How, and for whom, will activity patterns be modified by self-driving cars? Expectations from the State of Georgia

Patricia L. Mokhtarian
with Sung Hoo Kim & Giovanni Circella
School of Civil & Environmental Engineering
patmokh@gatech.edu
SMARTer Together Webinar, April 8, 2021
What is the relationship between our use of travel time (TT), and our travel choices?

**TT perceptions**
- Nuisance?
- Pleasure?
- Little different from non-travel time?

**TT use inclinations**
- Work?
- Play?
- Exercise?
- Chill?

**Travel choices**
- Frequency
- Destination
- Mode
- Route
- Vehicle ownership
- Residential location

**Actual TT use**
- Work activities?
- Leisure/personal activities?
- “No” activities?

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**Transportation Research Part A**

The Times They Are A-Changin’? What Do the Expanding Uses of Travel Time Portend for Policy, Planning, and Life?

Patrick McKinnon

---

Do millennials value travel time differently because of productive multitasking? A revealed-preference study of Northern California commuters

Alessandro Malicki, Giovanni Circella, Patrick L. McKinnon

---

What makes travel pleasant and/or tires? An investigation based on the French National Travel Survey

Patrick L. McKinnon

---

It's not all fun and games: An investigation of the reported benefits and disadvantages of conducting activities while commuting

F. Araya Rojas, Alessandro Malicki, Patrick L. McKinnon, Giovanni Circella
How will AVs change our travel choices?

A day in 2021

Drive to work Work at the office Drive to an activity location Social activity @ Ponce City Market Drive home

A day when AVs give you hands-free travel in your personal vehicle

- Prepare for the monthly meeting you will have tomorrow
- Reduce the amount of time at the office by working in the vehicle
- Read your book in the vehicle
- Go to Chattanooga to hang out with your friends there
- Watch TV show while coming back to ATL
How do we study AV impacts?

AV studies

**Survey (+ interview)**
- Haboucha et al. 2017
- Daziano et al. 2017
- Payre et al. 2014
- ...

**Scenario-based projection**
- Truong et al. 2017
- ...

**Scenario-based simulation**
- Zhang et al. 2018
- Liu et al. 2017
- Levin and Boyles 2015
- ...

**Naturalistic experiment**
- Harb et al. 2018

**Virtual reality**
- Sportillo et al. 2018
- Branzi et al. 2017
- ...

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**Transport Systems Catapult**

- https://procarandlimo.com/termsfaqs/

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Daziano et al. 2017

Truong et al. 2017

Zhang et al. 2018
Limitations of the approaches

Great uncertainty
- Timing of market maturity
- AV business models
- AV related policy & regulations
- (new normal?)
- ...

AV studies

Survey (+ interview)
- Expectations are not necessarily realized
- Current thoughts are shaped based on current settings

Scenario-based projection
- Subjective and deterministic assumptions

Scenario-based simulation
- Behavioral models and parameters yet unknown

Naturalistic experiment
- High cost
- Limited number of subjects
- Not fully “driverless”

Virtual reality
- High cost
- Limited experimental variability
### Empirical data

<table>
<thead>
<tr>
<th>Content</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project</strong></td>
<td>The Impact of Emerging Technologies and Trends on Travel Demand in Georgia</td>
</tr>
<tr>
<td><strong>PI/co-PI</strong></td>
<td>Drs. Patricia Mokhtarian and Giovanni Circella</td>
</tr>
<tr>
<td><strong>Timeline</strong></td>
<td>2016-2017: Survey design</td>
</tr>
<tr>
<td></td>
<td>2017-2018: Data collection/cleaning</td>
</tr>
<tr>
<td><strong>Study area</strong></td>
<td>15 planning regions (MPOs) + rural counties in GA</td>
</tr>
<tr>
<td><strong>Target population</strong></td>
<td>Georgia residents (over 18 years old)</td>
</tr>
<tr>
<td><strong>Sampling</strong></td>
<td>1) Address-based stratified random sampling</td>
</tr>
<tr>
<td></td>
<td>2) Selected NHTS-2017 participants</td>
</tr>
<tr>
<td><strong>Data collection channel(s)</strong></td>
<td>Paper survey (with online option)</td>
</tr>
<tr>
<td><strong>Sample size</strong></td>
<td>~ 3,300</td>
</tr>
<tr>
<td><strong>External data appended</strong></td>
<td>American Community Survey (ACS), Longitudinal Employer-Household Dynamics, Alltransit, Google Place API, and Google Map API</td>
</tr>
</tbody>
</table>

Kim, Mokhtarian, and Circella (2019) *The Impact of Emerging Technologies and Trends on Travel Demand in Georgia*. Georgia Department of Transportation.
Potential behavioral responses to AVs

**Perceptions**
- AV pros
- AV overuse cons

**Short-term responses**
- AV use intentions
  - Own privately
  - Use SAV alone/others
  - Use SAV with strangers

**Medium-term responses**
- Trip/activity changes
  - More distant
  - Flexible time-use
  - More frequent
  - More long-distance

**Long-term responses**
- Residential relocation
  - Close to frequented places
  - Stay
  - To attractive (farther) place

**Mode use propensity**
- AV vs. walk
- ZOV vs. OV
- AV vs. flight
- AV vs. transit

**Number of vehicles**
- Reduce
- Keep same
- Increase

---

Kim, Circella, Mokhtarian (2019) TR-A

Kim, Mokhtarian, Circella (2020) TR-D

Kim, Mokhtarian, Circella (2020) TR-F
Goals of the present study

1. To measure (at a general level) how people expect their travel/activity patterns to change in the AV era;
2. To identify population segments having similar profiles of expected changes; and
3. To further profile each segment on the basis of attitudinal, sociodemographic, and geographic characteristics
Contextual setting for AVs

- Assume a future where all cars are **fully automated** (level 5)
- Focus on **behavioral response** after sidestepping safety and cost concerns

- Traditional cars can no longer be used in regular traffic – self-driving cars are the **only way to go by car**.
- Driverless cars are **at least as safe** as today’s cars are, and **cost about as much** as today’s cars do.
- You could **furnish** your self-driving car with a TV, kitchenette, recliner, light exercise equipment, etc.
- You could send an empty self-driving car somewhere to **pick up other people or things**, or to **park** after dropping you off at work or the ball game.
- You could let a self-driving car take you places while you are **sleeping**.
Familiarity with AVs

We are interested in your awareness of or familiarity with the concept of a self-driving car.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Very Familiar</th>
<th>Somewhat Familiar</th>
<th>Not Familiar</th>
<th>Never Heard</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-34</td>
<td>23.6%</td>
<td>28.9%</td>
<td>18.1%</td>
<td>19.8%</td>
</tr>
<tr>
<td>35-44</td>
<td>49.7%</td>
<td>43.8%</td>
<td>10.4%</td>
<td>4.7%</td>
</tr>
<tr>
<td>45-64</td>
<td>44.7%</td>
<td>37.5%</td>
<td>8.2%</td>
<td>6.8%</td>
</tr>
<tr>
<td>65+</td>
<td>37.5%</td>
<td>51.0%</td>
<td>8.2%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Total</td>
<td>44.0%</td>
<td>43.8%</td>
<td>10.4%</td>
<td>12.7%</td>
</tr>
</tbody>
</table>

- I’ve heard of it and am very familiar with it
- I’ve heard of it and am somewhat familiar with it
- I’ve heard of it but am not familiar with it
- I’ve never heard of it
If self-driving cars were the only cars available, how likely would you be to **own** a self-driving car, **use** self-driving services (such as a driverless taxi), or do both?
## Measurement of opinions about activities

How likely is it that self-driving cars would **change your behavior**, in each of the following ways?

<table>
<thead>
<tr>
<th>I would...</th>
<th>Very unlikely</th>
<th>Unlikely</th>
<th>Somewhat likely</th>
<th>Likely</th>
<th>Very likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Eat out in restaurants more often.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Go to grocery stores or shopping malls more often.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eat out in restaurants more often.</td>
<td>2.04</td>
</tr>
<tr>
<td>Go to grocery stores or shopping malls more often.</td>
<td>2.06</td>
</tr>
<tr>
<td>Travel to social/leisure activities more often.</td>
<td>2.36</td>
</tr>
<tr>
<td>Go to more distant restaurants.</td>
<td>2.45</td>
</tr>
<tr>
<td>Go to more distant grocery stores or shopping malls.</td>
<td>2.28</td>
</tr>
<tr>
<td>Socialize with people who live farther away.</td>
<td>2.52</td>
</tr>
<tr>
<td>Travel to more distant locations for leisure.</td>
<td>2.73</td>
</tr>
<tr>
<td>Eliminate some overnight trips because it would be easier to come back the same day.</td>
<td>2.80</td>
</tr>
<tr>
<td>Make more overnight trips by car because it would be less burdensome to travel long distances.</td>
<td>2.87</td>
</tr>
<tr>
<td>Go to work/school at a different time to avoid traffic jams, since I can sleep/work in the car.</td>
<td>2.32</td>
</tr>
<tr>
<td>Take part in more leisure activities after dark, because I wouldn't need to drive myself.</td>
<td>2.63</td>
</tr>
<tr>
<td>Take vacations more often.</td>
<td>2.48</td>
</tr>
<tr>
<td>Reduce my time at the regular workplace and work more in the self-driving car.</td>
<td>2.03</td>
</tr>
<tr>
<td>Sleep less time at home and more time in the car, to be more efficient.</td>
<td>1.83</td>
</tr>
<tr>
<td>More often eat meals in a self-driving car instead of at home or in a restaurant.</td>
<td>1.96</td>
</tr>
<tr>
<td>Cultivate new hobbies or skills with the time I saved.</td>
<td>2.25</td>
</tr>
</tbody>
</table>

Generally expecting changes will be “unlikely”.
## Factor analysis of activity changes

<table>
<thead>
<tr>
<th>Statements</th>
<th>Factors →</th>
<th>Distance</th>
<th>Time flexibility</th>
<th>Frequency</th>
<th>Long-distance/leisure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eat out in restaurants more often.</td>
<td></td>
<td>0.062</td>
<td>0.069</td>
<td>0.782</td>
<td>0.043</td>
</tr>
<tr>
<td>Go to grocery stores or shopping malls more often.</td>
<td></td>
<td>0.076</td>
<td>0.066</td>
<td>0.822</td>
<td>0.023</td>
</tr>
<tr>
<td>Travel to social/leisure activities more often.</td>
<td></td>
<td>0.375</td>
<td>0.060</td>
<td>0.452</td>
<td>0.138</td>
</tr>
<tr>
<td>Go to more distant restaurants.</td>
<td></td>
<td>0.666</td>
<td>0.077</td>
<td>0.247</td>
<td>0.062</td>
</tr>
<tr>
<td>Go to more distant grocery stores or shopping malls.</td>
<td></td>
<td>0.630</td>
<td>0.114</td>
<td>0.254</td>
<td>0.027</td>
</tr>
<tr>
<td>Socialize with people who live farther away.</td>
<td></td>
<td>0.654</td>
<td>0.102</td>
<td>0.080</td>
<td>0.214</td>
</tr>
<tr>
<td>Travel to more distant locations for leisure.</td>
<td></td>
<td>0.504</td>
<td>0.049</td>
<td>0.038</td>
<td>0.444</td>
</tr>
<tr>
<td>Eliminate some overnight trips because it would be easier to come back the same day.</td>
<td></td>
<td>0.106</td>
<td>0.106</td>
<td>0.080</td>
<td>0.652</td>
</tr>
<tr>
<td>Make more overnight trips by car because it would be less burdensome to travel long distances.</td>
<td></td>
<td>0.086</td>
<td>0.054</td>
<td>0.047</td>
<td>0.789</td>
</tr>
<tr>
<td>Go to work/school at a different time to avoid traffic jams, since I can sleep/work in the car.</td>
<td></td>
<td>0.055</td>
<td><strong>0.428</strong></td>
<td>0.098</td>
<td>0.335</td>
</tr>
<tr>
<td>Take part in more leisure activities after dark, because I wouldn't need to drive myself.</td>
<td></td>
<td>0.185</td>
<td>0.147</td>
<td>0.184</td>
<td><strong>0.457</strong></td>
</tr>
<tr>
<td>Take vacations more often.</td>
<td></td>
<td>0.221</td>
<td>0.212</td>
<td>0.171</td>
<td><strong>0.417</strong></td>
</tr>
<tr>
<td>Reduce my time at the regular workplace and work more in the self-driving car.</td>
<td></td>
<td>0.039</td>
<td><strong>0.614</strong></td>
<td>0.127</td>
<td>0.120</td>
</tr>
<tr>
<td>Sleep less time at home and more time in the car, to be more efficient.</td>
<td></td>
<td>0.040</td>
<td><strong>0.817</strong></td>
<td>0.013</td>
<td>-0.025</td>
</tr>
<tr>
<td>More often eat meals in a self-driving car instead of at home or in a restaurant.</td>
<td></td>
<td>0.020</td>
<td><strong>0.687</strong></td>
<td>0.060</td>
<td>0.034</td>
</tr>
<tr>
<td>Cultivate new hobbies or skills with the time I saved.</td>
<td></td>
<td>0.181</td>
<td><strong>0.463</strong></td>
<td>0.117</td>
<td>0.196</td>
</tr>
</tbody>
</table>

Numbers represent strength of relationship between statement & factor; closer to 1 means stronger relationship.
Cluster analysis on the resulting factors

- Purpose: Divide the sample into groups on the basis of having similar sets of scores on the four “activity change” factors:
  - Composite scores will also range from 1 to 5
- K-means algorithm
- 1000 sets of randomized starting points
- Selected the 6-cluster solution
Looking into market segments (1)

Average “activity change” factor scores for each cluster

No change (20%)
- Presents the most negative reactions to any activity changes
- Mostly expecting “very unlikely”

Change unlikely (26%)
- Exhibits less optimistic responses for all four activity changes
- Mostly expecting “unlikely”
More leisure/long distance (15%)

- “Unlikely” reactions to three of the activity dimensions
- But distinctively high expectations of making more leisure and long distance trips
- Expects little change in daily travel, but would like to take advantage of AVs for occasional long distance trips

Longer trips (12%)

- Expresses less enthusiasm for using time more flexibly and making trips more frequently
- But envisions traveling to more distant places, for both daily (e.g. grocery, restaurant) and long-distance trips
More travel (14%)

- Exhibits greater enthusiasm for changing the quantity of travel
- But, still thinks it unlikely that they will employ time more flexibly because of AVs

Time flexibility & more leisure/LD travel (13%)

- Shows a generally high level of enthusiasm
- Distinctively presents positive reactions to time flexibility
Profiles

Based on relative comparisons

- Least favorable to non-car modes
- Least tech-savvy
- Least urbanite
- Lowest perceived AV benefits
- Living in least dense areas
- Oldest
- Lowest income

- Favorable to non-car modes
- Tech-savvy
- Travel-liking
- Perceiving AV benefits
- Youngest

- Age of 45-64
- Middle income
- Living in mid-sized regions

- White
- Male
- Higher income

- Urbanite
- Black
- Lower income
- Fewer vehicles

More travel

- Longer trips
  - Living in densest areas
  - Living in greatest accessibility to amenities
  - Female
  - Atlantan

- Time flexibility & more leisure/long distance
- More changes
- More leisure/long distance
- No change
- Change unlikely

- No change
- More changes

Creating the Next © 21
Based on people’s current (well, 2017!) opinions, the expected shifts are relatively modest on average.

People reported particularly lower expectations with respect to time flexibility.
  • However, some fraction of people will take advantage of hands-free travel (the time flexibility & more leisure/long distance segment); such people are more likely to be tech-savvy, younger, and workers.

AVs will have stronger impacts on distance than on frequency.
  • Important to distinguish between more versus longer trips in efforts to predict aggregate increases in travel time due to AVs.
  • Relatively less burdensome to add more travel time to existing trips than to make entirely new trips.
Increased overall trip distance implies that the service areas of some types of places (e.g. restaurants or shopping malls) could be enlarged in the AV era.

Behavioral responses will vary across demographics and regions:

- AVs could facilitate the potential travel needs of younger/middle-age adults, higher income individuals, and Atlantans more than others.
- In addition, such travel generation may occur only for long distance trips for some, whereas others may employ AV benefits more in daily life, for example by using time differently.
- As such, future modeling for demand forecasting or prescriptive planning in preparation for the AV era should consider these heterogeneous responses of people.
Selected references on AVs and uses of travel time (1)


Selected references on AVs and uses of travel time (2)


Thank you!

Questions?

patmokh@gatech.edu
MINNESOTA’S NEXT STAGE IN AUTONOMOUS VEHICLES

#SMARTER TOGETHER WEBINAR

MIKE KRONZER
Senior Project Manager, MnDOT CAV - X
ROCHESTER AUTOMATED SHUTTLE PILOT
PROJECT BACKGROUND

- Project selected through MnDOT CAV Challenge RFP process.
- Operation of two (2) EasyMile EZ10’s:
  - low speed, 12 passenger, level 4 automated shuttles (no steering wheel or pedals).
- Onboard ambassador has ability to take over operation from the shuttle if needed.
- Project proposes an urban route in downtown Rochester.
- Open to the public with a minimum of 12 months of operation.
AN INNOVATIVE COLLABORATION BETWEEN GOVERNMENT, KEY STAKEHOLDERS AND INDUSTRY.

PROJECT LEAD
MNDOT

PROJECT PARTNERS
CITY OF ROCHESTER
MAYO CLINIC
DESTINATION MEDICAL CENTER

TECHNOLOGY PARTNERS
FIRST TRANSIT
EASYMILE
ENHANCE THE TRANSIT EXPERIENCE FOR THE CITIZENS OF ROCHESTER AND INCREASE MOBILITY IN A HIGH DEMAND DOWNTOWN URBAN ENVIRONMENT

MOBILITY
ENHANCE THE TRANSIT EXPERIENCE FOR THE CITIZENS OF ROCHESTER AND INCREASE MOBILITY IN A HIGH DEMAND DOWNTOWN URBAN ENVIRONMENT

PUBLIC EDUCATION
ENGAGE AND EDUCATE THE PUBLIC ON THE BENEFITS AND OPPORTUNITIES Afforded BY AV TECHNOLOGY

INFRASTRUCTURE
IDENTIFY INFRASTRUCTURE GAPS AND SOLUTIONS TO SAFELY OPERATE AV TECHNOLOGY ON PUBLIC ROADWAYS

WINTER WEATHER
ADVANCE THE OPERATION OF AUTOMATED VEHICLE (AV) TECHNOLOGY IN WINTER WEATHER CONDITIONS

PROJECT GOALS
CIRCULATOR ROUTE THAT OPERATES ON 6^1^ST^ SE, 3^RD^ AVE SW, W CENTER ST, AND S BROADWAY.

SUMMER/FALL 2021 LAUNCH
SERVICE HOURS

- Launch shuttle service Summer 2021
- 12 months of operation
- Hours: 9am-3pm, 7 days a week

Visit EasyMile’s website for more information on the EZ10 automated shuttle:
https://easymile.com/driverless-technology-easymile-how-does-it-work/
LESSONS LEARNED: INFRASTRUCTURE

- Signals, road signage, pedestrian signage, road quality, pavement markings, curb management
- Minnesota **not** investing in DSRC
- Dual mode RSU solution at signals
- **Systems Engineering!**
  - Conduct route analysis, infrastructure analysis, cost analysis, and assign task responsibility prior to any operations work
COMMUNICATIONS & ENGAGEMENT

- KEY MESSAGING
- WEBSITE
- PUBLIC BROCHURES
- LAUNCH EVENT
- MEDIA OUTREACH AT KEY MILESTONES
- SOCIAL MEDIA PRESENCE
- CRISIS PROTOCOL AND RESPONSE
- EMERGENCY SERVICES EDUCATION
THANK YOU

MIKE KRONZER, PE
Senior Project Manager, MnDOT CAV - X
Michael.Kronzer@state.mn.us
#SMARTer Together - EasyMile’s success is built on building true partnerships

EasyMile brings driverless vehicle solutions for people and goods to life with leading technology that provides a real service.
EasyMile Background

*EasyMile brings* **automated vehicle solutions** *for people and goods to life with leading technology that provides a real service*
EasyMile at a glance

- 7 locations
- 2220+
- 30+ PhDs
- Leader in R&D
- 22 nationalities
- Since 2014
- Shareholders: Founders, Continental, Alstom and Bpifrance

Map locations:
- Denver, USA
- Berlin, Germany
- Dubai, UAE
- Singapore
- Adelaide, Australia
- Toulouse, France
- Japan
EZ10 automated shuttle

Driverless and electric shuttle

6 seats with seatbelts

16h autonomy, 10h with A/C

ADA Compliant

Pre-mapped network of roads

150 Shuttles worldwide - nearly 30 in US

EZ10 maximum speed

Other vehicles’ maximum speed

>300 Deployments in 30+ countries
TractEasy Specifications

VEHICLE CHARACTERISTICS

Energy
Electric

Battery technology
Lead-acid or Li-ion

Maximum towing capacity
25 tonnes / 55k lbs

Maximum speed
* Up to 15 mph in Manual Mode*
* Up to 10 mph in Autonomous Mode

*Speed depends on weight towing

Dimensions (l * w * h, mm)
3200 * 1940 * 2050

Turning radius, wall-to-wall
4.25m minimum, depending on trailers

Gross Vehicle Weight
8,500 lbs

Available Today!
Flagship locations

Various use cases including, Department of Transportations, Airports, Fortune 500 firms and University Campuses
2 EZ10 Gen3s will connect Methodist Hospital with hotels, shops, restaurants, and parking for 12 months.
- Projected passenger operation hours are 9am to 3pm.
- The site involves mixed traffic, signalized intersections, and Minnesota weather!
- NHTSA approval will be required
- Project will leverage MnDOT’s EZ10 winter testing experience from 2017 project
- Project can show potential for applying AVs in transit setting
- Project will identify any infrastructure improvements that might be necessary for AVs while ensuring safety on public roadways.
Delaware DOT and DART, Dover, Delaware

Delaware Department of Transportation is partnering with EasyMile to deploy Delaware's first electric, fleet of 2 self-driving transit shuttles, at various locations throughout the State in 3 different phases over the next few years.

<table>
<thead>
<tr>
<th>Customers and Client URL</th>
<th>Delaware DOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Public Road</td>
</tr>
<tr>
<td>Description of the project scope</td>
<td>Mixed Traffic with Pedestrians, Bikes and Motorized Vehicles</td>
</tr>
<tr>
<td>Route length / Number of stops</td>
<td>1.9 miles with 5 stops</td>
</tr>
<tr>
<td>Make, Model and Number of shuttles used</td>
<td>Two EasyMile EZ10 Gen-3s</td>
</tr>
<tr>
<td>Project Duration, hours of service</td>
<td>Long term relationship Monday to Friday, 10am to 2pm</td>
</tr>
<tr>
<td>Average temperatures and weather encountered</td>
<td>The highest average temperature is 85° and the lowest average temperature is 19°F. Weather includes rain, wind, fog, hail, snow.</td>
</tr>
</tbody>
</table>
The EZ10 shuttle services Verizon employees from the Verizon Employee Hotel to the Corporate Campus working with their current shuttle service provided on the campus. This project is an exciting R&D opportunity of between Verizon and EasyMile, using the EZ10 as a mobile 5G test bed.

<table>
<thead>
<tr>
<th>Customers and Client URL</th>
<th>Verizon - <a href="http://www.verizon.com">www.verizon.com</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Private campus</td>
</tr>
<tr>
<td>Description of the project scope</td>
<td>Mixed Traffic with Pedestrians, Bikes and Motorized Vehicles</td>
</tr>
<tr>
<td>Route length / Number of stops</td>
<td>1.1 mile with 3 stops</td>
</tr>
<tr>
<td>Make, Model and Number of shuttles used</td>
<td>One EasyMile EZ10 Gen-3</td>
</tr>
<tr>
<td>Project Duration, hours of service</td>
<td>Long term relationship Monday to Friday, 10am to 3pm.</td>
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<td>Average temperatures and weather encountered</td>
<td>The highest average temperature is 85° and the lowest average temperature is 19°F. Weather includes rain, wind, fog, hail, snow.</td>
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</table>

Reference: Available upon request
EasyMiles Gen-3 shuttles are now taking pre-packaged food boxes from St. Stephen’s Food and Nutrition Center to the Rosewind Community Center in Columbus OH, where residents can meet the shuttle to pick up the boxes as well as face masks Monday through Friday. A trained operator rides on board the shuttle to ensure safety and then helps distribute the boxes once at the community center.

**Customer and Client URL**
City of Columbus, OH - [https://smart.columbus.gov/](https://smart.columbus.gov/)

**Environment**
Public Road

**Description of the project scope**
Mixed Traffic with Pedestrians, Bikes and Motorized Vehicles

**Route length / Number of stops**
1.7 miles

**Make, Model and Number of shuttles used**
Two EasyMile EZ10 Gen-3s

**Project Duration, hours of service**
Ongoing 6am to 7pm Monday to Sunday

**Average temperatures and weather encountered**
Temperatures in Columbus OH can range from a high 105° to a low of -22°. Weather conditions included wind, rain, snow, and fog.
Moving engines to the assembly line

The challenge
- High labor costs
- One of the largest car manufacturing plant in the US
- Automate indoor and outdoor processes
- Towing 14,000lbs

The solution
- 100% driverless
- No Safety Driver on-board
- Transporting engines from powertrain to assembly line
- Mixed-traffic operations
- 1.68 mile loop with indoor and outdoor phases
- Through intersections, pedestrian crosswalks, a roundabout and a railway crossing
- V2I communication with doors and traffic light

“Integrating the TractEasy into one of the busiest car plants in North America the TractEasy is a perfect compliment to our vision of clean technologies driving efficiencies to processes”
EZFleet - Fleet Management System

Control Center
● Interface to supervise vehicles’ performance and safety
● Interaction with vehicles: access to cameras, change mode, re-arm etc…

Mission & Fleet Management
● Mission assignment to the vehicles
● Manage vehicles’ behavior at stations
● Send alerts to point of contact

System Integration
● Ability to connect to third party systems (e.g. Warehouse Management Systems) to increase coordination and flexibility

Data Reports & Statistics
● Aggregate information from operating vehicles
● Provide operations insights through recurrent reporting
Building Partnerships to enable success

<table>
<thead>
<tr>
<th>PROJECT INITIATION</th>
<th>INSTALLATION</th>
<th>OPERATIONS</th>
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<tbody>
<tr>
<td><strong>SCHEDULE</strong></td>
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<td>SITE</td>
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<td>VEHICLES</td>
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3 to 6 months*

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<tbody>
<tr>
<td>Site Assessment</td>
<td>Site Adaptations</td>
<td>Site Update Review</td>
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<tr>
<td>TractEasy Procurement</td>
<td>TE Shipping</td>
<td>TE Importation**</td>
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3 to 5 weeks*

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<tr>
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<td>Setup and Tests</td>
<td>Fleet Setup</td>
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<td>Operators/Supervisor Training &amp; Evaluation</td>
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<td>SUPPORT AND MAINTENANCE</td>
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Driverless operations

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<tr>
<td>Safety driver onboard</td>
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<tr>
<td>Safety driver follower</td>
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**Depending on site**
**Depending on destination**

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*Depending on site
**Depending on destination

EasyMile activity
Partner activity
Customer activity

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13
Thank you

Connect with us:

#EasyMile