Heaven or Hell?
SMART CITIES AND AUTONOMOUS VEHICLES

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THREE REVOLUTIONS

ELECTRIFICATION
• World’s fleet of electric vehicles grew 54% to 3.1 million in 2017 (IEA)
  • Reduces noise and local pollutants, making urban living more attractive

AUTOMATION
• Of the 5 levels of autonomy, Levels 1-3 are increasingly common: cruise control, braking, parking. Google’s Waymo is launching a minivan taxi fleet - without anyone in the driver’s seat but with remote oversight (Level 4) - in Phoenix by the end of 2018.
  • Increases safety and “free” time in the vehicle.
  • AV taxi fleets, shuttle buses and micromobility services could significantly reduce private car ownership, increasing affordability

SHARING
• Lyft, Uber, & Chariot have already demonstrated the popularity of sharing rides on reliable on-demand mobility services.
  • Traffic congestion could significantly decrease with more shared rides – or significantly increase by adding zero-passenger trips
LIKE IT OR NOT, AVs ARE HERE

- Tesla: Level 2 (monitored driving) available today. 1 fatality.
- Audi: Level 3 (driver in position, but not full monitoring) in 2017
- Google/Waymo: 3M miles self-driven. Level 4 (no steering wheel) in 2018-20
- Baidu/BMW: buses & trucks, not cars, on fixed routes by 2019
- Uber/Otto: completed 120-mile Budweiser shipment in driverless truck in 2016
- Ford, Nissan-Renault, Daimler plan to deliver robotaxi fleets by 2021
- Bishop Ranch, CA office park has 2 fully autonomous shuttle buses
- Phoenix is running a ride-hailing program w Waymo’s minivan AVs
- Customers can request a driverless uber in Pittsburgh today

ARE WE PLANNING FOR THEIR IMPACT ON COMMUNITIES???

- Oslo announced it will ban private vehicles from the city center by 2019
- Helsinki has planned a publically-owned mobility-on-demand system linking buses to bikes and ferries so as to make private car ownership obsolete by 2025
- iUS DOT: 2016 $40M Smart City Challenge grant: Columbus OH to develop fleet of AV shuttles to aid in first/last mile connectivity
- Palo Alto has 11 “smart” intersections, the Ohio Turnpike has installed fiber optic cables along 241 miles – to relay traffic and weather info
IMPACT ON COMMERCIAL REAL ESTATE?

PARKING
- Glut of excess parking lots, decks and garages ready to be redeveloped or regreened
- More decoupling or elimination of parking from new buildings changing typical lot and block sizes and uses for mid-block conditions

GAS STATIONS
- More need for battery recharging. Opportunities for corner sites to become pick-up/drop off mobility and neighborhood hubs

CURB MANAGEMENT
- Less on-street parking and more time-specific deliveries, pick-up/drop off/transit stations with bike and scooter parking. Cities will seek to replace parking meter revenue and increase multi-modal access.

SINGLE-USE ZONING
- If cars, trucks, & buses become safer and less noxious, if 3D printing and robotics make manufacturing less noxious, if single-use retail continues to evolve towards mixed-use nodes so as to provide social and physical experiences that compete with online shopping, and if SAVs reduce car ownership, single-use zoning may become a dinosaur.
AUTONOMOUS VEHICLES

Benefits

• Save time and reduce driver stress
  • Avg commute is 200 hours a year

• Reduce accidents, safer journey
  o Car accidents kill 35,000 people/year in US
  o 90% of accidents are caused by human error

• Reduce lane widths and parking space
  o 50 - 90% less parking than needed today
  o twice as efficient use of existing parking spaces

• Mobility for non-drivers, elders and disabled

• Reduce costs
  • Normal Taxi :$2-3/mile vs AV Taxi: 60¢/mile (VTPI)
  • Normal private car : 46-73¢/mile (AAA)
  • AV private car: 17.5¢/mile (Driverless Car Revolution)

• Increased Municipal Revenues
  • $0.5 Trillion from reduced highway lanes, roads, police and E.R visits

• Reduce the # of cars
  • U.Mich and Barclays estimate avg US household will reduce car ownership from 2.1 to 1.2 vehicles
  • Several studies estimate a single AV could replace 10-12 regular vehicles
AUTONOMOUS VEHICLES

Costs

- Massive loss of jobs
  - 6M truck drivers, taxis, etc
- Technological vulnerabilities
  - Hacking
  - Software/communication crashes
- Ethical dilemmas
- Induced demand leading to increased congestion and VMT and decreases in transit?
  - ‘15 study of 87 urban areas in U.S. over 11 years found congestion dropped after Uber
  - ‘17 study of NYC: Uber/Lyft outpaced transit ridership and added more VMT than taxis
  - VMT may increase by 2-3 trillion miles over next 30 yrs – more than 5X the increase of past 30 years (Fehr & Peers)
- Exacerbated urban sprawl?
AUTONOMOUS VEHICLES

- EX10 AV bus at Bishop Ranch
- Nuro last-mile delivery prototype
- Google/Waymo AV car
- Airbus modular flying car/quadcopter concept
The key question is not how can your community hop on the bandwagon to welcome or resist AVs?

The key question is what kind of future does your community desire and how might you leverage AVs to achieve that vision?
Downtown Atlanta
2041: Autonomous Vehicles and A-Street Grids

Georgia Institute of Technology
Spring 2016: Urban Design Studio
Professor Ellen Dunham-Jones
https://smartech.gatech.edu/handle/1853/55814

Greater Atlanta Magazine, 1910
Illustration of Downtown in 2010….meets Google car in 2016
Topography
• Peachtree Street sits atop a ridge line that was a central Creek Indian Trail
• The Eastern Continental Divide runs through the city and produced the location of the rail lines

Railroads
• Early street grids oriented to railroads

Downtown Atlanta topography with existing street network
Excessive parking

- 95,000 parking spaces
  - 62% used under “normal usage”
  - Opportunities for better event parking management?

Too few residents

- 5,500 residents in the core
A/B-street Criteria

A-streets

- Regional and Campus Connections
- Street Frontage and Existing Character
- Retail Presence or Active Ground Floors Uses
- Existing Transit
- Opportunities for Infill/Redevelopment
- History & Significance
- Supportive of an Evenly Distributed Network
Georgia Tech GIS Center simulation modeling shows that in Atlanta, each shared driverless car (SAV) can replace 8.9 privately-owned cars. The difference between “heaven” and “hell” will depend on policies and designs that increase willingness to share rides.
AUTONOMOUS VEHICLES

Assumptions for Downtown Atlanta 2041

The 1st Assumption
Autonomous bus will take over the proposed streetcar route, with a high-frequency dedicated lane.

The 2nd Assumption
Driven cars will continue to need 50% of current parking spaces. But growth in AVs and ART will result in a 70%-90% reduction in overall parking. New buildings will not require parking.

The 3rd Assumption
Lane widths will shrink as shown and speed limits will not exceed 20mph in Downtown except on the highway.

70%-90%
Hybrid Scenario street modifications: some lanes shared, others designated AV-only, and much replacement of on-street parking with pick-up/drop off zones.
New Neighborhoods

1. Baker Street
   Create Safe Route to Attractions

2. Fairlie Poplar
   Strategic park-facing Infill

3. Five Points
   Intersection of A-streets & transit

4. South Downtown-Garnet
   Arts-driven, affordable TOD
Leveraging topography for water recycling, urban farming demo’s, and connectivity via SAVs
Fairlie Poplar: Bicycle-Oriented Development
Meghan McMullen, Mikhail Payson

Illustrative Site Plan
The future Fairlie Poplar vision extends the neighborhood west toward Centennial Olympic Park, replacing parking lots and underutilized sites with dense, active uses and using complete streets and public plazas as the seams between buildings.
Intense densification at transit coupled with green walls above and below grade
South Downtown: Arts District TOD
Meredith Blakely, Lu Pang, Animesh Shrestha

Large and small infill buildings on top of parking lots

New school and arts programming building on existing artist community

Dedicated ART loop connecting to MARTA rail station and providing “eyes on the street”
Lack of new parking allows for:
- infill affordable housing, including “missing middle”
- mid-block eco-system services (water harvesting/treatment, solar, urban ag, etc.)
- mid-block trash & delivery systems

Frequent autonomous bus and robotaxi allows for:
- Affordable, convenient mobility choices
- Lane width reductions & improved public realm
- Automated surveillance
- Safer, quieter, streets with wider, livelier sidewalks
Impacts on Downtown

- Safer, slower, quieter streets
- Road diets with more pedestrian space
- Reduce parking areas
- More frequent buses
- An opportunity to raise the bar on the quality and experience of Downtown Atlanta
- Added capacity: 21.4M sq ft by building on 1/2 of Downtown’s surface parking lots and a few aging low-rise, non-historic buildings
- If 70% of that is residential: ~60,000 new residents by 2041 without any new parking

- Can the reduction of parking and increased walkability encourage more people to use shared AVs and transit? Maybe if we plan for it…
Buy-Low pacification of humans with Hovercrafts and cup holders
Pixar: Andrew Stanton, Jim Reardon

Solar suburbs, AVs, Drones, & Greenery
MIT, Center for Advanced Urbanism
SHARED MOBILITY SUBURBS

Incentives for shared rides on ART & robotaxis combined w/ tolls on solo passenger rides reduce VMT and grow car-light, affordable, compact, walkable redevelopment and light industry

- Combat the convenience of the private AV
  - Reduce lanes for robotaxis and private AVs
  - Give ART dedicated lanes
  - Toll solo-passenger rides in robotaxis and private AVs

- Enhance the experience of sharing
  - Design ”better bus stops” along the ART lanes that make “waiting” a more social, productive, and enjoyable experience
  - Design community-building into mobility system & package-delivery

The keys are more shared rides, public ownership of the streets and willingness to toll their use

retrofitting challenge:

LOWER-DENSITY SHARED MOBILITY
REDESIGNING USER EXPERIENCE on AUTONOMOUS SHUTTLE BUSES (SAVs)

GEORGIA SMART COMMUNITIES CHALLENGE:
SAV Best Practices Manual for Chamblee, GA
Sept. 2018-19

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GAME-CHANGER for LOCAL BUS TRANSIT?

COST ADVANTAGE: Without the salary of a driver, instead of one big bus that comes every 30 minutes, a system could operate three smaller shuttles that come every 10 minutes.

TIME ADVANTAGE: Shared Autonomous shuttle buses on dedicated routes require far less machine learning than private autonomous cars that need to be able to drive anywhere.

Today, an SAV is estimated to be 70% cheaper to operate than a regular bus.
41 pilots worldwide today. 4 coming to Metro Atlanta
• North Ave, Atlanta
• Georgia Tech campus, Atlanta
• Chamblee, GA
• Peachtree Corners, GA

1st SAV on U.S. public street: Downtown Las Vegas, Jan, 2017

Olli, 3-D printed, 6-12-passenger SAV
To combat congestion from zero- and solo-passenger AV trips, while addressing San Francisco’s acute housing shortage and affordability crisis, Calthorpe proposed two changes.

• Change the commercial zoning along El Camino Real, a 45-mile boulevard that stretches from San Francisco to San Jose, to allow higher density housing.
• Install ART in dedicated lanes on El Camino Real. This could lead to the redevelopment of aging strip malls and other property types to accommodate more than 250k housing units whose residents could live without a car.

Note: Peter Calthorpe will speak at GT on March 27.
CAN SAVs/ART BE A GAME CHANGER AGAINST PRIVATE AVs?

The SAV head start provides an opportunity to build ridership. But can it be sustained after the novelty wears off and private AVs are marketed as living rooms on wheels?
A railroad town with a diverse population of 30k, mix of jobs, a sleepy Main St, and a variety of older industrial and commercial buildings that are rapidly being redeveloped into urban housing. The city has ambitious plans to grow its 25% Millennial population by leveraging its:

- MARTA station access to downtown Atlanta and new walk/bike trails
- Affordable transit-oriented urban housing
- Proximity to major employers (CDC, IRS) and new creative industries (3rd Rail Studios)
- Embrace of diversity and ethnic restaurants and businesses
- Autonomous Shuttle Bus pilot, designed by Stantec, between the Chamblee MARTA station and Assembly, an in-process 100-acre mixed-use redevelopment.
SAV USER EXPERIENCE?

BUS STIGMA: The user experiences associated with buses range from dehumanizing bus stops and frustrating wait times at worst, to boring at best.

BORING: SAVs are being engineered for safety – job one. But, so far, the 40+ pilots’ slow speeds and car-oriented contexts (mostly office parks) are reinforcing the idea of buses as boring – despite some efforts at cutesy exteriors.

PROPOSAL: We need better urban design, station design, vehicle design and app design to improve the user experience and sustain ridership.
LEARN FROM SCOOTERS?

FUN (and DANGEROUS)

FASTER THAN AN AV SHUTTLE

SUPER SIMPLE INTERFACE

CHEAP and POPULAR (in good weather)
- Used both for joyrides and first/last mile
- Weather-dependent
- Limited demographic

Bird Invasion: Atlanta’s electric scooters are fun, dangerous, exciting, annoying, and unstoppable
MAKE THE SAV USER EXPERIENCE MORE FUN?

URBAN DESIGN
• Improve walkability, bikability, scooterability to station stops with curb management, streetscaping, r.o.w. re-striping, and pedestrian-friendly zoning
• Require new development to anticipate and integrate future station stops

MOBILITY HUB/BUS STOP DESIGN
• Improve waiting with mix-of-uses, vending, on-time info, seating, and wifi
• Integrate play

APP DESIGN
• Provide opportunities for social interaction with others going to the same destination or within so many social media connections
MAKE THE SAV USER EXPERIENCE MORE USEFUL?

URBAN SCALE

• Expand the pilot into a network and fleet that can go many more places and connect with various other transportation modes
  • our research finds that current US projects avg 1.5 miles, carry 9 people at a time, and 6-9k passengers so far per project, at avg cost of $721k/mile
• Expand the destinations and users by redeveloping excess parking lots & decks near stations. Encourage ground floor uses that are of interest to SAV users.
MAKE THE SAV USER EXPERIENCE MORE SUSTAINABLE?
MAKE THE SAV MORE COMPETITIVE?

Provide dedicated lanes so the SAV has an advantage over private vehicles in traffic.

Provide connectivity with traffic signals for priority movement.
MAKE THE SAV USER EXPERIENCE MORE DIVERSE?

VEHICLE DESIGN

- One size no longer needs to fit all. Fleets with vehicles of varied sizes and configurations can be more responsive to user needs, and build community identity/brand

- Local Motors is 3D printing customized versions of Olli, its AV Shuttle, (in 10 hours)

- Ala Uber, luxury vehicles with more privacy might be offered at a higher price.
MAKE THE SAV USER EXPERIENCE SAFER?

URBAN DESIGN

- Leverage SAV IOT communication to light-up next-stop stations at night
- Install advanced motion sensors to light-up sidewalks at night on popular routes

VEHICLE DESIGN

- Expand safety thinking beyond the vehicle itself to those along its route. Leverage SAVs to be “eyes on the street” for local police
QUESTIONS?

Would your community be interested in sponsoring my graduate urban design studio to explore your community’s vision of how to leverage AVs? Let me know edj@gatech.edu

Here’s the url again for the report my studio did for Downtown Atlanta 2041: Autonomous Vehicles and A-Street Grids. https://smartech.gatech.edu/handle/1853/55814

RESEARCH TIMETABLE

**Sept:** analysis of various parameters of 42 current SAV pilot projects.
- Found relatively little discussion of human factors or user experience, but identified the most promising case studies

**Oct:** development of human factors research method for gathering data, phone interviews with the designers of the selected case studies

**Nov:** Identify land-use, urban design and parking retrofit best practices for SAVs and related mobility modes

**Dec:** Illustrate Mobility Hub, station design, and app design possibilities

**Jan:** site visits to assess how different case studies are applying the above

**Spring:** Get feedback and begin writing and drawing for the Best Practices Manual

**September 2019:** Publish