The Disruptions of Driverless Mobility

“Affordable Living”

Auto-optional, sustainable, mixed-use communities
Transportation and housing consume half of the average family’s disposable income.

Today, we’ll focus on transportation.

Source: Federal Highway Administration
Auto-optional lowers housing cost

- Cars sit parked 95% of the time
- America has a billion parking spaces for 250 million vehicles—enough to pave Connecticut
- Up to 30% of our downtown cores are used for parking

Sources: UC Berkeley: Parking Infrastructure and the Environment, ©New Republic
Denver: 237 acres of parking—let’s re-imagine our cities!

Image courtesy of Ryan Keeney, University of Denver
Auto-optional puts money back in tenants’ pockets

The median two-bedroom U.S. city code requirement of 1.5 parking structure spaces consumes about half the area of a typical two-bedroom condo and adds about $375 per month to its rent or mortgage payment.

Source: Seth Goodman, Graphing Parking
The shift away from personally-owned vehicles has already begun.
April 2017 Reuters/Ipsos poll: Of the nearly 25% of American adults who sold or traded in a vehicle in the last 12 months, 9% are switching to ride-hailing services (mostly Uber and Lyft) as their main way to get around.

USDOT: Almost half of today’s 16 to 19 year-olds do not have a drivers license.

*The driver is currently over half the cost of an Uber: What happens when autonomous electric vehicles cut that cost/mile by well over half?*
Automakers are anticipating their own disruption: Electric and autonomous vehicle investments

<table>
<thead>
<tr>
<th>Company</th>
<th>Investment Amount</th>
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<tr>
<td>VW Group</td>
<td>$84 billion</td>
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<td>Daimler</td>
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<td>Intel</td>
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<td>Baidu</td>
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<td>GM</td>
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<td>Tesla</td>
<td>$1 billion/year</td>
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<td>Waymo/Uber/Lyft/et al</td>
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In California alone, there are over 60 companies testing autonomous vehicles.

Sources: CA DMV, Daniel Cardona, Nextremer.com
Ford plans to offer "tens of thousands" of RoboTaxis by 2021

- Ford bought Argo AI (driverless tech) and Spin (electric scooters)
- Ford/Argo is delivering Dominos Pizza in Miami and just announced a delivery deal with Walmart
- Within 3 years all Ford sedans except the Mustang will be EVs
- Ford: Our driverless rides could cost half the price of Uber or Lyft

Source: MIT Technology Review: Nov 2018 Ford Announcement
GM to offer Cruise RoboTaxis in multiple major cities in 2019

- GM acquired Cruise ($1 billion) & Strobe to jump-start RoboTaxi biz
- Honda investing $2.75 billion, Softbank $2.25 billion in GM AV biz
- GM: 20 pure EVs by 2023, plus GM e-scooters and e-bikes
- GM: $1.7 trillion U.S. AV market, "All AVs must be EVs"
- Price/mile far below Uber or Lyft

Source: November 2017 GM Investor Meeting
Google’s Waymo is now commercially available in Phoenix

Eight-passenger driverless service, some with no one behind the wheel

Waymo has ordered 63,000 Pacifica vans

Morgan Stanley just valued Waymo at $175 billion, more than GM, Ford, and Tesla combined

Source: Waymo CEO John Krafcik, 10/31/18
Waymo - Jaguar: 1 million driverless rides/day by 2022

2018: Driverless services in AZ w/ Chrysler vans

Electric I-Pace, 240 mile range

2022: 20,000 Jaguars plus thousands of Chrysler Pacifica’s

Source: WSJ, April 2018 announcement
Google Waymo: Same software, same electronics, many vehicles

Implemented on 5 passenger vehicles plus Peterbilt semi’s

10 million miles of driverless testing on public roads plus 7 billion on simulators
Volkswagen Group: 50 pure electric models by 2025

And at the touch of a button. In other words, the vehicle can be very easily called up – mobility on demand.

©Volkswagen SEDRIC Concept Car
Over a million EVs were sold in China in 2018, an increase of 83% from 2017 and three times as many as were sold in the U.S.

Bloomberg New Energy Finance projects that China will produce 70% of the world's electric-vehicle batteries by 2021.

With about 100 EV startup companies, China is positioned to supply much of the world with reasonably-priced EVs.

Source: OilPrice.com, Nikkei Asian Review

CATL factory in Ningde, China
Here are just two examples of different kinds of potentially disruptive driverless vehicles.
360c Concept Car: Not your grandfather’s Volvo
Volvo’s Vera Autonomous Semi
Here’s why the future of personal mobility will be **Autonomous**, **Electric**, and **Shared**.
Why **Autonomous**?

Because it costs less and saves lives...

*The driver is half of the cost and most of the risk:*

94% of crashes are due to distraction, driver errors, drowsiness, or drunkenness
Why *Electric*? Very low operating expenses

80% of operating costs

- **Maintenance**: No lubrication, so other than tires, very long service intervals
- **Fuel**: Electric is half to a third the cost of gasoline, and a stable & declining cost
- **Depreciation**: Drivetrain lasts 2 to 3 times longer than gasoline vehicles

Sources: Consumer Reports, AAA
And why *Shared*?
Because that’s the only way we’ll beat congestion!

The leading cause of congestion isn’t accidents or road repairs... it’s driving alone!

9 of 10 of rush-hour autos are *single-occupancy*. 
Uber’s Fatal AZ Crash

Uber’s software failed to recognize the cyclist until 1.3 seconds before crash

Automatic braking was turned off due to too many false alarms

The “Safety Driver” was watching *The Voice* on Hulu since leaving the garage

Uber doesn’t monitor all Safety Drivers

This Safety Driver had served four years for armed robbery
By 2027, mobility for a dime a mile per passenger

• Cost of electric driverless mobility services
  ➢ 2 seat vehicle: 18¢/mile
  ➢ 4-5 seat vehicle: 24¢/mile
  ➢ 10¢/mile if you share a ride
  ➢ prices include a 25% pre-tax profit for the operator

• Barclays Capital estimates 8¢/mile with ride sharing

Source: Barclays Capital, May 2015
Projected 2027 annual mobility service cost

Solo ride: Saves $5,965 per year
Ride share: Saves $7,045 per year

Assumes no EV tax credits

Consumers Reports Median Sedan

Sources: Consumer Reports, Our Driverless Future: Heaven or Hell
Trading car ownership for personal mobility

Want a car? Get a driver's license, choose a car, negotiate with dealers, qualify for a loan, make the down payment and monthly payments, pay registration, maintenance, fees, taxes, tires, insurance, inspections, parking fees, then wash and fuel your car...

Or summon a RoboTaxi, or grab a scooter and catch a lift to a bus or light rail, and save thousands!
A Tipping Point

Zero ‘entry cost’ and the desire to save money and simplify our lives will combine to drive the rapid adoption of autonomous electric ride-hailing and micro-mobility services, making new Affordable Living communities appealing places to live.
Affordable Living: How to save over $10,000 per year

- $5,000/year: Uber/Lyft/Waymo or transit instead of car ownership
- No downtown parking plus 50 free commute minutes/day
  - $1,700/year: Median cost of U.S. downtown parking
  - $2,000/year: Freed up time during commuting—240 days times 50 minutes/day times $10 per hour
- $4,500/year: Not needing a garage space saves $375/month on rent or mortgage payments, or $4,500/year

Total savings: $13,200/year
Parking-optional creates a larger pool of eligible buyers

- **No parking** lowers condo prices
- Mobility means no car payments
- More people can qualify for loans
- Thus, a bigger pool of eligible buyers!

Source: Seth Goodman, [Graphing Parking](#)
Targeted residential market segments

• Gen Z and Millennials who don’t want the hassle and expense of owning and parking cars
• Young families who’ll trade a two-car garage for extra living space and a park-like setting
• Seniors downsizing to simplify their lives
• Environmentally conscious consumers
Targeted commercial market segments

• Retail: Grocery, convenience, specialty, electronics,…

• Companies that don’t want the expense of providing parking now that it is no longer tax-deductible

• Companies that are environmentally focused

• Co-working office space companies: WeWork, Regus

• Group Living companies: Common, Ollie and Outside

Source: 2012 American Taxpayer Relief Act
Instead we need...

Public greens rather than garages and concrete

No “free parking” but public garages and short-term car, SUV and RV rentals available

Micro-mobility Vehicle (MMV) rental is included in HOA fee or rentals—about $15/month
Uber/Lyft/MMV Stations are located around the outside perimeter of the property and near interior commercial and residential buildings to minimize greenspace traffic.

Since fewer roadways and parking structures are needed, development costs are lower with both higher density and more public greenspace and gardens.
Food Truck Service Area / Farmers or Artists Market

• A perimeter parking area dedicated to rotating-cuisine food trucks, specialty shops, and even a weekend Farmers Market or pop-up Artists Market

• On summer evenings, these picnic areas show movies or host concerts, speakers or buskers

• Schedules and menus would be shown on LED screens in buildings plus on the Village app and website
Shared bike and scooter fleets are growing exponentially.

*Lime alone is currently doing about 7,000,000 trips per month*

Sources: SmartCitiesDive.com, Emily Castor Warren
The greatest challenge for MMV implementation:
The safety of slow pedestrians mixed in with speedy scooters and bikes

The solution:
Separate Pathways
Separate pedestrian and micro-mobility pathways

- Family and senior-friendly pedestrian pathways
- Separate paths (with soft pavers?) for scooters, eBikes and delivery ‘bots
- 15 mph maximum—with use suspended for reckless behavior
- Village scooters/bikes must be returned to a docking station
Not dockless! Docking controls theft and abandonment

- To rent: Scan QR code & provide biometric ID (finger/voice/face)
- If taken outside the geofenced zone, scooter locks up
- If dumped, renter gets a text and is charged a daily fee until scooters/eBikes are properly returned
Rules for the use of micro-mobility vehicles

- 15 mph maximum, one person per scooter
- Scooter riders must be 18 or older
- 30-day suspension for reckless use; then 90; then one year
- Must dismount when exiting MMV pathway
- Dock MMVs after use or $10/day fine until returned

We’ll provide helmets but we can’t make you use them.
We also won’t pay for your broken bones or brain surgery.
The stylish Hovding airbag helmet

- Automatically detects accidents
- Inflates in a tenth of a second
- Claimed to be 10X safer than conventional helmets, and
- It won’t mess up your hair!!!

*Unfortunately, it costs $340 (cheaper than brain surgery)*

Source: Hovding Airbag for urban cyclists
Unfortunately, some people either can’t understand or just don’t want to understand even the most simple rules.
Micro-mobility as a public transit partner

- MMVs can help address first/last mile problem—but piles of bikes near transit stations is unacceptable
- We need more bike lanes and fewer MMV’s on sidewalks
- With reasonable rules, a partnership could grow transit ridership while also benefiting MMV vendors
- MMVs can also expand the radius of transit-oriented development
Fun for all ages—but cities will need more bike lanes!
Scooters are becoming increasingly sophisticated

- Geofenced speed governor
- Automated crash detection
- Automated parking restrictions
- Cloud-based fleet management with hardware monitoring and automated maintenance tickets

Source: The Verge, Superpedestrian scooter
Morgan Stanley recently valued Google's Waymo at $175 billion, more than GM, Ford, and Tesla combined.

Juicers are paid to charge scooters, which can lead to problems.
Residents just pop into a 24/7 battery swap kiosk if the MMV needs “charging.” One-minute battery swap minimizes customer delays and reduces operating costs.
Examples of micro-mobility vehicles (MMVs)

- **Upright e-scooter**
  - 15mph
- **2-wheel winter e-bike**
  - To 40mph
- **Seated e-scooter**
  - Street legal: To 40mph
- **3-wheel e-trike**
  - Max 15mph
Torrot’s Velocipedo enclosed scooter-car

Two passenger, 59 mph, 60-mile range, 540-lb, $6,800, carbon fiber cage w/ seat belts, enclosed glass all-weather cabin

Swappable batteries, front and rear hydraulic disc brakes, USB charging, OTA app w/ GPS, predictive maintenance, driver analytics, crash and theft notification, fleet management

Source: Electrek.co
For those with moderate physical disabilities

Some folks may be able to climb onboard a three-wheeler with minimum if any assistance, but we’ll need to insure that all on-property stores and restaurants are accessible and appropriately equipped with conventional wheelchairs.
Other forms of micro-mobility

Serve: food and grocery delivery robot—up to 50 pounds

Nuro autonomous delivery vehicle
Intel/Strategy Analytics estimates 2040 economic impact of driverless vehicles at $4 trillion, delivery services at $3 trillion.

Commercial and consumer deliveries: meals, retail shopping, business-to-business, etc.

©NURO/Kroger’s

Source: Fortune Magazine
Continental’s new delivery “RoboDogs”

At the January 2019 Las Vegas CES show, Continental debuted a new concept for doorstep package delivery using robotic dogs.

Source: CNET RoadShow
Conclusions

- Affordable Living concepts apply to all age and income levels
- These concepts can work now using Uber/Lyft or public transit, but will save even more with low-cost electric RoboTaxis
- Combined commercial, retail and residential means easy access to employment, healthcare, job training, groceries and more
- The low-carbon footprint of Affordable Living will matter more and more as our planet grows warmer
Your questions/comments