with the White House R&D priory area of American Prosperity. The definition of mobility is dramatically evolving with the rise of transformative multi-modal concepts, public/private partnerships, traveler expectations, and emerging technical/technological capabilities. FTA's mobility innovation research also explores options to integrate flexible and customizable public transit improvements for enhanced mobility at a lower cost. The overarching goals of FTA's Mobility Innovation research are to examine the development and applicability of complementary and supplemental mobility options that enhance operational efficiency and the overall travel experience for public transportation riders, leading to the adoption of new, integrated, multi-modal networks of mobility choices through both public and private resources.

The definition of mobility continues to evolve dramatically with the rise of new multimodal concepts, traveler needs, and emerging technical capabilities. These fundamental changes in the way transportation service is offered also influence the form of our communities. Options such as mobile way-finding, bicycling (and bike-sharing), on-demand ridesharing, and a future that could include autonomous vehicles mean that mobility options, particularly in urban areas, will alter the nature of public transportation. The traditional transportation split between public transit and the personal automobile will give way to a traveler-centric mobility portfolio offering seamless service through peer auto-sharing schemes, on-demand taxi trips, demand-responsive paratransit, and other innovative transportation methods.

Program Objectives:
The overarching objectives of FTA's Mobility Innovation research are to engage in advanced research and innovation, encourage the development of complementary and supplemental mobility options, and improve the overall experience for public transportation travelers, leading to the adoption of new, integrated, multimodal mobility options by public and private transportation providers.

Mobility Innovation research will focus on the following objectives:

- Enhance transit operational efficiency and reduce costs by leveraging public and private assets and technologies.
- Advance personal mobility by identifying and facilitating speedy adoption of proven mobility solutions, partnerships, and business models from both the private and public sectors for enhanced mobility for all travelers.

Anticipated Program Activities:

1. **Mobility on Demand (MOD)** – to provide travelers with enhanced mobility options, improved travel decision tools, convenient and seamless travel, and integrated payment and to provide innovative new operational models to transit agencies such as solutions for first/last mile, better leverage existing investments, improve service quality. FTA's research is focusing on four areas: identifying MOD models; promoting transit industry's awareness of MOD; supporting preparedness for MOD; and understanding impediments to implementation – including regulatory barriers. The research will also increase awareness and buy-in from local stakeholders and transportation companies/vendors needed for successful deployments of integrated community MOD solutions.
2. **Transit Automation Research** – to develop and employ automation use case scenario analyses (analyses of how various types of users will interact with the system) to assess and prioritize vehicle automation technologies for public transit. Once the assessment is completed, then a plan for future transit automation development and demonstration projects will be developed.
3. **Accessible Transportation Technologies Research Initiative (ATTRI)** – to enhance the mobility of travelers with disabilities using Intelligent Transportation Systems (ITS) and other advanced technologies and to extend those benefits to improve accessible transportation for all travelers. This program leverages recent advances in vehicle, infrastructure, and pedestrian-based technologies, as well as accessible data, mobile computing, robotics, artificial intelligence, object detection, and navigation.
4. **Integrated Payment System** – to research and promote speedy adoption of integrated payment options for transit agencies and other mobility providers at the regional and interregional levels to facilitate and increase seamless traveler experiences and data availability, thus improving overall system wide mobility efficiency and performance.
5. **Small Business Innovation (SBIR)** – The aim of this effort is to stimulate technological innovation, use small business to meet federal research and development (R&D) needs, encourage participation by minority and disadvantaged businesses in technological innovation, and increase private sector commercialization of innovations derived from federal research and development objectives.

Expected Program Outcomes:

The expected outcomes of FTA's Mobility Innovation research will continue to be to:

1. Improve transportation efficiency by promoting agile, responsive, accessible, and seamless multimodal service inclusive of transit through enabling technologies and innovative partnerships.
2. Increase transportation effectiveness by ensuring that transit is fully integrated and a vital element of a regional transport network that provides consistent, reliable, and accessible service to every traveler.

3. Enhance the customer experience by providing each individual with equitable, accessible, traveler-centric service, leveraging public transportation's longstanding capability and traditional role in this respect.

Collaboration Partners:
FTA collaborates closely across the Department on mobility projects, especially with the Joint Program Office, the Volpe Center, and the FHWA's Turner-Fairbank Highway Research Center. External partners include APTA, Transit Center, Booze-Allen-Hamilton, and CTAA.

How Program meets Statutory Requirements:
A federal Public Transportation Law research goal is to improve the mobility of people and goods, and FTA's Mobility Innovation program is directly focused on this important area. In addition, Chapter 53 49 U.S.C. 5312, Public Transportation Innovation specifically notes that providing more effective and efficient public transportation service and mobility management and improvements to travel management systems are eligible projects areas.

Describe how public and stakeholder input have been utilized in the development of this research program:
FTA will continue its Mobility Innovation research program based on significant outreach activities that included internal FTA leadership briefings and staff discussions, a public online dialogue with 462 registrants and an accompanying webinar, a two-day meeting of TRAC and a resulting letter report, and feedback on trends from CUTR. TRAC noted that mobility is an important area of research, and one that should expand.

Infrastructure

Program Description:
FTA will continue to leverage findings in infrastructure/asset innovation, specifically related to vehicle technologies and supporting cleaner technology for FY 2019. FTA has a successful history of supporting transformative public transportation infrastructure research and demonstration projects to include those assets that are used to directly support and provide public transportation service. FTA's research focus has been to ensure that transformative innovations meet the public demand for safe and speedy adoption. FTA has applied this thinking to all research activities within the infrastructure research program to include zero emissions vehicles and related facilities, for example. At present, FTA conducts transformative research on and demonstrations of zero emission transit buses, facilities, and related charging and maintenance technologies that have been developed and tested by the private sector (fuel cells, lithium ion batteries) but have not yet been widely applied or adopted in the public transportation industry, aligning with the White House R&D priory area of Increasing Government Accountability and Efficiency by not duplicating efforts conducted by the private sector.

This Infrastructure research program promotes the development and deployment of technologies to reduce the energy consumption and GHG emissions of transit systems. Because operating funding is a continuing issue for transit agencies, maintaining a diverse fleet infrastructure while

also improving and understanding the effects of transportation activities on the natural environment continues to require additional research.

Program Objectives:
The focus on infrastructure to improve asset management and drive asset innovation will:

- Improve lifecycle maintenance by evaluating methods, products, approaches, and practice to develop products or service more efficiently.
- Enhance the environment by providing mechanisms for mainstreaming and determining performance specifications for low and no emission transit bus components through university-based laboratory testing.
- Improve the build and project approval process.
- Stimulate economic growth.

Anticipated Program Activities:

1. **Low- and no-emission component assessment program (LoNo-CAP)** – FTA competitively selected two university-based facilities to conduct assessments of low- and no-emission vehicle components intended for use in transit buses. The statutorily-required LoNo-CAP program supports FTA's investments to date of more than $100M in competitive funding to support the commercialization of low and no-emission buses and will provide critical information to reduce negative environmental impacts and improve operational efficiencies.
2. **Advanced Propulsion Research** – FTA will demonstrate "health" monitoring techniques of transit assets using advanced technologies to include sensors and the use of innovative construction techniques and new materials to include nano-particles, recycled polymers, and composites. There have been major advances in sensor technology to include strain gauges and unmanned vehicles (drones) and increased processing power and data analytic tools such as hand-held field devices to make real-time health monitoring of fixed and moving infrastructure/assets a viable alternative or complementary to existing visual inspection.
3. **Bus Testing** – With the goal of furthering the commercialization of zero emission vehicles, FTA will evaluate its previously funded low and no emission demonstration programs to better assist both grantees and the industry with technology transfer and capital equipment selection. In addition, FTA will begin a comprehensive program of testing and certifying a range of components specifically for use on low and no emission transit buses.

Expected Program Outcomes:
The outcomes of FTA's Infrastructure research will be the ability of transit agencies to:

1. Determine performance specifications and life cycle metrics for components.
2. Ensure that transit buses can withstand the rigors of daily revenue public transportation service.
3. Increase US manufacturing and economic competitiveness in the development and production of next generation transportation.

Collaboration Partners:
FTA collaborates closely with other agencies and external partners, including the private sector bus manufacturing industry. Key partners are the Volpe Center, APTA, and NREL.

How Program meets Statutory Requirements:
A Federal Public Transportation Law research goal is to improve infrastructure by improving the durability and extending the life of transportation assets and preserving the environment; FTA's Infrastructure research program is directly focused on these important areas. In addition, Chapter 53 49 U.S.C. 5312, Public Transportation Innovation specifically notes eligible projects associated with infrastructure, including the deployment of low- and no-emission vehicles, zero-emission vehicles, or associated advanced technology.

The FTA Bus Testing Program is a statutorily-required program (49 U.S.C. § 5318) that provides independent evaluation of new transit bus models and previously-tested bus models being produced, with major changes in the areas of maintainability, reliability, safety, performance (including braking performance), structural integrity, fuel economy, noise, and emissions. It ensures that the highest-quality buses are procured annually using more than $8B in Federal capital funds.

Describe how public and stakeholder input have been utilized in the development of this research program:
FTA will continue its Infrastructure research program based on significant outreach activities that included internal FTA leadership briefings and staff discussions, a public online dialogue with 462 registrants and an accompanying webinar, a two-day meeting of TRAC and a resulting letter report, and feedback on trends from CUTR. TRAC noted that FTA has invested heavily in this area, and going forward, suggested harvesting the findings from the $100+M in demonstration programs by focusing on research to practice and dissemination once projects are completed.

Safety

Program Description:
Safety is central to public transportation and will remain a major area of focus for FTA's research program in FY 2019. Previous research on safety culture and promising activities that promote safety will help agencies implement appropriate safety policies and procedures. As the steward of the nation's public transportation system, FTA is obligated to provide the resources necessary for safe, efficient, and effective operations for transit customers, employees, and others through safety research, innovation, and/or regulation. The nation's economy depends on a safe and secure public transit system for millions of Americans to get to work every day. FTA supports research on the safe and secure integration of new technologies into society that can potentially contribute significantly to American economic and technological leadership. The goals of FTA's Safety research program are to improve public transportation safety, support its regulatory role, and develop a safety oversight framework. The Safety program's goal is to improve public safety by reducing transit-related injuries, fatalities safety events, and system reliability. This area aligns with the White House R&D priory area of American Prosperity

Program Objectives:
The Safety research program's objectives are to improve public safety by reducing transit-related injuries and fatalities; increase the number of safety events; and improve system reliability (state of good repair). The specific objectives of projects funded under the program are to:

1. Operate systems in a safer manner through improved:
    a. Application of advanced technologies and innovative practices
    b. Safety culture
    c. Human factors
2. Reduce injuries and fatalities associated with:
    a. Innovative technologies to improve worker safety
    b. Innovative technologies to improve rider safety

Anticipated Program Activities:

1. **Safety Research Demonstration Program** –builds a portfolio of research projects that assist transit agencies to demonstrate new, innovative technologies in areas such as collision avoidance and worker safety. This program will add to the current portfolio of safety demonstration projects started under the Innovative Safety, Resiliency, and All-Hazards Emergency Response and Recovery (SRER) Program that focuses on (1) improving operational safety, (2) strengthening infrastructure resiliency, and (3) improving the state of good repair for transit assets.
2. **FTA Standards Development Program** –covers a variety of public transportation topics with current focus on safety standards development. This safety standards work is a product of the FTA Safety Standards Strategic Plan project. FTA is working with public transportation industry organizations in the development of voluntary safety standards. FTA's Standards Development Program tasks include a) modification and enhancement of existing standards, b) development of new voluntary standards, and c) expansion and re-establishment of partnerships with Standard Development Organizations (SDOs).

Expected Program Outcomes:
Safety research demonstrates the feasibility of innovative solutions and technologies to improve the safety of transit operations. Through this program, agencies share their successes (reduction in number of, fatalities, injuries and collisions) to help other agencies adopt these promising practices. Specific outcomes will:

1. Complete a comprehensive review of public transportation safety standards and establish Federal minimum public transportation safety standards for the industry, including the development of standards in other areas such as connected vehicles, automation, electric vehicles, charging infrastructure, etc.
2. Identify and suggest the adoption of standards that improve the visibility of new transit buses.
3. Promote the adoption of employee safety reporting systems across the US as well as the use of the data to improve transit agency safety policies and practices.

Collaboration Partners:
FTA collaborates closely with external industry partners to promote safety. Key partners are the Volpe Center, APTA, and CUTR.

How Program meets Statutory Requirements:
A Federal Public Transportation Law research goal is to promote safety in a variety of ways, including using technology. In addition, Chapter 53 49 U.S.C. 5312, Public Transportation Innovation specifies safety improvements as an eligible project area.

Describe how public and stakeholder input have been utilized in the development of this research program:
FTA will continue its Safety research program based on significant outreach activities that included internal FTA leadership briefings and staff discussions, a public online dialogue with 462 registrants and an accompanying webinar, a two-day meeting of TRAC and a resulting letter report, and feedback on trends from CUTR. TRAC noted that safety research should always be a significant area of focus due to the importance of ensuring the safety of public transit systems for employees and riders.

TCRP

Program Description:
The statutorily-required Transit Cooperative Research Program (TCRP) will continue in FY 2019 as a cooperative agreement through the National Academy of Sciences to produce early-stage applied research that prepares the U.S. public transportation workforce and transit providers to innovate. TCRP's mission is to promote, select, and conduct research and disseminate research findings to improve the practice and performance of public transportation. TCRP produces research reports across a broad spectrum of subject categories. An independent board comprising primarily public transportation executives selects projects to ensure that the research responds to the most pressing needs of the industry and stakeholders. Recent research reports address critical issues such as public private partnerships, value-capture financing, shared use mobility, rail transit safety, emergency response, and multiagency electronic fare payment systems. TCRP is a critical partner in both shaping and sharing information about FTA's public transportation innovation projects and is a key driver for moving research to practice. TCRP plays a unique role as a pooled national level resource for public transportation agencies whose operations are usually so lean as to make individualized research activities cost prohibitive. TCRP's ability to respond to common challenges of the highest urgency is ensured through high levels of public transportation executive representation on its TCRP Oversight and Project Selection (TOPS) committee. A unique characteristic of TCRP is that a panel of expert practitioners from the industry works with each private sector research contractor that develops research deliverables to ensure the work is actionable for "real-world" operations. The engagement inherent in TCRP studies brings together the transit industry, interested stakeholders, and the public. TCRP is a trusted and enduring forum for the transit community to share ideas and best practices to improve public transportation in communities across the country.

Program Objectives:
The scope of TCRP research includes a variety of transit research fields, including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices. Key objectives for TCRP include:

1. Lead and complete research that is of the highest priority for the public transportation and industry stakeholders.
2. Lead and complete research that supports FTA's strategic research goals and TCRP strategic priorities through a process guided by a broad group of industry stakeholders.
3. Support the growth and continued excellence of the nation's public transportation infrastructure to meet the safety, infrastructure, mobility, and energy objectives of public transportation systems.
4. Solve operating problems, help public transportation adapt to new technologies, meet service area/frequency needs, and introduce innovations into the transit industry
5. Field approaches to research that are local and problem-solving in nature and can easily transfer into useful practice in to public transit providers and to the broader transportation industry.

Anticipated Program Activities:

1. Twice yearly, requests are issued for research problems and synthesis statements. The TCRP Oversight and Project Selection (TOPS) committee meets twice annually to discuss, identify, and prioritize research needs and selects approximately 15 problem statements.
2. Selected statements are developed by TRB staff, the TCRP project panel, and FTA liaisons collaboratively into requests for proposals and are released to solicit bids to carry out the research. Proposal submissions are evaluated, winning proposals are selected, and a project panel oversees the applied research product to offer insights, guidance, and feedback. Publish final results on the TRCP website.
3. Expert technical panels are appointed and guide the research.
4. Research reports and findings are published, disseminated, and promoted.

Expected Program Outcomes:

Key outcomes for TCRP are to:

1. Enhance the transit customer travel experience by identifying ways to increase customer satisfaction, improve access to transportation options, expand service time/geography, and connect to life activities.
2. Help transit take advantage of technology and integrate affordable and sustainable technology solutions that improve transit service quality in mobility, accessibility, operations, and community access.
3. Increase the effectiveness and efficiency of public transportation through identifying processes and methods that support continuous improvement in public transportation industry services, safety, asset management, and operations.

Collaboration Partners:

Hosted by the National Academies within TRB, TCRP engagement links closely across DOT and the transportation industry. OST-R is a key partner, as TCRP research often relates to multimodal research issues that OST-R may be coordinating. Additionally, as the dissemination partner for TCRP, APTA play a critical role in supporting TCRP research to practice.

How Program meets statutory requirements:
49 U.S.C. 5312, Public Transportation Innovation, specifies a statutory requirement to fund, issue, and manage a cooperative agreement with TRB to manage TCRP at $5 million per year from FY 2016–FY 2020.

Describe how public and stakeholder input have been utilized in the development of this research program:
The TCRP TOPS committee selects research topics that are submitted by a transparent public process.