HOW PUBLIC TRANSIT TIPS
THE SCALES IN THE
AUTOMATED VEHICLE FUTURE

DR. KARI WATKINS
ASSOCIATE PROFESSOR
GEORGIA TECH
What do we do?

Let’s start by defining the problem.
<table>
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<tr>
<th>Rank</th>
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<td>Unintentional Injury</td>
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<td>Diabetes Mellitus</td>
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<td>Influenza &amp; Pneumonia</td>
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<td>Diabetes Mellitus</td>
<td>Chronic Low Respiratory Disease</td>
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</table>

Safety

![Safety Chart](chart.png)

**Fatalities per 100,000,000 passenger miles**

- **Motor Vehicle**: 1.42
- **Commuter Rail**: 0.06
- **Transit Bus**: 0.05
- **Amtrak**: 0.03
- **Rail Transit**: 0.02

Source: APTA, 2011, Public Transportation Fact Book
The risk of obesity increases 6% with every additional hour spent per day commuting in a car.

When I say “Future of Transportation”, what do you think of?

How do you think we are planning to get around in 20 years?
Solutions:

Self-driving cars

TNC’s (Uber and Lyft)
Future of Transport
How can we ensure a livable and effective future transportation system?
All I really need to know I learned in Kindergarten

1. Share everything.
2. Play fair.
3. Don't hit people.
4. Put things back where you found them.
5. CLEAN UP YOUR OWN MESS.
6. Don't take things that aren't yours.
7. Say you're SORRY when you HURT somebody.
8. Wash your hands before you eat.
10. Warm cookies and cold milk are good for you.
11. Live a balanced life - learn some and drink some and draw some and paint some and sing and dance and play and work everyday some.
12. Take a nap every afternoon.
13. When you go out into the world, watch out for traffic, hold hands, and stick together.
14. Be aware of wonder. Remember the little seed in the Styrofoam cup: The roots go down and the plant goes up and nobody really knows how or why, but we are all like that.
15. Goldfish and hamster and white mice and even the little seed in the Styrofoam cup - they all die. So do we.
16. And then remember the Dick-and-Jane books and the first word you learned - the biggest word of all – LOOK.
Possible Autonomous Futures

1. Personal autonomous vehicle ownership
   – Typical driver only able to afford one vehicle - sized to maximize usefulness
   – Zero-occupant trips

2. Single occupant ride-hailing
   – Circling to wait for pick-ups
   – Passengerless delivery trips
   – Increased travel demand
     Dinner in Chattanooga?

3. Shared usage of mobility services
Future of Public Transport

1. If travel is a utility, then mobility must be a service

2. Spatial priority must be given to collective transportation modes

3. Focus first on service, then on technology

4. “Scientia potentia est” - knowledge is power
Future of Public Transport

1. If travel is a utility, then mobility must be a service
   – Seamless travel with collective transportation as the backbone
     • Best of high capacity public transportation for the bulk of travel distances
       – Travel collectively = system efficiency
     • Localized services for short trips and first-mile, last-mile connectivity
       – Individual needs for origin to destination
   – Mobility must be transformed to be seen more like a high quality utility
     • Connection from one service to another must be efficient and pleasant
     • Good information and minimal delay
Future of Public Transport

2. Spatial priority must be given to collective transportation modes
   – Transit + carpooling mixed with general traffic = no incentive to share
   – Exclusive right-of-way to collective transportation modes
     • HOV lanes, transit lanes, BRT must become the norm
     • Heavy rail versus bus has never been about steel vs rubber wheels
   – Spatial allocation for collective modes much more important with driverless vehicles
Future of Public Transport

3. Focus first on service, then on technology
   - Streetcar? Gondola? Hyperloop? Don’t chase technology
   - First create a connected, accessible transit network
   - Link major nodes with frequent service
   - Minimize number of modal transfers
Future of Public Transport

4. “Scientia potentia est” - knowledge is power
   – Use of technology and data to improve transit services has been far too slow for transit to compete
   – Information intense society
     • Inform customers in real-time
     • Open data kept updated
     • Service disruption alerts
     • Customer feedback mechanisms
Takeaways

• Many in industry are assuming driverless vehicles will automatically be shared
  - Little evidence to show this is true

• Individuals who are using space efficiently must receive priority over those who congest the network
  - Design for preferential right-of-way for transit
  - Price the travel of vehicles
Thank You!

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Shared Autonomous Shuttle Project
Feasibility Study and Capital Improvements

1. Phase I
Phase I

Feasibility Study:
- Description of technology
- Chamblee analysis
- Cost estimates
- Route alternatives
- Recommendations
- Next steps
Phase I

Peachtree Road Streetscape:
• Road diet
• Safety and operational improvements
• Future project – MARTA Mobility Hub
2. Phase II
Challenge Scope

Research:
• Ellen Dunham-Jones + Zach Lancaster – Best Practices Manual

Implementation:
• Stantec – Operations Plan
Research

Best Practices Manual:

- Study of how the prevalence of autonomous vehicles will alter user preferences (mode choice, commute distance, parking ratios) that will eventually impact land use patterns.
- Research into the user experience at existing and proposed SAV installations.
- Design of the mobility hub adjacent to the MARTA station.
- Proposals for retrofitting existing parking lots and garages to park fully autonomous fleets or for more intense redevelopment.
Implementation

Operations Plan:
- Project description and schedule
- Charging/Storage/Maintenance plan
- Routing and signage/signalization criteria
- Technology provider(s) and operations team and responsibilities
- Use case scenarios
- Testing and evaluation plan
- Funding (if applicable) and procurement of system/services
- Risk assessment and mitigation strategies
- Emergency response plan
- Licensing requirements
- Cost estimates
Route Analysis

Core Route:
• Peachtree Station to Broad Street

Extended Route:
• Broad Street to Assembly Yards
Chamblee Tucker Intersection

Required Improvements:

• Connected intersection
SAV Stops

Required Improvements:
• ADA concrete landing pad
• Sidewalk connectivity
• Signage
Operations

Peachtree Station - Assembly
Length = 2.1 miles

10 hour service day / 7 days / week

Single SAV (no spare) = 15-minute headway
Service Profile

- Commuter / Last Mile Service
- Leisure/Entertainment
- Hybrid
Estimated Cost to Implement

**Infrastructure Improvements**
$75,000 - $100,000
- Connected infrastructure
- Flashing beacon stop signs
- Benches
- Sidewalk connectivity
- Lane painting / signage

**Capital Expenditures**
- $10,000 - $35,000 (monthly lease)
- $250,000 - $425,000 (own)
  - Vehicle
  - Start up training & programming

**Annual Operating Costs**
$250,000 - $350,000
- Software licensing
- Insurance
- Maintenance
- Onboard attendant
- Program management
Next Steps

1. Stakeholder Buy-In: Support & Funding
2. Vehicle Vendor Evaluation: Determine which vehicle to purchase (2 months)
3. Manufacturer’s Site Review (1-3 weeks)
4. Manufacture Vehicle & Import (2-8 weeks)
5. Route Programming & Testing (1-2 weeks)
6. Operator Training (1 week)
7. Service Launch
Deployment

3. Phase III
USDOT Grant

- Significant Public Benefits
- Economic Vitality
- Complexity of Technology
- Diversity of Projects
- Transportation-challenged Populations
  - Last mile connectivity; rate of car ownership; vehicle and stop accessibility
- Collaboration
- Data
- Scalable
Partners + Supporters

• ATL
• GDOT
• ARC
• GTRI
• EasyMile
• Stantec
• CPL
• DeKalb County
• Senator Isakson
• Representative McBath
Data Collection

• Vehicle-level data for an AV shuttle operating at L4 in mixed traffic for safety analysis and rulemaking
• Test cases:
  • Weather conditions
  • Temporary construction zones
  • Vehicles or transit stopped in the travel lane
  • Vehicle collisions blocking the travel path
  • Pedestrians, cyclists, and other users
  • Other scenarios which will strain the current state of the art autonomous systems
• Understanding and recommending potential requirements for data and communications requirements to promote safer AV use on-road
Grant Schedule
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<th>Detailed Budget – Cost Share Totals</th>
<th>Costs</th>
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<td>Total Non-Federal Share</td>
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<tr>
<td>Total</td>
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<table>
<thead>
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<tr>
<td>Monitoring API</td>
<td>$35,000</td>
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<tr>
<td>3G/4G Plan</td>
<td>$6,000</td>
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<tr>
<td>Data Management subcontract</td>
<td>$1,200,000</td>
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<tr>
<td>Hardware equipment</td>
<td>$500,000</td>
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<tr>
<td>Additional Data Storage</td>
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<tr>
<td>Private Transport Operator</td>
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<tr>
<td>System Signage/information kiosks/stop amenities/furniture</td>
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<tr>
<td>Easements</td>
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<tr>
<td>Vehicle Storage/charging</td>
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<td>First responder vehicle pre-emption units/DSRC technology</td>
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<td>Marketing</td>
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<td>a. Total Federal Share</td>
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<td>c. Total Project Cost (a + b)</td>
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CTE Overview

- The Center for Transportation and the Environment (CTE) is a national 501(c)(3) non-profit that specializes in the development and deployment of clean, efficient, and sustainable transportation technologies.
- Since its start in 1993, CTE has managed a portfolio of over $530 million in team research, development, and demonstration projects.

CTE...

- Educates federal and state policymakers
- Assembles top-notch teams
- Writes winning proposals
- Oversees grant contracting, cash flow, and reporting
- Provides technical assistance to early adopters
- Manages technology demonstrations and deployments
CTE Activity Map
ADS Demonstration Grant Opportunity

- USDOT issued a Notice of Funding Opportunity (NOFO) on December 21, 2018 for up to $60M worth of grants for automated vehicle (AV) demonstration projects.

- “must be used for demonstration grants that test the safe integration of ADS (automated driving systems) into our Nation’s on-road transportation system”

- MARTA is the project’s lead applicant and prime recipient.

- 73 total applications representing diverse communities and public entities across the United States.

- Award announcements expected by June 21 (‘Spring 2019’).
# ADS Demonstration Grant Objectives

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<th>Goals</th>
<th>Focus Areas</th>
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<tr>
<td>1. Safety</td>
<td>1. Significant Public Benefit(s)</td>
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<td></td>
<td>4. Complexity of Technology</td>
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<td>5. Diversity of Projects</td>
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<td>6. Transportation-challenged Populations</td>
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<td>7. Prototypes</td>
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Project Summary

- The project would demonstrate two battery-electric buses outfitted with sensors, cameras, processing hardware, and software to support SAE Level 3+ automation.

- They would operate on an alignment between the College Park MARTA Station and the International Terminal at Hartsfield-Jackson Atlanta International Airport. This would be the world’s first airport AV demonstration on public roads.

- The on-board technology would be collecting and processing performance data during service, which will be reported to USDOT to inform policymakers on the technology’s safety applications.

- There will be a driver on board at all times during the demonstration to ensure safe operation of the vehicle, and to gather data on driver interaction with the technology.

- Depot charging infrastructure would be deployed to support electric bus operations.
Levels of Automation

Credit: United States Department of Transportation
Federal AV Actions
Transit Automation

U.S. Department of Transportation

Notice of Funding Opportunity (NOFO) Number 693JJ319NF00001

“Automated Driving System Demonstration Grants”

Issue Date: 12/21/2018

Application Due Date: 3/21/2019
ADS Technology Inputs

- Automation software
- Drive-by-wire capabilities
- Sensor architecture
  - Radar
  - Ultrasonic
  - LiDAR
- Cameras
- GPS/GNSS
- V2X communications (optional)
- 3-D mapping (optional)
Aerotropolis Transit Plan

- The Aerotropolis CID's recently completed the first phase of their transit master plan.

- The "Corporate Crescent" circulator has been identified as a top service priority.

- Aerotropolis is exploring multiple potential transit technologies for that route, including AVs.
Aerotropolis Proposed Route(s)
Project Team

Partners and Supporters

- Metro Atlanta Rapid Transit Authority (MARTA)
- Center for Transportation and the Environment (CTE)
- Aerotropolis Atlanta CIDs
- Hartsfield-Jackson Atlanta International Airport
- New Flyer
- New Flyer ADS Technology Partner
- Southern Company/Georgia Power
- ABM Industries
- The Atlanta-Region Transit Link Authority (The ATL)
- Georgia Department of Transportation (GDOT)
- Atlanta Regional Commission (ARC)
- Delta Air Lines
- City of Atlanta
- Cities of East Point, Hapeville, and College Park
- Fulton and Clayton Counties
Transit Bus Automation

Increase bus transit operational efficiency and safety
- Potential for highly or fully automated BRT operations
- Reduced liability and maintenance costs from fewer collisions
- Improved driver performance and reduced job stress from assistive features
- Increased efficiency of service from lane keeping features (shoulder driving), automated docking, and collision avoidance
- Reduced energy consumption from eco-drive features and faster travel speeds
Data collected and reported to USDOT

- “Near misses” with pedestrians, other vulnerable road users, and other motorized vehicles, with object details
- Other failures to detect and appropriately respond to road users
- Failure to properly respond to road signage or signals, with object details
- Lane-keeping precision and deviations
- Docking precision for curbside pickup/alighting

Also:
- An inward-facing camera will capture the actions of safety drivers, and will be directed at their hands and feet to omit facial details. This will allow the team to assess safety driver responsiveness to ADS cues.
- Energy consumption metrics
- Rider and driver surveys
Contact Info

Jason Hanlin – CTE
Technology Director – Jason@cte.tv

Nathaniel Horadam – CTE
Managing Consultant, Automated Vehicle Specialist – Nathaniel@cte.tv

Kirsten Mote – Aerotropolis Atlanta CID
Program Director – kmote@aerocids.com
Assembly is the most connected multi-modal transportation site in the Southeastern United States.
connectivity

GDOT Managed Lanes
Doraville Connection

Expeditied travel for executive work force

Utilized for Bus Rapid Transit (BRT) connection
assembly master plan

145 contiguous acres includes:

- 3+M SF Commercial Space
- 4,000 units multifamily
- 500,000 SF of retail
- +/- 1M SF under way
- Interior roadways
- Greenspace
- 16 acre Central park
- 3 miles onsite rail, multi-use greenway loop
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Interior roadways
Greenspace
16 acre Central park
3 miles onsite rail, multi-use greenway loop
master plan density

assembly

assembly yards

future expansion
**connectivity**

**Vehicular Travel**

- I-85 • 1 mile from Assembly

- I-285 • adjacent to Assembly with 2 interchanges: Peachtree Boulevard & Buford Highway

- GA 400 • 4 miles from Assembly

- I-75 • 10 miles from Assembly via I-285

Direct managed lane interchange onsite
sustainability

Largest adaptive reuse in the Southeastern United States

Planned District Utility

3/4 mile bioswale network on site

Central Chilled Water Plant

Powered with renewables and compressed natural gas

Water hub sanitary to Gray Water Recycling Plant

Solar farm capacity

Greenway infrastructure with 16 acre central park for: recreation, storm conveyance, storm detention

Planned autonomous shuttle
context imagery
Within a 15 minute drive radius

Demographics

Population (2016)

- Ponce City Market
- The Forum
- The Battery Atlanta
- Avalon
- Assembly

Households (2016)

- Ponce City Market
- The Forum
- The Battery Atlanta
- Avalon
- Assembly

Employees (2016)

- Ponce City Market
- The Forum
- The Battery Atlanta
- Avalon
- Assembly

Average Household Income (2016)

- Ponce City Market
- The Forum
- The Battery Atlanta
- Avalon
- Assembly
Committee Chair Remarks

➢ Marsha Anderson Bomar, Chair
ADJOURN