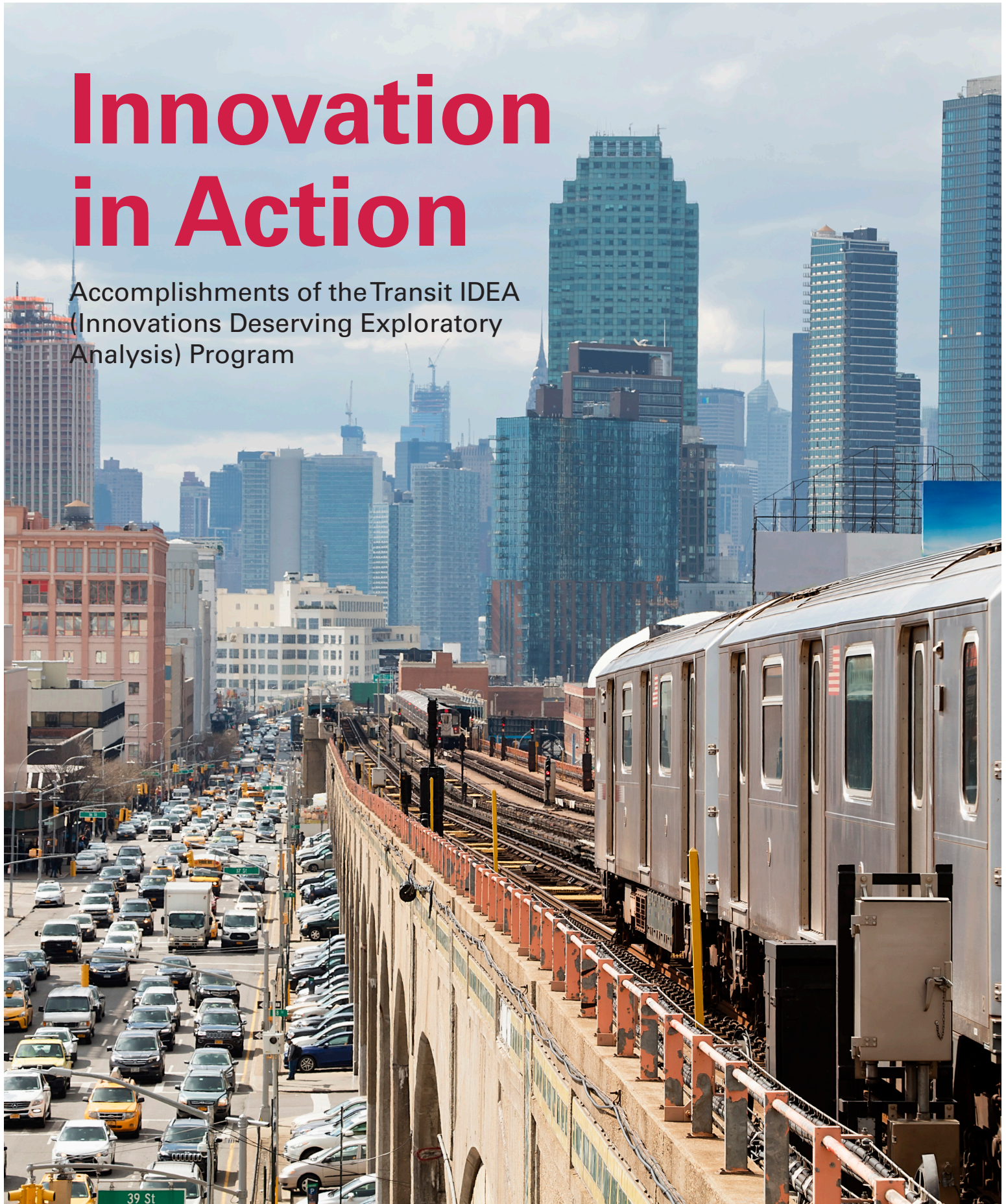


# Innovation in Action

Accomplishments of the Transit IDEA  
(Innovations Deserving Exploratory  
Analysis) Program



TRANSPORTATION  
RESEARCH BOARD

*The National Academies of*  
SCIENCES • ENGINEERING • MEDICINE



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# Transit IDEA Program Offers Innovators a “Chance to Take a Chance”

The nation's growth and the need to meet mobility, environmental, and energy objectives place high demands on public transportation systems. Current systems, some of which are old and in need of upgrading, must improve efficiencies to serve customer needs. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the public transportation industry.

To encourage innovative approaches to public transportation problems, the Transportation Research Board (TRB) administers the Transit IDEA (Innovations Deserving Exploratory Analysis) program, which is funded by the Federal Transit Administration (FTA) as part of the Transit Cooperative Research Program (TCRP). Since its inception in 1992, the Transit IDEA program has awarded over \$9 million in funds to researchers.

This visionary program—which aims to produce real-world, cutting-edge research every year—is a major milestone in the broader history of innovation in the public transportation industry.

The Transit IDEA program emphasizes new and unconventional approaches that could potentially produce significant advances in public transportation. Project topics cover a diverse range of public transportation types and services, and they may explore the feasibility of new technologies, applications, or processes; develop proofs of concept; or test the performance of prototypes in the field.

“

**The IDEA program is great. It does allow for creativity and innovation. There are not a lot of opportunities for that. It's a chance to take a chance.**”

—Phil Winters, Principal Investigator,  
Transit IDEA Project 52: Travel Assistance  
Device (TAD) to Help Transit Riders



TCRP's Transit IDEA Program  
awards up to **\$100,000**

...to **2 to 5** public transportation  
projects each year.



Since 1992, TCRP has  
received **787** proposals...

...and funded **97** innovations.

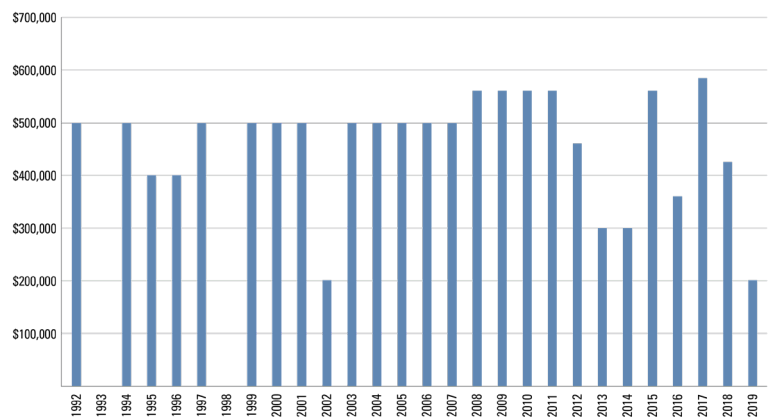


# Transit IDEA by the Numbers

## Program Budget

While the program's funding has varied, the budget has been at or above \$500,000 for 17 of its 26 funded years.

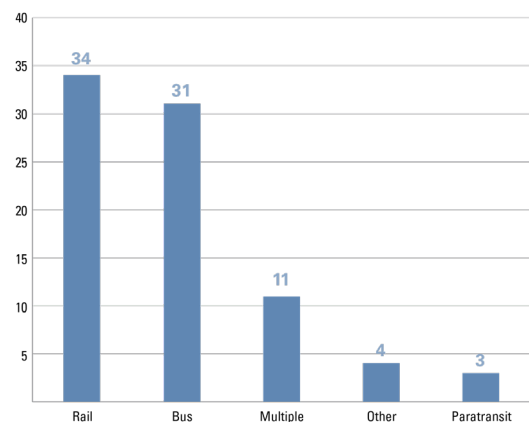
Program Budget by Fiscal Year (through 2019)



## Public Transportation Type

The program supports many types of public transportation projects, with rail and bus projects being most prevalent.

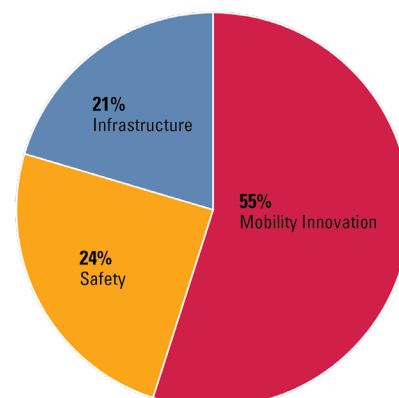
Projects by Public Transportation Type



## Research Areas

Transit IDEA projects align with the FTA and U.S. Department of Transportation's strategic goals related to research that improves transportation safety, mobility, infrastructure, and accountability—with many projects addressing multiple research areas.

FTA Research Area (through 2019)



# Priorities

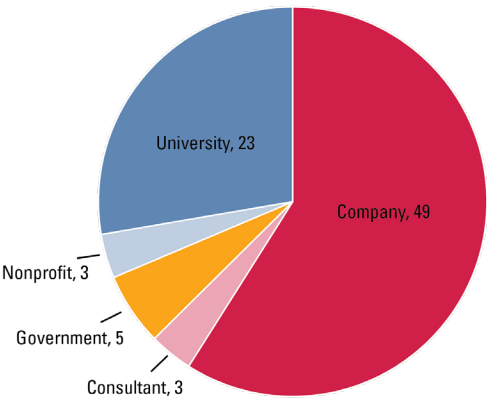
Regardless of topic, all projects must address at least one of the Transit IDEA program’s four high-priority focus areas.



# Innovator Affiliations

Principal Investigators come from diverse backgrounds, with more than 60 percent representing private companies.

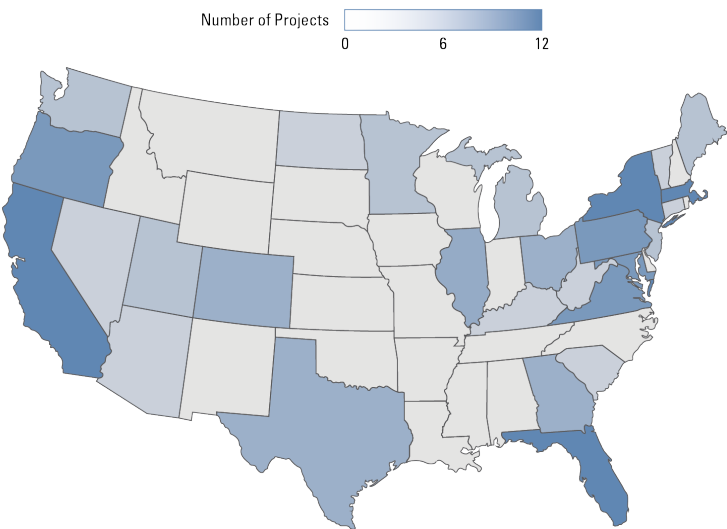
Principal Investigator Affiliations (through 2019)



# Locations

Project locations span the United States from coast to coast.

Transit IDEA Project Locations





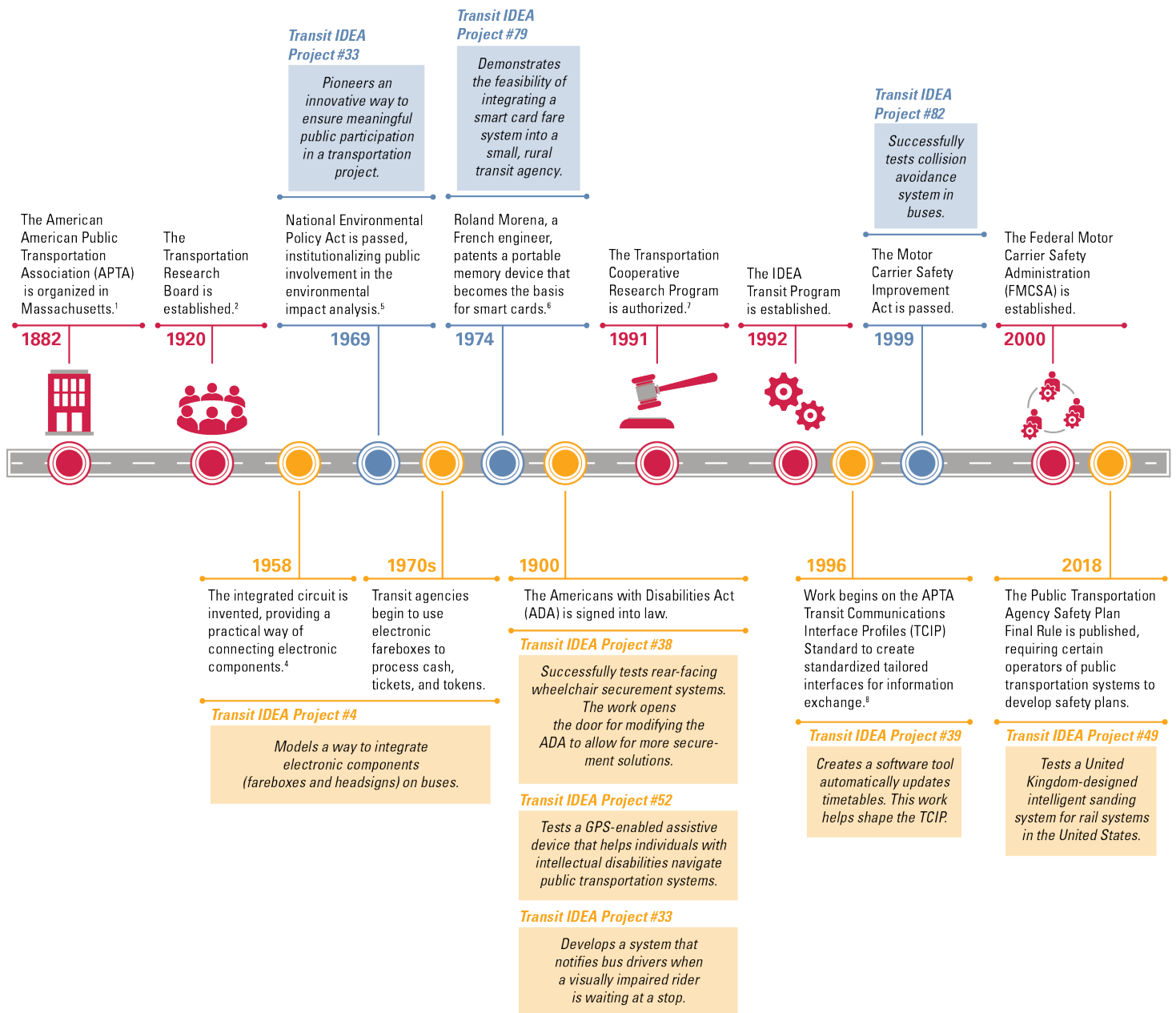
# Notable Innovations

By funding early-stage, high-risk, high pay-off research in public transportation safety and performance, the Transit IDEA program has paved the way for unexpected concepts to progress next-generation transportation technologies and methods. Read on to learn about just a few of the notable projects the program has funded over the years. These range from pioneering software applications to novel public participation approaches to devices that have helped make public transportation safer and more accessible to all riders.



# Milestones in Innovation

## How Transit IDEA Projects Have Contributed to Mobility, Safety, and Performance



<sup>1</sup> <https://www.apta.com/about/apta-history/>

<sup>2</sup> <http://www.trb.org/AboutTRB/AboutTRB.aspx>

<sup>3</sup> [http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp\\_rpt\\_43.pdf](http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_43.pdf), p. 7

<sup>4</sup> [http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp\\_rpt\\_43.pdf](http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_43.pdf), p. 7

<sup>5</sup> Slotterback, Carissa Schively. "Public Involvement in Transportation Project Planning and Design." *Journal of Architectural and Planning Research*, vol. 27, no. 2, 2010, pp. 144–162. JSTOR, [www.jstor.org/stable/43030901](http://www.jstor.org/stable/43030901).

<sup>6</sup> <https://www.nytimes.com/2005/08/10/world/europe/smart-card-invented-here.html>

<sup>7</sup> <http://www.trb.org/TCRP/AboutTCRP.aspx>

<sup>8</sup> US DOT, Federal Highway Administration, ITS Deployment Guidance for Transit Systems Technical Edition, April 1997, and <http://www.aptatcip.com/>



# Thinking Outside of the Farebox

Transit IDEA Project 4, 1994 to 1995

## Challenge

Bus fareboxes have come a long way. Historically, these devices were simply used to securely collect passengers' money. But once the boxes became electronic, they were also counting passengers. However, the quality of the count data was often poor, so that public transportation agencies couldn't use that count data for planning or monitoring performance.

## Solution

This project, headed by Principal Investigator Dr. Peter Furth at Northeastern University, assessed the benefits of integrating with other electronic devices buses, such as headsights. Headsights are changed every time a bus turns around to start a new trip; by passing that change of trip to the farebox, public transportation agencies can get passenger count and revenue information by route, trip, and direction, which is far more valuable for planning, scheduling, marketing, and service monitoring than simply a count of passengers per day.

How much of an impact did the project make? "It's hard to say," says Dr. Furth. "The trend in society toward having more technology and better integrated technology was there. But what this project demonstrated has absolutely happened. Fareboxes have been integrated with other devices, and people use passenger counts derived from fareboxes in a lot of transit agencies."

## Benefits

- More reliable data at a lower cost
- Eliminates the need to hire and train manual counters
- Provides key performance information on passenger counts and passenger miles
- Enhanced data for calculating loading standards, service monitoring, route planning, performance evaluation, operations, and marketing



*Headsights are just one of the onboard electronic devices on buses that can be integrated to generate valuable data.*

**I can't trace the line from my project to today. But there is a good chance the information helped public transportation agencies get more useful data out of their fareboxes.**



**Peter Furth,**  
Principal Investigator



# Ensuring Meaningful Input in Public Transportation Decisions

Transit IDEA Project 33, 2001 to 2003

## Challenge

Getting efficient and meaningful community input on important public transportation decisions can be difficult. Possible outcomes are often whittled down to just a handful of choices from which the public can choose, or public participation is relegated to an advisory committee. In either case, the public transportation agency loses valuable public input for the decision process.

## Solution

Two researchers who were then at the University of Kentucky, Dr. Ted Grossardt and Dr. Keiron Bailey, developed a novel approach to transform the public participation process. They termed this approach CAVE, short for Casewise Visual Evaluation, and used it to help the Transit Authority of River City in Louisville, Kentucky, design a new light rail facility.

Through a series of community focus groups, the research team presented visualizations of variations in the proposed facility's features, such as building type, open space options, height, and other variables. The community rated their preference for different features on a scale of 1 to 10. These numeric ratings were then matched up with the different features and applied to combinations of the features. According to Grossardt, the process not only "allows a community to evaluate 10 to 20 alternatives in a night," but enables "the team to gain an understanding of their preferences for up to 10 times that number of combinations. Thus, complex solution outcomes can be evaluated by large numbers of community members productively."

Many things can go wrong as transportation projects worth millions of tax dollars move from concept to reality. The voices of the people who benefit—and pay for such projects—are not always heard, or their input doesn't clearly inform the project team. The CAVE process has shown to be a successful approach for ensuring efficient and meaningful public participation. It has been used in a wide range of collaborative decision-support processes, including bridge design projects in Kentucky and Ohio, sound barrier design in Arizona, and integrated transportation and land use planning projects in Indiana and Kentucky.

## Benefits

- Greater public ownership on a project
- Improved agency understanding of the role and contribution of the community
- Enhanced agency credibility within the community
- Better quality of decision-making by agencies
- Improved community understanding of public transportation issues and decision points



Louisville residents take part in a community focus group to provide input on proposed transit authority features.

**We discovered that the public really desires and enjoys being productively involved in a planning or design decision.**



Ted Grossardt, Principal Investigator

# Securing Dignity and Safety for Wheelchair Users on Buses

Transit IDEA Project 38, 2003 to 2005

## Challenge

Transportation should be safe and dignified for everyone. However, the standard way of securing wheelchairs on buses uses a forward-facing belt system that can be invasive to passengers and difficult for drivers to use. Not only do such systems limit wheelchair users' freedom and independence, but they also increase the time a bus has to wait at a stop because they require driver assistance. Safety is also of prime consideration. With any kind of securement system, wheelchairs need to be stable and upright if a driver has to swerve to avoid an accident or make a sudden stop.

## Solution

In Europe and Canada, public transportation agencies use rear-facing systems that don't require the driver to secure the wheelchair, giving passengers a much-valued sense of autonomy. Wheelchairs are positioned where their movement is constrained by the side of the bus or an aisle side restraint.

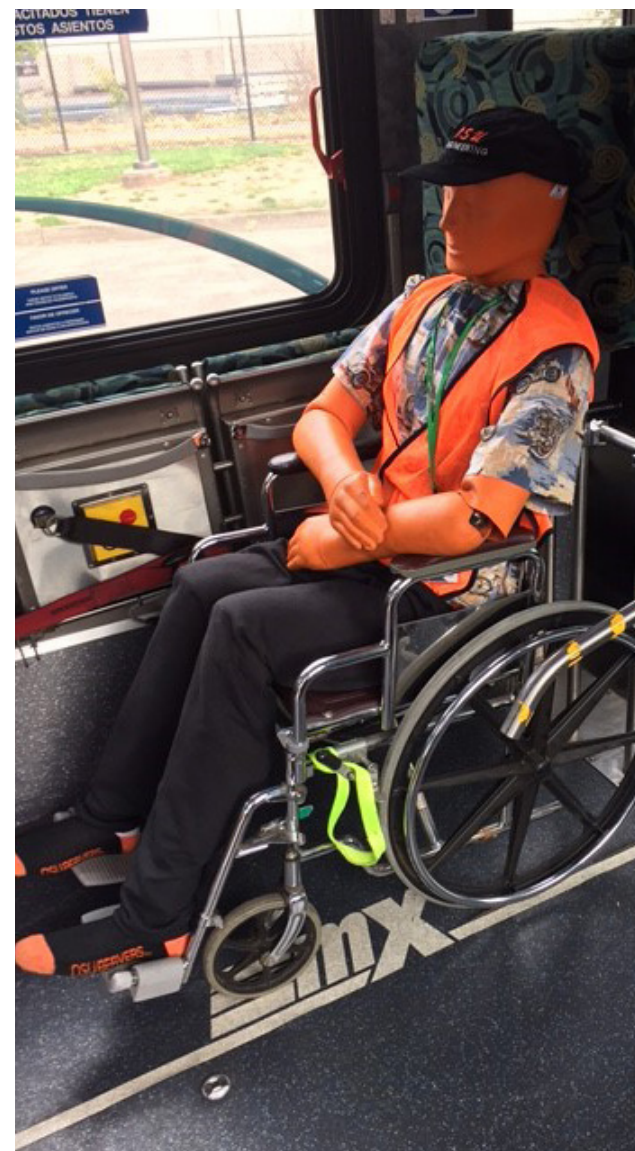
Principal Investigator Kate Hunter-Zaworski, with Oregon State University, was aware of the technology, having worked on the issue of accessible transportation for years. So, she led this project to evaluate rear-facing wheelchair securement on bus rapid transit (BRT), along with user response to the concept.

While the project found that rear-facing wheelchair securement can be successful, it must be paired with proper side containment features to prevent falls when a bus goes around a corner or stops suddenly. Riders also were enthusiastic. People wanted to travel independently and be rear facing. As Dr. Hunter-Zaworski observed, "Once they tried it, they liked it."

After the testing, Eugene implemented the technology, as did the Greater Cleveland Regional Transit Authority. Many other cities followed suit. Today, many BRT systems across the United States are using rear-facing wheelchair securement, and some are even migrating the system to light rail transit.

## Benefits

- More comfort, safety, and dignity for wheelchair users
- Fewer injuries
- Less dwell time for buses
- Operational flexibility



Crash dummy used in one of the rear-facing securement tests.

**We put our most precious cargo, our children, rear-facing in the back of a car for a very good reason.**



**Kate Hunter-Zaworski, Principal Investigator**



# Helping Public Transportation Agencies Keep Up with the Times

Transit IDEA Project 39, 2003 to 2006

## Challenge

Keeping timetables up to date is a universal challenge among public transportation agencies. Detours, special events, emergencies, and other unforeseeable circumstances can easily disrupt planned schedules, prompting the need to update timetables. But when information is not updated quickly enough, passengers are inconvenienced and may see the public transportation service as inefficient or unreliable.

## Solution

This project developed and tested the Dynamic Timetable Generator (DTG), a software tool that enables public transportation agencies to automatically update timetables—and share the information in a standard and consistent way. The main impetus for the tool were newly introduced industry standards, particularly the American Public Transportation Association's Transit Communications Interface Profile, which defined standardized mechanisms for information exchange in data formats among transit business systems.

"We knew [the standard] was a significant need in the industry because of the time it took to format timetables," says Polly Okunieff, Principal Investigator of the project. Before people can access timetable information from a website, mobile device, or other platform, the "raw" schedule data must first be ingested, processed, and visualized. The project team worked closely with organizations in three different cities representing varying sizes and types to build and test the DTG and then develop a strategy to make the tool freely available to public transportation agencies.

Ellwood Hanrahan of the New York State Department of Transportation, whose agency has used the DTG, sees a real need for more open source data tools, especially as public transportation agencies evolve their services and systems become more and more linked. As Hanrahan observes, people don't "care what transit agency you are, they just need to get there. How can we make travel more efficient?"

## Benefits

- Increased passenger convenience
- Added passenger satisfaction
- Less labor hours for public transportation agencies to update schedules
- Less need for specialized skills to keep timetables up to date



*The DTG enables public transportation agencies to automatically update their timetables, increasing passenger convenience and satisfaction.*

**The tools we used were advanced for their time; now they are standard issue.**



**Polly Okunieff, Principal Investigator**

# A Smart Solution to a Slippery Situation

Transit IDEA Project 49, 2005 to 2007

## Challenge

Trains must be able to brake effectively in slippery conditions. Without this ability, trains could overrun stations or crossings—with potentially catastrophic results. In addition, railways have to extend their schedules to accommodate longer braking times, which can create service delays and customer dissatisfaction. Plus, the strain of skidding can damage train wheels and rails, leading to costly repairs.

## Solution

The answer to solving this problem was an innovative technology located 3,000 miles away in the United Kingdom: an intelligent sanding system known as SmartSander. Realizing the potential to transfer the technology to other rail systems, SmartSander creator DeltaRail—led by Principal Investigator Graham Curtis—brought the technology across the pond for testing on U.S. commuter trains.

SmartSander uses a combination of input from the train driver (brake demand) and the train itself (speed, wheel-side activity) to sense when a train is skidding. It then applies a variable amount of sand underneath the wheels to allow them to grip the rail and stop efficiently while protecting track circuits.

The U.S. prototype was tested first with Metro-North, a commuter rail service that runs between New York state and Connecticut, and then with the Long Island Railroad. In all tests, SmartSander performed well. There was just one issue. Any equipment installed on a U.S. train has to be inspected and maintained every calendar day, adding a large cost and inconvenience. As a result, the technology is not being used in the United States. In the United Kingdom and Europe, however, the technology went from being a retrofit system, where it transformed the performance of older trains, to a standard fit on every train.

## Benefits

- Improved safety
- Improved punctuality
- Less train downtime
- Better performance and less wheel skidding
- Longer life for wheel bearings and suspension
- Operational flexibility



*The technology deploys a variable amount of sand to allow the wheels to grip the rail.*

**We set out to make SmartSander automatic so a train could sense itself that it was skidding and would apply sand underneath the wheels and brake. It made the train safer and reduced the number of times that wheels skidded.**



**Graham Curtis,**  
*Principal Investigator*



# Giving Public Transportation Riders a Helping Hand

Transit IDEA Project 52, 2007 to 2010

## Challenge

Mastering a public transportation system can be a daunting experience for new riders, especially for individuals with cognitive challenges. Some public transportation agencies use travel trainers to help individuals learn how to navigate a system, but not all agencies offer these services and even for those who do, the waiting list can be long.

## Solution

It often takes a champion to help solve a problem. In Tampa, Florida, that individual was Mark Sheppard. A travel trainer with Hillsborough Area Regional Transit, Sheppard knew firsthand the challenges people with disabilities face when using fixed route public transportation. At the same time, the Center for Urban Transportation Research and the Department of Computer Science and Engineering at the University of South Florida were developing cutting-edge mobile technologies for transportation applications. The Florida Department of Transportation put the researchers in touch with Sheppard.

The research team developed a travel assistive device that uses multimedia cell phones with built-in GPS to help riders navigate a public transportation system. They worked closely with Sheppard to test the device. Principal investigator Philip Winters explains how the technology works: “Informational prompts are delivered to the rider [using] a just-in-time method that triggers the phone to vibrate and deliver audio and visual messages when the rider should pull the stop cord and exit the bus.”

In 2018, the team integrated the technology into an open source project, OneBusAway, which provides real-time transit information. As part of this project, the researchers built in a feedback mechanism, so riders can provide a “thumbs up or down” to help them see how well the algorithm works and what can be done to improve it.

The OneBusAway software has been deployed by agencies in several U.S. and international cities, with the OneBusAway iOS and Android apps serving around 300,000 active users. In 2019, public transportation agencies, universities, and software developers created the nonprofit OpenTransit Software Foundation to serve as the organizational and legal home for OneBusAway. Together, they are helping to make public transportation easier to use—not only for people with special needs, but for anyone who needs help navigating a complex public transportation system.

## Benefits

- Increased public transportation ridership
- Decreased costs to the public transportation agency
- Increased independence for people with cognitive disabilities
- Improved quality of life for public transportation riders
- Increased productivity of public transportation agencies’ travel trainers



Mark Sheppard and one of his trainees test the original mobile app.



**Phillip Winters,**  
Principal  
Investigator

**Sean J. Barbeau,**  
Researcher



**A key output of this project is telling riders when to get off the bus. When you are on a vehicle traveling 40 miles per hour, you have to do things quickly. A 30-second difference can put you quite a way down the road.**

# Getting Smart About Fare Payments in Small and Rural Public Transportation Agencies

Transit IDEA Project 79, 2014 to 2015

## Challenge

Most of the nation's large public transportation agencies have adopted electronic smart card systems for fare payment that offer benefits ranging from improved customer satisfaction to better system efficiency. However, many small and rural agencies are still tied to manual, cash-based systems. The main hurdles? The complexity and price tag of most proprietary smart card options.

## Solution

The consulting firm Acumen Building Enterprise, Inc., set out to conduct the first-ever smart card fare payment system pilot in a rural agency by implementing the American Public Transportation Association (APTA) Contactless Fare Media Standards (CFMS). The CFMS standardizes the formats of the data and messages that smart card-based fare collection systems require, eliminating proprietary issues while providing interagency compatibility of fare payment systems.

Acumen teamed with Texas A&M University, the Yuma County Intergovernmental Public Transportation Authority, APTA, and Infineon Technologies to conduct the 90-day pilot in Yuma County, Arizona, which is small and isolated from large regional public transportation systems. A key benefits Acumen brought to the County, according to Walter E. Allen, Principal Investigator, was the ability for passengers to purchase and load fare products online.

Unfortunately, this feature was not well utilized during the short pilot span. Possible reasons include language barriers, lack of outreach, unbanked customers, and limited availability of public transportation agency staff to support the project. However, even with these hurdles, the project demonstrated that it is possible to implement the CFMS at a small, rural agency at a reasonable cost—suggesting that multiple agencies can replicate this success and be integrated into a common regional system. But for this to happen, Allen says, “We need more openness in systems and standards.” Small and rural public transportation agencies also need more resources and support to keep up with rapidly advancing technologies and address their own, unique mobility challenges.

## Benefits

- Increased passenger convenience and satisfaction
- Seamless transfers
- Higher security
- Less maintenance and environmental burden (cards last a long time)
- Reduced bus dwell time
- Improved data collection efficiency and quality



*Passengers on one of the Yuma buses that participated in the pilot testing.*

**There are 1,000 small or rural agencies in the United States that do not have an integrated card system. We aim to make that process easier.**



**Walter E. Allen**, *Principal Investigator*



# Saving Lives and Saving Money with Collision Avoidance Technology

Transit IDEA Project 82, 2016 to 2017

## Challenge

Driving accidents are impossible to avoid, and bus operators may be even more at risk than the average car driver. Not only can collisions be deadly, they also cost public transportation agencies millions of dollars in insurance claims from buses rear-ending other vehicles and hitting people.

## Solution

In 2017, Principal Investigator Jerry Spears was working at the Washington State Transit Insurance Pool, which insured more than three-quarters of the public transportation agencies in the state. He was seeing firsthand the large losses these agencies incurred. Seeking to reduce accidents and save lives, this project tested a collision avoidance warning system designed specifically for buses.

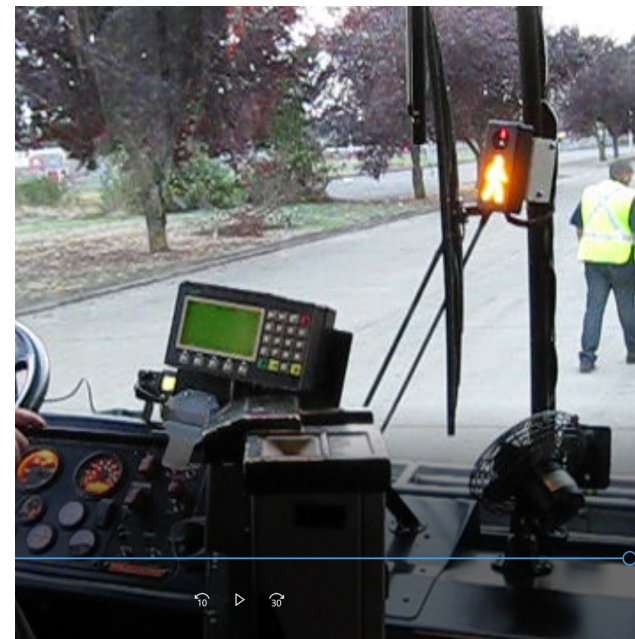
Over a three-month pilot, researchers tested the Rosco/Mobileye Shield+ system, which provides both visual and audible alerts and warnings to bus drivers for a number of conditions that could lead to a collision. In all, 38 buses were equipped, and eight public transportation agencies participated.

During the pilot, buses equipped with the Shield+ systems logged just over 350,000 miles and nearly 24,000 operating hours. None of the buses equipped with the technology were involved in a collision. In contrast, 10 collisions were reported on buses not equipped with the technology in the participating public transportation agencies. Although driver acceptance was mixed, there also were large reductions in near-miss events for the buses equipped with the Shield+ system.

The project examined the costs of collisions and the potential of the technology to reduce associated claims. The team estimated the technology could reduce vehicular claims by \$13 million and pedestrian claims by nearly \$7 million. Because of these promising results, more research and testing are under way. The researchers were also fortunate to garner the sponsorship of a public transportation agency for this research. As the study's co-author, Dr. Jerry Lutin notes, public transportation agencies are not necessarily set up to do research. "Safety has to come first. The logical place to get research done is through initiatives like the IDEA program. We need this kind of stimulus and funding."

## Benefits

- Less accidents
- Fewer fatalities
- Increased safety
- Reduction in insurance claims and lawsuits



A test run in Vancouver illuminates a pedestrian walking in front of the bus.

**We wanted to introduce some additional technology, essentially another pair of eyes, to help mitigate potential catastrophic events.**



**Jerry Spears,**  
Principal  
Investigator

**Jerry Lutin,**  
Researcher



# Looking Out for Riders with Visual Disabilities

Transit IDEA Project 85, 2017 to 2019

## Challenge

People with visual disabilities are highly functional but heavily dependent on public transportation, which is an essential service for getting to and from work and engaging in social functions. When it comes to using buses, a key challenge for these passengers is boarding the correct bus. How do you notify the driver that a visually impaired rider is waiting at a stop without jeopardizing anyone's safety?

## Solution

The answer is an advanced notification service—known as Artificial Intelligent—that alerts bus drivers when a rider with a disability is waiting at a stop, so the driver can help that person board the bus safely.

"The overall concept is simple to understand once it comes together," says Principal Investigator and LookingBus co-founder Yariv Glazer. "We have the smart bus stops that can detect the phones of people with visual impairments and retrieve their trip reservation. Then, they send alerts to relevant drivers letting them know that a person is waiting at a bus stop who is visually impaired and is trying to board."

In this way, the technology is looking out for everyone. It helps prepare drivers and gives visually impaired riders confidence that drivers will be ready for them.

The Capital Area Transit Authority (CATA) is working on installing the technology on about 100 vehicles in Lansing, Michigan. The first phase encompasses 300 bus stops, and the second phase will include 1,500 bus stops. The resounding feedback from the visually impaired community has been positive, says Lolo Robinson, Director of Marketing and Customer Experience at CATA. "They are happy that they are not a forgotten segment of our riders, that their voices have been heard."

For Glazer, the importance of this project cannot be understated. "I think there are many smarter people than me who should have done this a long time ago," he says. "We spent countless hours [of this project] searching for a system because we thought it must exist."

## Benefits

- Increased independence
- Increased confidence
- Improved service for people with disabilities
- Increased ridership
- Increased revenues



*LookingBus co-founder and CEO Nirit Glazer with the Governor of Michigan.*

**People with a visual impairment cannot drive. They must use public transport. The challenges they experience are because of their environment. It is the obligation of the community to fix the environment to make it work.**



**Yariv Glazer,**  
*Principal Investigator*



# Paving the Way for the Future of Public Transportation

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The past few decades of Transit IDEA projects have only scratched the surface of what the program envisions for the future of our nation's public transportation systems. In the years ahead, TCRP encourages inventors and innovators around the world to continue submitting promising, new ideas that have the potential to enhance the security of our transportation systems, increase ridership, improve efficiency for public transportation agencies, and protect the environment.

