DEVELOPMENT OF THE STAR PLAN

Scope of the STAR Plan

- Transit bus operations
  - "Bus" is defined broadly
    - Passenger capacities
    - Traditional and novel vehicle designs
  - Excludes rail and similar systems
  - Lessons learned from automation in rail, light-duty vehicles, commercial vehicles, and aviation considered
- Full range of automation (SAE Levels 1-5)
  - Does not include driver assistance systems without an automation aspect (e.g., driver warnings and alerts)

Development Process

Identify use cases

- Identify, analyze, and prioritize use case scenarios for automating transit bus operations

Engage stakeholders

- Interviews, workshops, and presentations

Develop a plan

- For future transit automation development and demonstration projects

Major Project Tasks

- Literature Review
- Risk/Barrier Assessment
- Stakeholder Engagement
- Benefit-Cost Analysis
- **Research Plan**

Transit Automation Use Cases

- Smooth Acceleration and Deceleration
- Automatic Emergency Braking and Pedestrian Collision Avoidance
- Curb Avoidance
- Precision Docking
- Narrow Lane/Shoulder Operations
- Platooning

Transit Bus Advanced Driver Assistance System (ADAS)
Technology Package 1

- Circulator Bus Service
- Feeder Bus Service

Automated Shuttle
Technology Package 2

- Precision Movement for Fueling, Service Bays, and Bus Wash
- Automated Parking and Recall

Maintenance, Yard, Parking Operations
Technology Package 3

- Automated First/Last-mile
- Automated ADA Paratransit
- On-Demand Shared Ride

Mobility-on-Demand (MOD) Service
Technology Package 4

- Automated Bus Rapid Transit

Automated Bus Rapid Transit
Technology Package 5

Key Findings

- The transit industry is increasingly interested in the potential applications and benefits of automation.
- Investment in automated transit application development and deployment has been relatively modest.
- Transit agencies face many potential barriers to automation (legal, financial, and institutional), in addition to technical challenges.
- Federal investment in transit automation can accelerate adoption.

Potential Risks

Safety and security	Operations & cost effectiveness	Passenger experience	Equity
• Software and hardware failures or limitations • Human factors • Security and cybersecurity considerations • Emergency response • Quiet operations and interactions with other road users	• Unplanned technology and transition costs • Workforce costs • Obsolescence • Costs of new service patterns • Congestion and emissions • Increased competition from other modes and transit providers	• Travel times and reliability • Convenience and access • Customer service • Ride quality, comfort, and privacy	• Payment • Accessibility • Service changes

Potential Barriers

Product availability	Labor relations & human resources	Financial constraints	Risk aversion
• Limited market size • Complex operational requirements • Certification	• Opposition from labor • Training and workforce needs	• Procurement • Buy America	• Risk aversion in some transit agencies

Potential Barriers (cont.)

Accessibility	Law, regulation, liability & insurance	Institutional capacity & planning	Interagency cooperation	Public opposition
• ADA compliance	• Need to update insurance policies, safety regulations, and state laws for automated vehicles	• Difficult to communicate internal business case • Possibly a lack of long-term planning resources	• Vehicle standards • Supporting infrastructure • Regional planning	• Privacy concerns • Equity concerns • Other policy concerns

Benefit-Cost Analysis

Objectives

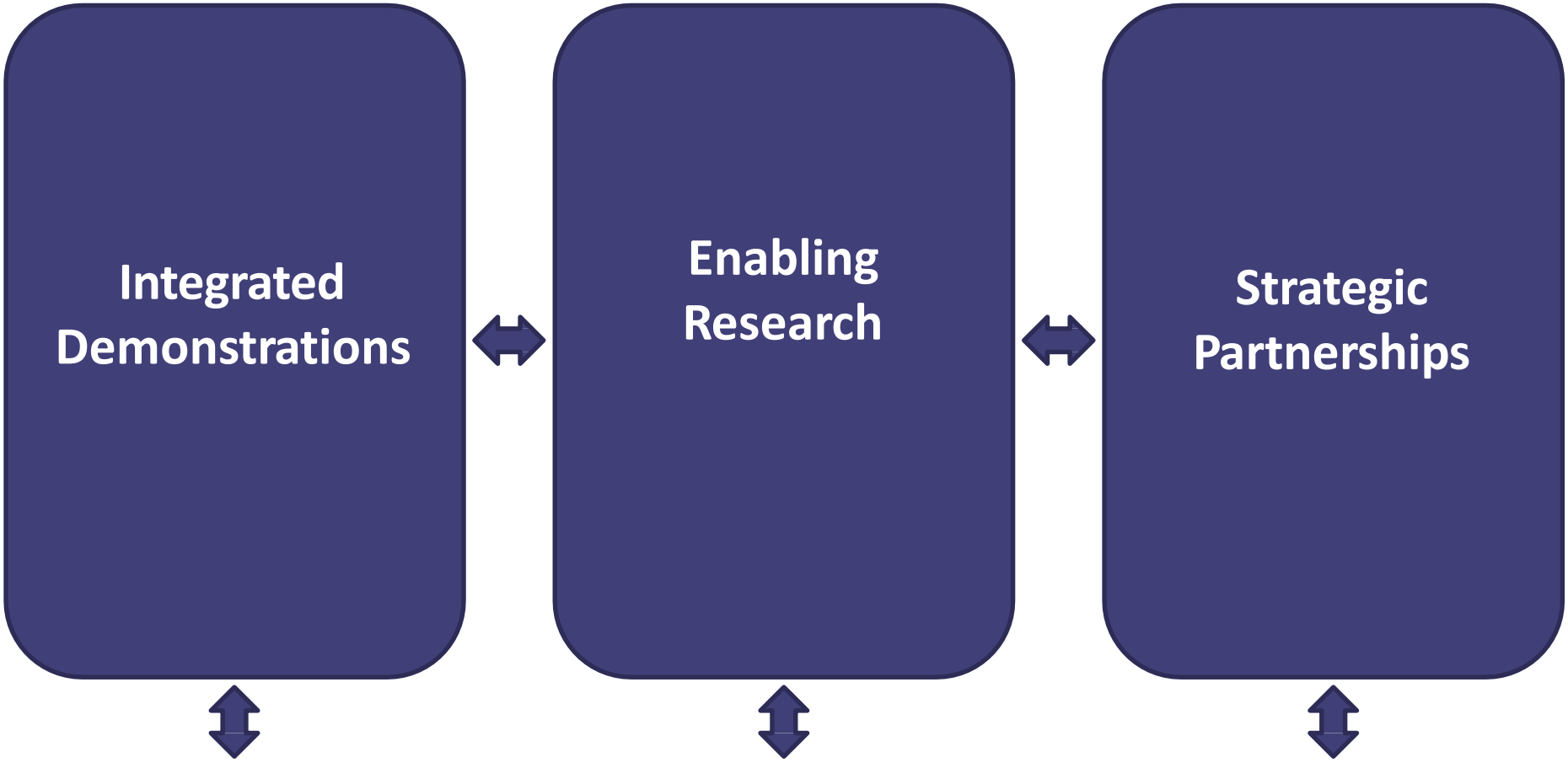
- *Build knowledge*: Extend research on five transit automation technology packages (use cases) to include info on benefits and costs
- *Gauge adoption prospects*: Assess the benefit-cost profile of the five packages from the perspective of transit agencies, as one indicator of likelihood of adoption
- *Identify research needs*: As part of the BCA process, identify data gaps and modeling needs in the area of transit automation

Benefit-Cost Analysis

Findings

- Business case for automation applications is highly influenced by specific characteristics of the transit service or facility
- Advanced driver assistance systems (ADAS) have a favorable investment profile
- More cost-effective to implement capabilities as a package than a single application
- Results suggest potential for significant cost savings for fully driverless shuttle vehicles, BRT, and ADA paratransit, but could be offset by need for onboard attendant

STAR Plan Work Areas



Strategic Transit Automation Research Roadmap

Work Areas	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY2022

Enabling Research

- Automation Policy Review
- Automation Policy Implementation
- Security & Customer Acceptance Implications
- Applications of Light & Commercial Vehicle Tech
- Business Case
- Standards Assessment & Coordination
- Finance Options
- Market Analysis for Buses & Supporting Systems
- Accessibility Analysis
- Transition Costs & Planning for Deployment
- User Acceptance Study & Human Factors Research
- Stakeholder Guidance Updates
- Labor Impacts Assessment
- Labor Impacts Evaluation
- Hazard & Safety Analysis
- Impact on Service Patterns & Users

Integrated Demos

- Demonstration Evaluation Guidance
- Demonstration 5: Automated Bus Rapid Transit
- Test Facility Requirements
- Demonstration 4: Mobility on Demand
  - 04A: Automated ADA Paratransit
  - 04B: Automated First/Last Mile
  - 04C: On Demand Shared Ride
- Automation Consortium Solicitation
- Demonstration 3: Maintenance, Yard, & Parking Operations
- Demonstration 2: Automated Shuttles
- Demonstration 1

Strategic Partnerships

- Vehicle Manufacturer Automation Partnership
- Additional Partnerships

Knowledge Transfer, Stakeholder Engagement, & Technical Assistance

FY18 Ongoing and Planned

Integrated Demonstrations

- Test Facility Requirements for Automated Transit Vehicles
- Transit Automation High-Priority Use Case Demonstrations and Evaluation
- Transit Automation Consortium Solicitation

Enabling Research

- Automation Policy Review
- Transit Bus Applications of Light and Commercial Vehicle Automation Technology
- Transit Automation User Acceptance Study and Human Factors Research
- Hazard and Safety Analysis of Automated Transit Bus Applications *(ITS JPO-funded)*

Strategic Partnerships

- Valley Metro Automation Pilot
- Additional Partners as Identified

Stakeholder Engagement, Knowledge Transfer, and Technical Assistance