"The Future of Cars on Campus: Parking or Perish?"

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They are h-e-r-e!!
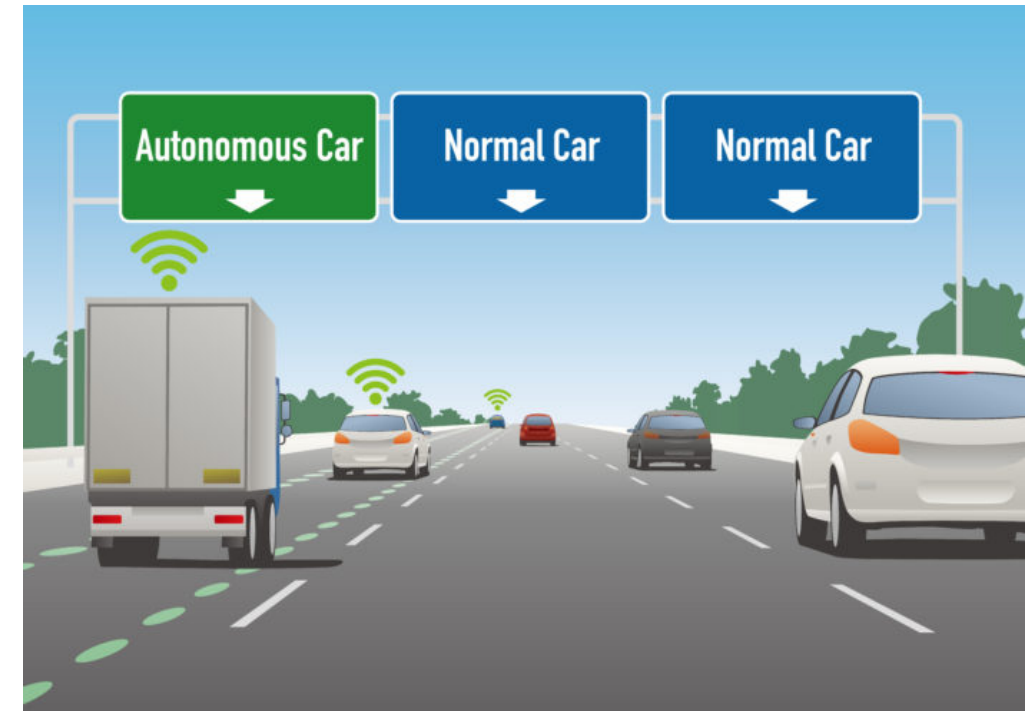
Autonomous vehicles are coming to your campus NOW!

The Building Blocks of Autonomy — Prepared by Vision Systems Intelligence. Copyright 2016 – Vision Systems Intelligence, LLC.

The Auto Industry is Ready…. Are You?

Fully autonomous vehicles (AV's) will be commercially available <u>BEFORE</u> 2020

- Tesla Model 3 "Autopilot" – first mass market car to come fully equipped with AV technology

- Autonomous taxis will add $2.3 Trillion to our annual economic output by 2035

- Auto accident rates will drop by over 80%, saving over 140,000 lives by 2035

- By 2030, AV's will increase traffic by 30%

- Release and use of AV's is being restricted by regulatory bodies and state policies not keeping up with this disruptive technology change

FIGURE 1
All-In Cost Per Mile of Vehicle Services

$3.50	$2.86	$0.70	$0.35
Average US Taxi	Uber San Francisco	Personal Car	Autonomous Taxi 2020
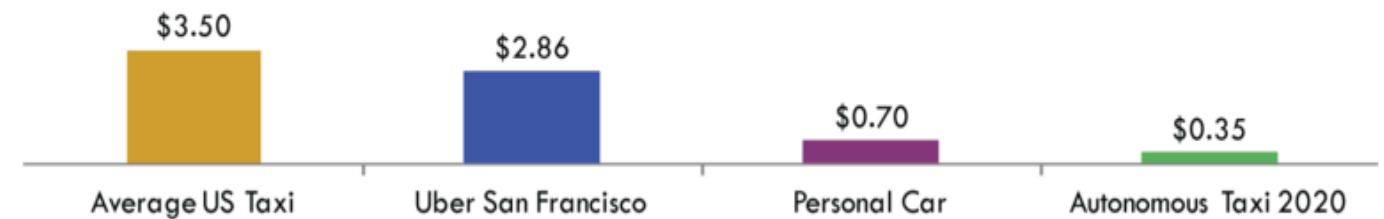
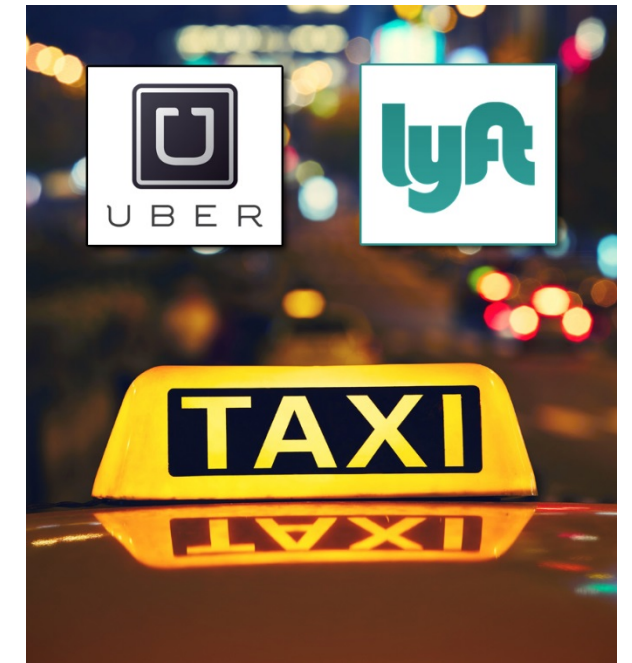Source: ARK Investment Management LLC

Millennials and GenZ's are not driving

University of Michigan Transportation Research Institute Study (Sivak and Schoettle, 2016)
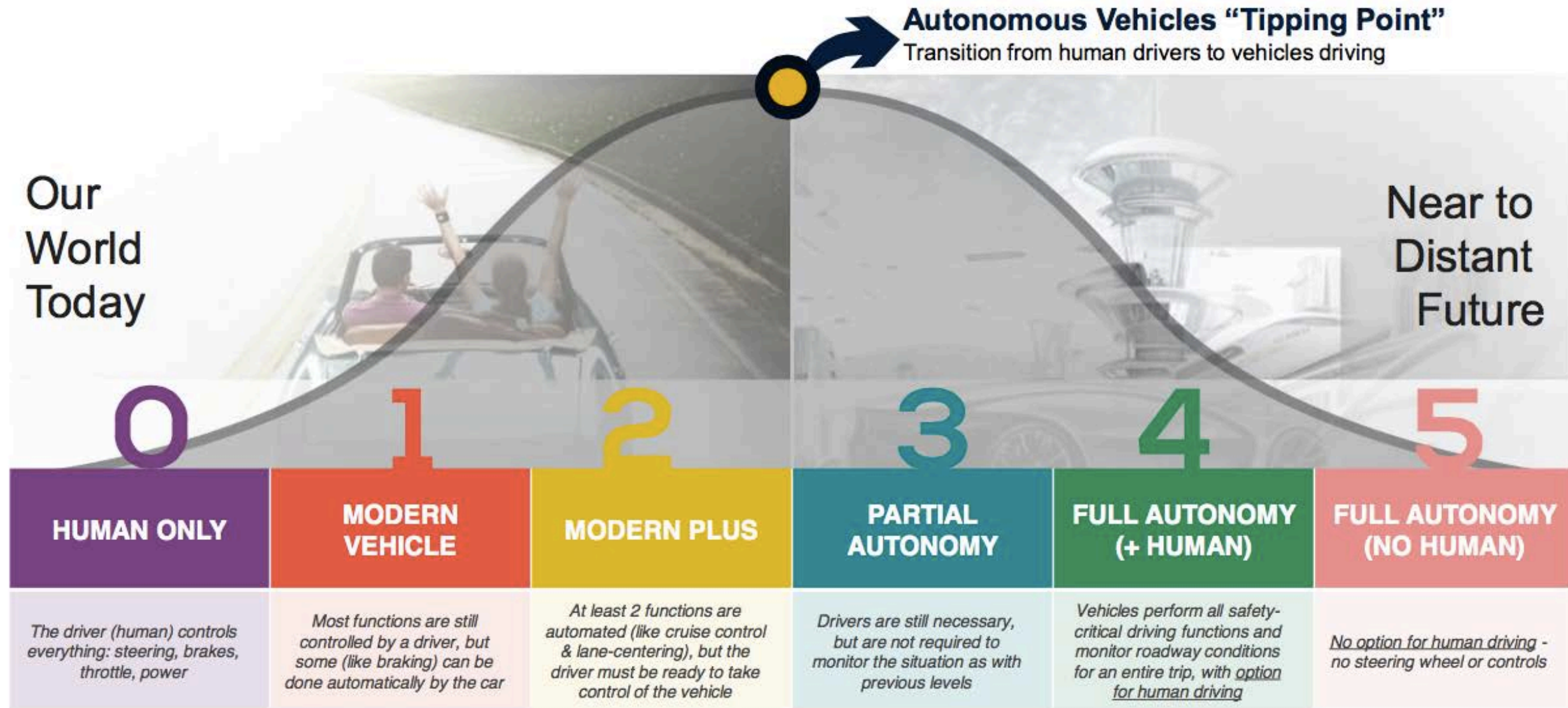
- 1 in 5, 20-24 year olds don't have a driver's license and 22% <u>never</u> plan to get a license
- 1983 (92%) to 2014 (76%) - 16% drop in 10 yrs.

- Young people are moving to large cities that have great transit, bicycle networks & ridesharing

- Top 8 reasons for not getting a driver's license:
  1. Too busy/not enough time to get a driver's license
  2. Owning/maintaining a vehicle is too expensive
  3. Able to get transportation from others
  4. Prefer to bike/walk
  5. Prefer to use public transportation
  6. Concerned about how driving impacts the environment
  7. Able to communicate/conduct business online instead
  8. Disability/medical/vision problems

As of January 2017...
- *Uber* - 8 Million Users Worldwide ($51B)
- Lyft – 631,000 Users Worldwide ($1.2B)
- In 2013 Google invested $258M in *Uber*
- In 2016 GM invested $500M in *Lyft*

The levels of Autonomous Vehicles

Autonomous Vehicles "Tipping Point"
Transition from human drivers to vehicles driving

Our World Today

Near to Distant Future

0	1	2	3	4	5
HUMAN ONLY	**MODERN VEHICLE**	**MODERN PLUS**	**PARTIAL AUTONOMY**	**FULL AUTONOMY (+ HUMAN)**	**FULL AUTONOMY (NO HUMAN)**
The driver (human) controls everything: steering, brakes, throttle, power	Most functions are still controlled by a driver, but some (like braking) can be done automatically by the car	At least 2 functions are automated (like cruise control & lane-centering), but the driver must be ready to take control of the vehicle	Drivers are still necessary, but are not required to monitor the situation as with previous levels	Vehicles perform all safety-critical driving functions and monitor roadway conditions for an entire trip, with _option for human driving_	_No option for human driving - no steering wheel or controls_

http://www.techrepublic.com/article/autonomous-driving-levels-0-to-5-understanding-the-differences/

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US Department of Transportation Research Grants
"Feds Open Door for University of Wisconsin Researchers to Test Driverless Cars" – Jan. 25, 2017

- UW-Madison is 1 of 10 national research ctrs.
    1. City of Pittsburgh
    2. Texas AV Proving Grounds
    3. U.S. Army, Aberdeen
    4. American Center for Mobility, Willow Run
    5. Contra Costa Transportation Authority
    6. San Diego Assoc. of Governments
    7. Iowa City Area Dev Group
    8. University of Wisconsin-Madison
    9. Central Florida AV Partners
    10. North Carolina Turnpike Authority

- Research will include:
    - Impacts in heavy pedestrian traffic
    - Operability in cold and snowy areas
    - Transition from all-human driven to all autonomous vehicles
    - Self-driving mini-buses with point-to-point service
    - "Community of Practice" to accelerate the safe testing & deployment of AV's

Campus Planning Design Impacts

What does this mean for the future of parking on our university campuses?

- Will we need parking facilities on our campuses in 10, 20 or 30 years??

- Cost of Parking Development Per Space
  - $2,500 surface parking space
  - $20,000 structured parking space
  - $80,000 under building/underground space

- Parking Structures typical use 25 to 30-year bonds

- With this disruptive change in transportation, should we build parking structures now or in the next 20 years?
- What about all the existing parking structures?

Will we need more transit centers and drop-off zones to accommodate more AV's and Rideshares?

Adaptive Reuse Facilities???

Phase 1: 2018-2025
Garage adapts to autonomous vehicles.

Today, the typical car is used only 5% of the time.
(95% of the time it is parked in a garage, at a house, or on the street.)

However, by the time today's garages are built,
self-parking cars and shared fleets will likely be a reality.

Driverless vehicle storage is packed in hyper-efficient rows on the top level.
Garages designed for autonomous or self-parking vehicles can substantially increase their efficiency and use **60% less space.**

Floor-to-floor heights are designed to accommodate future uses such as residential or office.

Conventional parking on lower levels for increased accessibility.

By 2025, fully autonomous cars are expected to be available to the general public for an additional $10,00.
Source: Boston Consulting Group

ARROWSTREET

Image by: Arrowstreet, Inc. (Boston, MA)

Adaptive Reuse Facilities???

Phase 2: 2025-2035
Building adapts to fully autonomous vehicles and new uses.

As car ownership evolves to a subscription service with intelligent fleets, there will be less need for parking.

Garages are transformed into other uses, such as offices, residential, and hotels.

In 2035, the need for parking is estimated to decline by more than 5.7 billion square meters in the United States.

(This equates to half the size of Connecticut) Source: The McKinsey & Co.

Upper levels evolve into residential, office, recreation and entertainment spaces.

Buildings adapt to accept packages from drones, eliminating loading docks and need for delivery vehicles.

Vehicles automatically charge when not being driven.

Users call cars via personal mobile devices and pick up vehicles in retrieval zones.

ARROWSTREET

Image by: Arrowstreet, Inc. (Boston, MA)

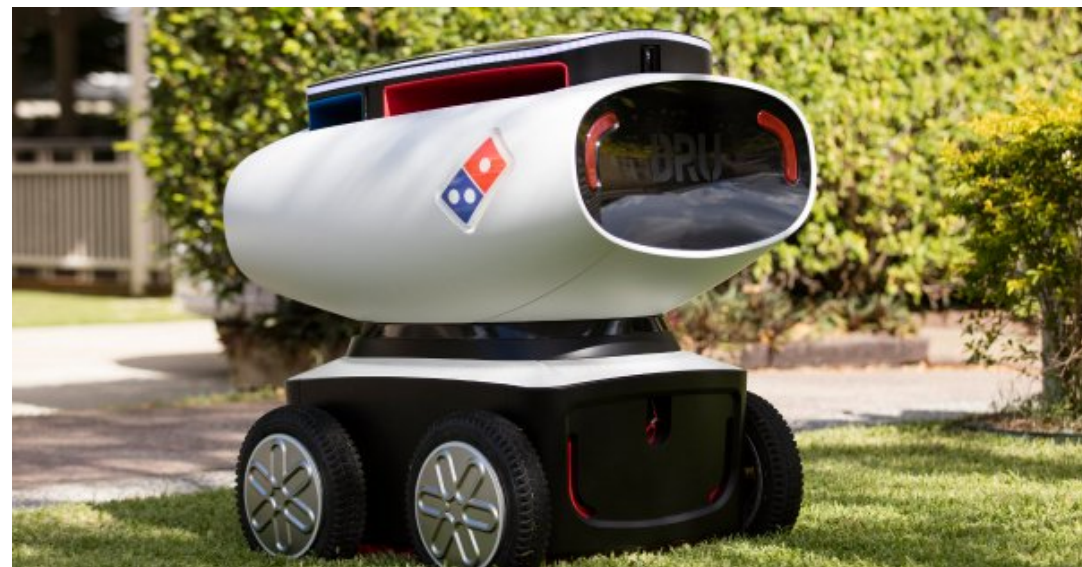# … And if we thought that was bad…. Robotic Delivery Drones!

Coming to a campus near you!

- *Tapingo* – on-ling ordering & delivery app
  - "The #1 mobile commerce app on campus!"
  - "A Better Way to Buy!"
  - "Never Wait in Line Again!"
  - "Focus on More Important Things in Your Life!"

Yelp's Eat24 "Marble" – San Francisco, CA 2017

Domino's "DRU" - Australia

"Kiwi" on the UC Berkeley campus – May 2017

Starship Technologies – February 2017
Washington, DC and Redwood City, CA