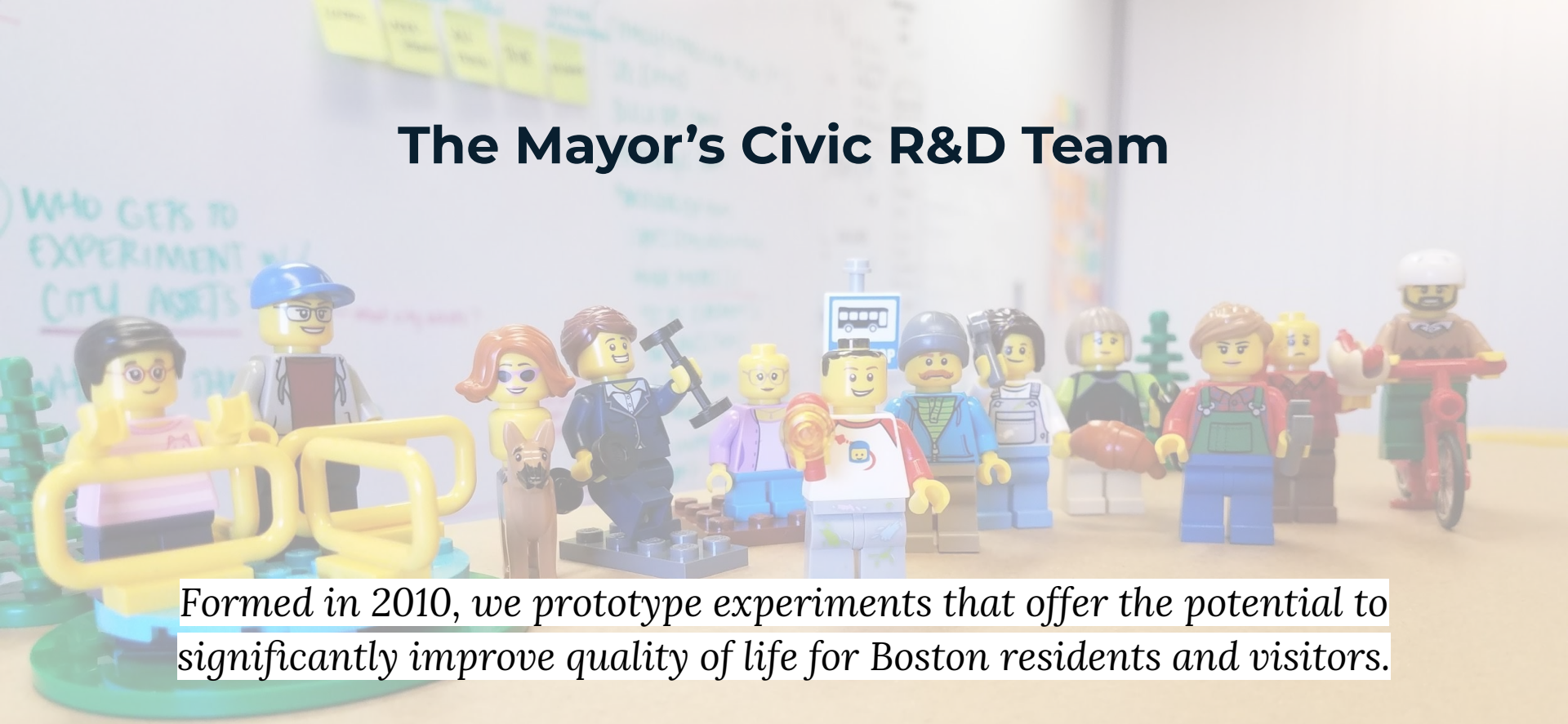
A Pick-up Game with Lebron James:

the complex future of mobility in Boston

City of Boston
Mayor Martin J. Walsh

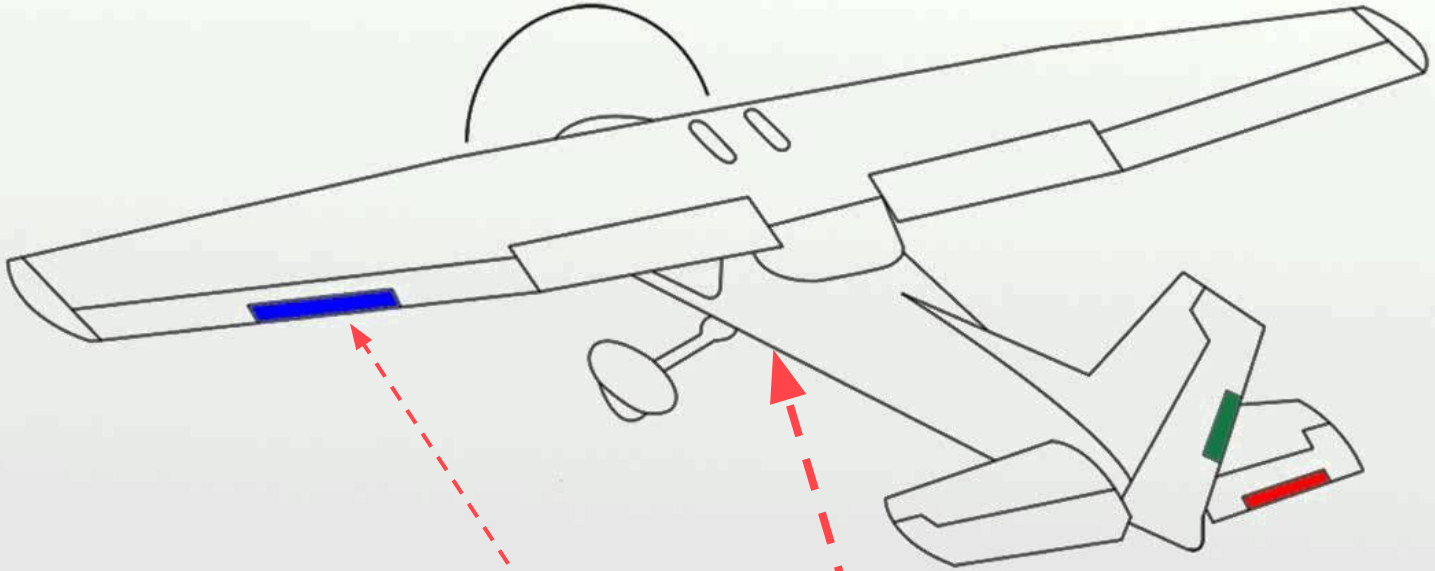
Kris Carter
Mayor's Office of New Urban Mechanics
Cities Dialogue on Automated Mobility
September 17, 2019

The Mayor's Civic R&D Team



Formed in 2010, we prototype experiments that offer the potential to significantly improve quality of life for Boston residents and visitors.

Trim tab



Me & My Team

Government

1. What is our motivation for experimentation?
2. Three mobility-related prototypes
3. Deeper dive into AV testing in Boston
4. Beyond Testing: What have we learned so far?

Boston: *Some Context*

125 km² *pop.***685,000**

Facts & Figures

Key characteristics

Population: 685,000 inhabitants
990,000 at daytime
4.5 Million in Metro Boston
8% growth 2010-2015

Pop.-density: 4,800 inh./km²

Size: 125 km²

Household income: $54,485

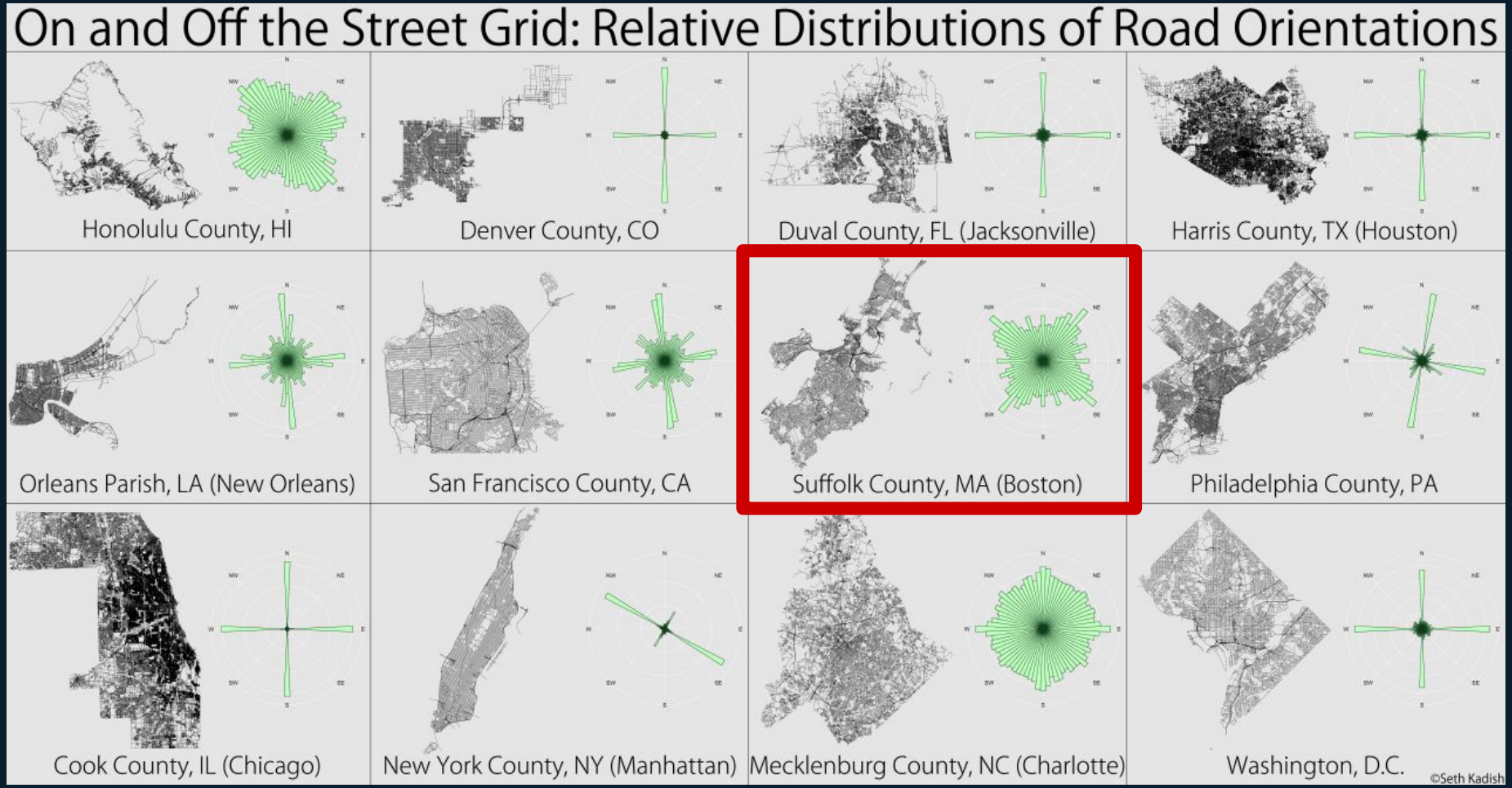
Unemployment rate: 3.5%

Private car ownership: 60% of households

Roadways: 850 miles

Getting to work: 40% drive alone, 5% carpool
33% use mass transit
15% walk, 2% bike

Boston: *Some Context of our roadways*



Worst Traffic in America *(if you're in a car)*

Inrix Global Traffic Scorecard

URBAN AREA	2018 IMPACT RANK (2017)	HOURS LOST IN CONGESTION
Moscow	1 (1)	210 (10)
Istanbul	2 (3)	157 (32)
Bogota	3 (2)	272 (1)
Mexico City	4 (4)	218 (9)
Sao Paulo	5 (5)	154 (39)
London	6 (6)	227 (6)
Rio de Janeiro	7 (8)	199 (13)
Boston, MA	8 (7)	164 (25)
Saint Petersburg	9 (9)	200 (12)
Rome	10 (13)	254 (2)

Source: Inrix Traffic Scorecard 2018

Autonomous Vehicles: *Made in Detroit. Tested in Boston.*

ALEX DAVIES AND AARIAN MARSHALL TRANSPORTATION 11.22.16 09:11 AM

SELF-DRIVING CARS WILL LOVE THE DRIVING HELL THAT IS BOSTON

Source: Wired Nov. 2016

Autonomous Vehicles: *Made in Detroit. Tested in Boston.*

BOSTON

Dan Primack
@danprimack
Follow

Lyft/NuTonomy choosing Boston to test its self-driving cars is like choosing to play against LeBron in a pickup game.

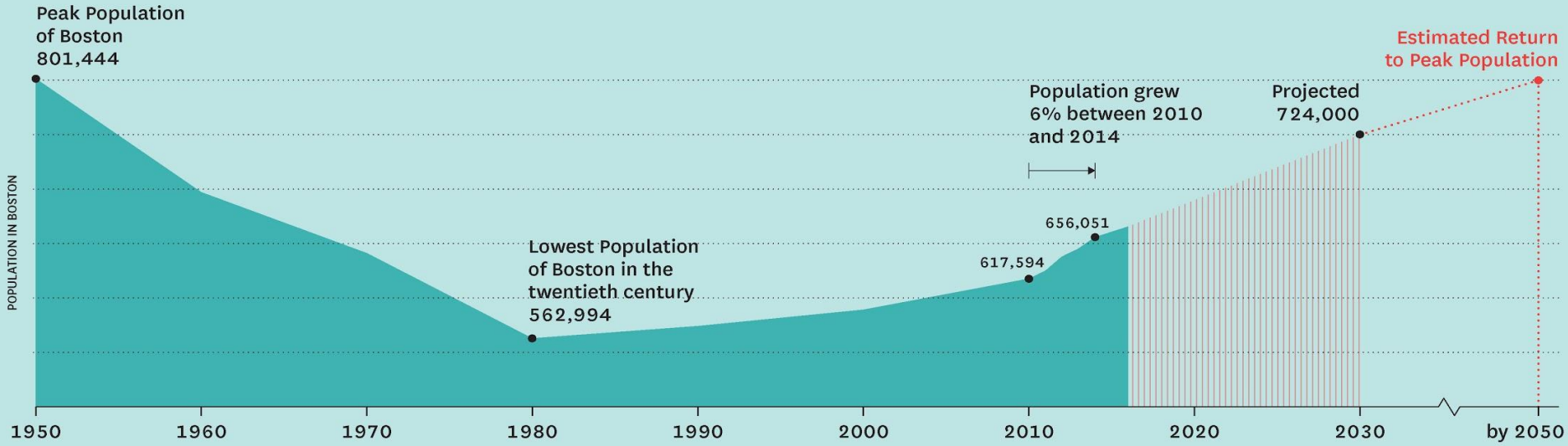
AVs

What are we *really* trying to solve for?

Increasing Inequality

Source: Brookings Institute
Graphic by Huntington News

Rapid Population Growth



The Effects of Climate Change

f Boston
r Martin J. Walsh

GoBoston 2030 Goals

ACCESS

Make Boston's neighborhoods interconnected for all modes of travel

SAFETY

Collaborate on design & education to substantially reduce collisions on every street

RELIABILITY

Prioritize making travel predictable on Boston's transit and roadway networks

GoBoston 2030 *Mode Shift Goals*

Boston Commuters	Share Today	2030 Aspirational
Public Transit	**33%**	**44%**
Walk	14.5%	20%
Bike	1.9%	8%
Carpool	5.4%	5%
Drive Alone	**40.6%**	**18%**
Other, Work from home	4.5%	5%

Three Case Studies of Boston Mobility Experimentation

PROTOTYPE #1:
How can we change the culture of driving in Boston?

PROTOTYPE #2:
How can we be more equitable in our approach?

PROTOTYPE #3:
How can we nudge a mobility revolution towards a better societal outcome?

PROTOTYPE #1:

Can we change the culture of driving in Boston?

93% of drivers surveyed,
rate themselves as above average.

Also known as "illusory Superiority"
a
Svenson, O (1981).
"Are we all less risky and more skillful than our fellow drivers?"
**93% is from the USA driver sample*

Allstate Insurance awards **Boston**
“worst drivers in the nation” two years in a row.

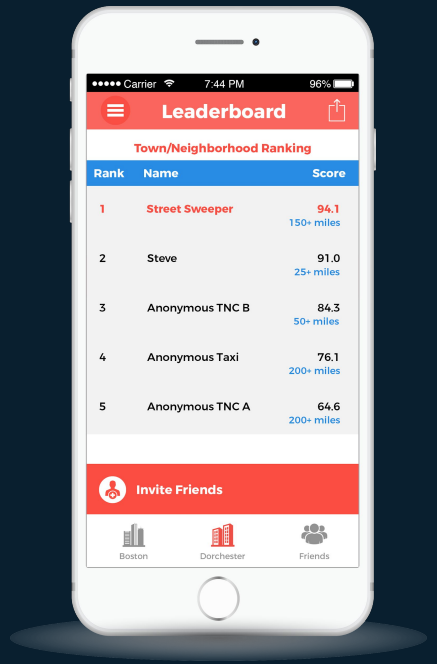
The typical driver in America gets into a collision once every **10 years.**
The typical driver in Boston gets into a collision once every **3.7 years.**

The Paradox: *an app for safer driving*

- Runs in the background
- Generates a Score out of 100
- Leaderboards & badges
- Points for “non-car” trips
- $10,000 in prizes

The Five Evaluated Behaviors

1. Phone Distraction
2. Speeding
3. Rapid Acceleration
4. Harsh Braking
5. Harsh Cornering



City of Boston
Mayor Martin J. Walsh

“This app *finally* allows me to prove to my husband I’m a better driver.”

Carrie, Charlestown, MA

Actual Impact: *3 Million Miles & 300,000+ trips*

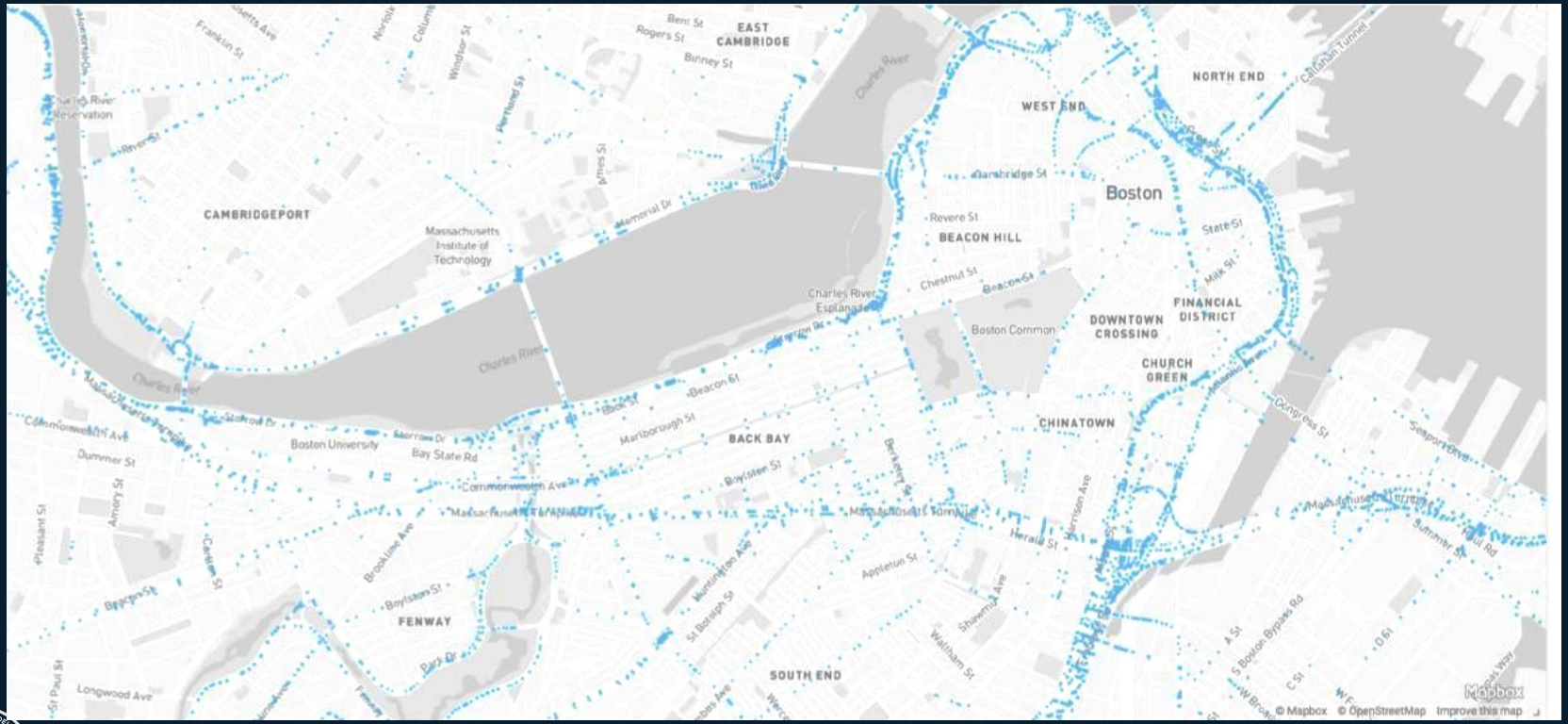
Over 10-weeks, among the top 25% of users...

Phone distraction scores dropped by -47%

Harsh braking scores dropped by -37%

Speeding scores dropped by -35%

Speeding events over one week *[> 6 mph over speed limit]*



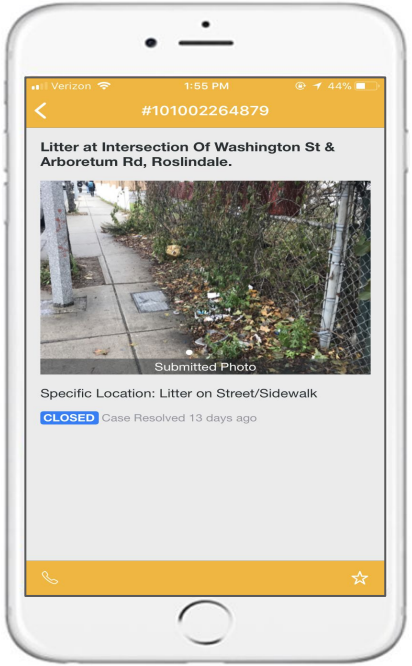
Phone Use Events over One Week

PROTOTYPE #2:

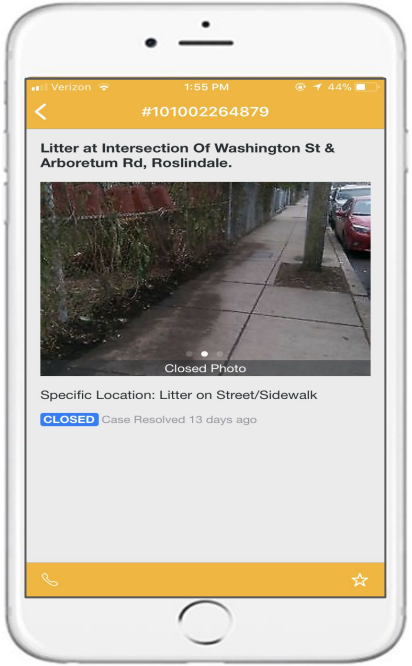
How can we be more equitable in our approach?

Civic Engagement with 3-1-1

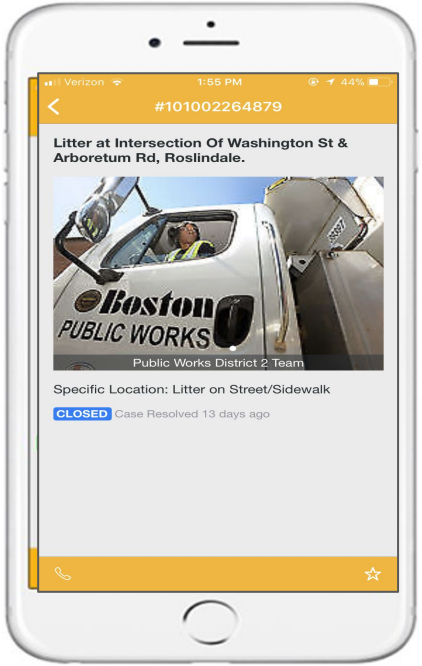
The Problem



The Result



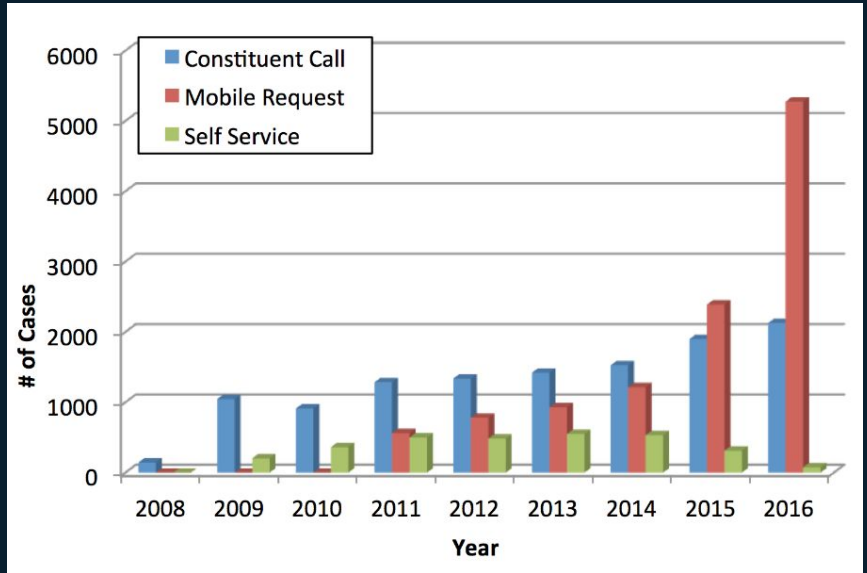
The Team



Too Much Civic Engagement?

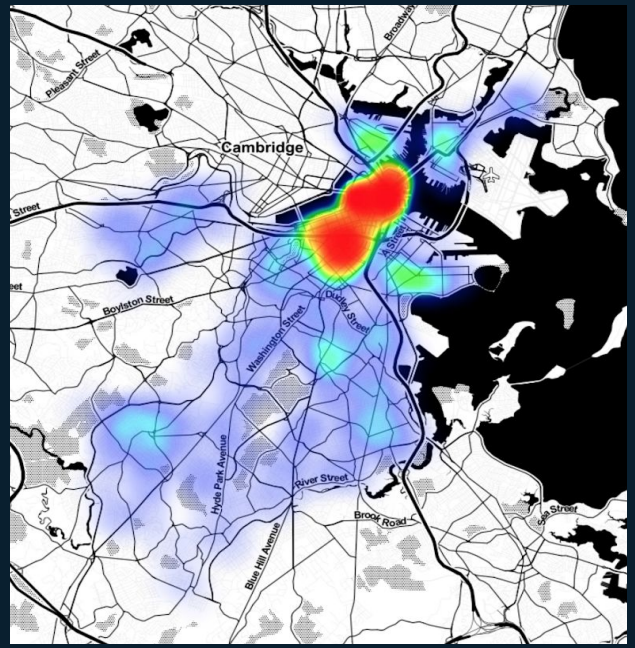
- The City used constituent requests to determine repair locations with the promise that all requests will be met within 18-24 months.

- After updating the 3-1-1 app to be more user-centered, the number of requests skyrocketed and made this “promise” impossible, creating a $500M repair backlog

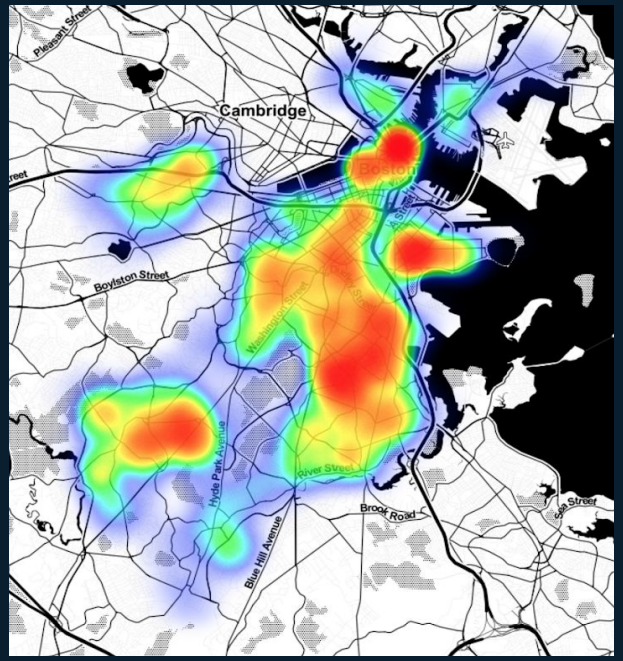


A Look at Repair Requests

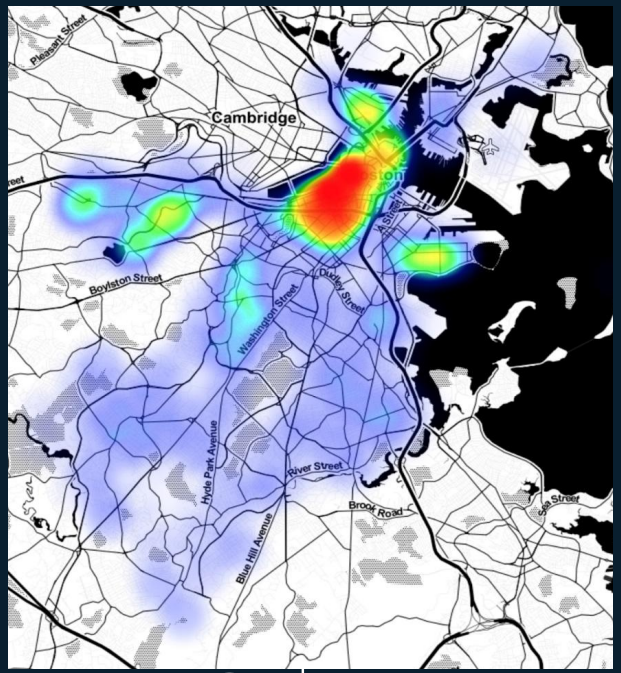
Requests
(red=high frequency)



Sidewalk Conditions
(red=poor)



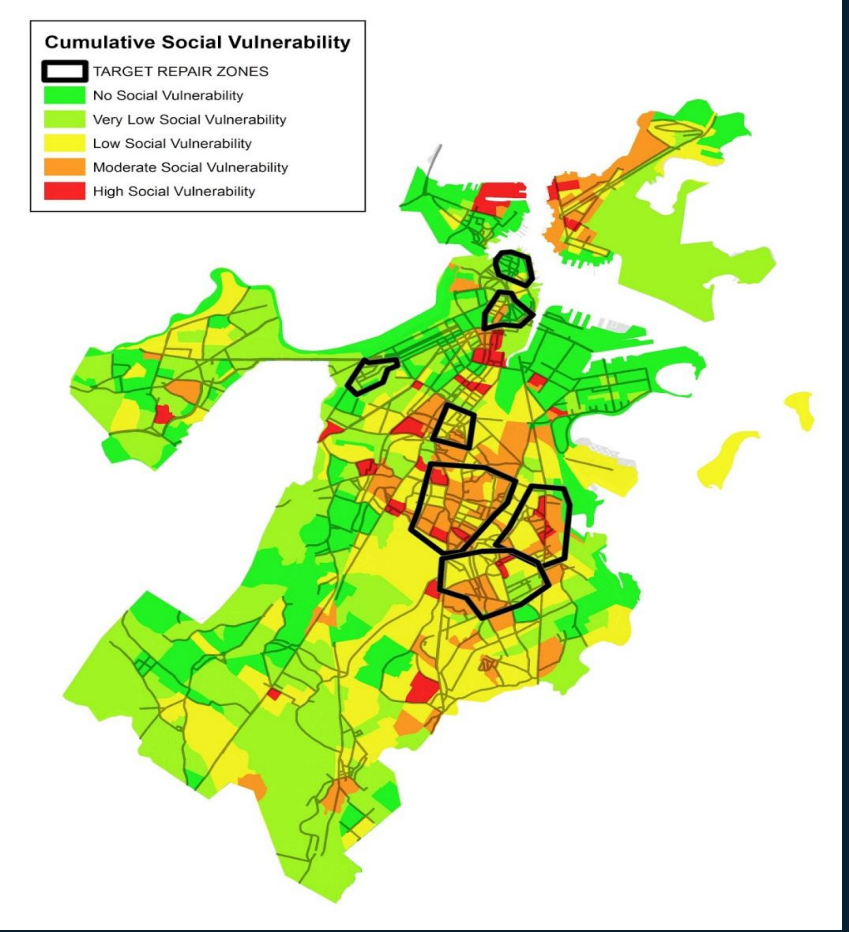
Per Capita Income
(red=highest)



Our New Strategy

Look for ***highest impact per dollar, increase effectiveness, focus on people***

- Full replacement instead of partial repairs
- Prioritize repairs where people are/walk the most **(high priority network)**
- Prioritize where our repairs will help citizens the most (**social vulnerability)**



PROTOTYPE EXAMPLE #3:

How can we nudge a mobility revolution towards better societal outcomes?

How will autonomous vehicles help us achieve these goals?

SAFETY **ACCESS** **RELIABILITY**

SAFER STREETS

for Bicyclists & Pedestrians

94% of crashes in the USA are a result of human error
28% of fatal crashes in the USA are alcohol related

2017 in Boston

14
FATALITIES

4,537
SERIOUS INJURIES

Sources: 2017 Boston Vision Zero
2016 NHTSA

City of Boston
Mayor Martin J. Walsh

BETTER ACCESS

Could autonomous micro-buses better connect Mattapan to rapid transit?

The longer an average commute...the worse the chances of low-income families moving up the ladder. Commute time has a stronger correlation than crime rates, school test scores, or family structure.

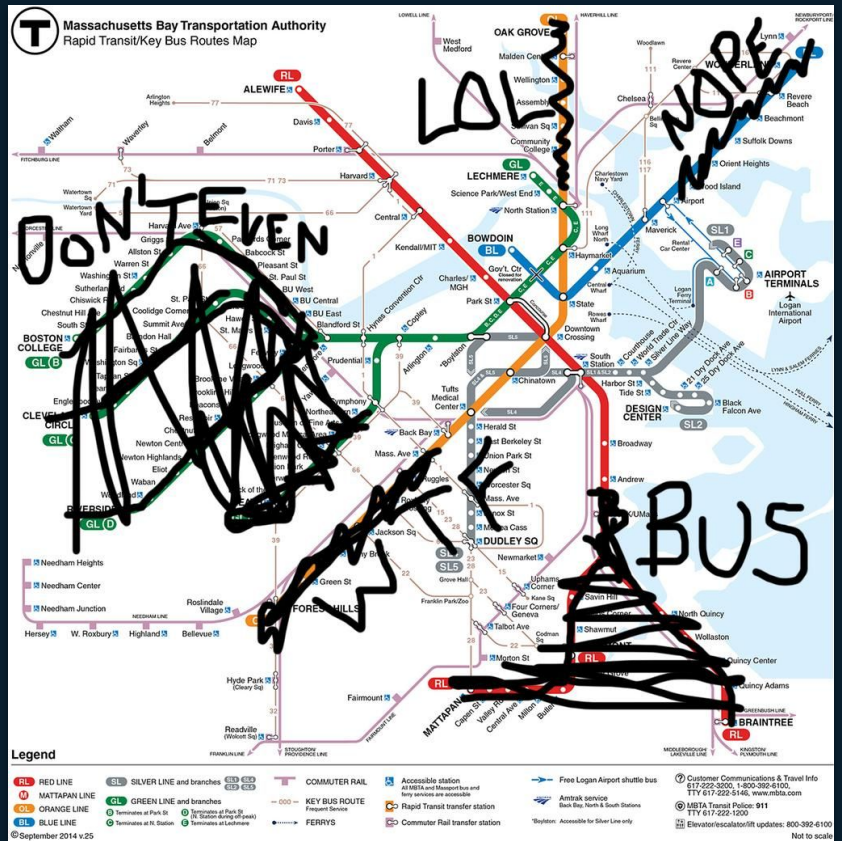
"The Impacts of Neighborhoods on Intergenerational Mobility"
Raj Chetty and Nathaniel Hendren, Harvard University

The average commute in Boston is 28 minutes

24% of Mattapan residents have a commute over 60 minutes

MUST BE RELIABLE TO BE MEANINGFUL

Mobility options that don't work in snow, don't work for us.

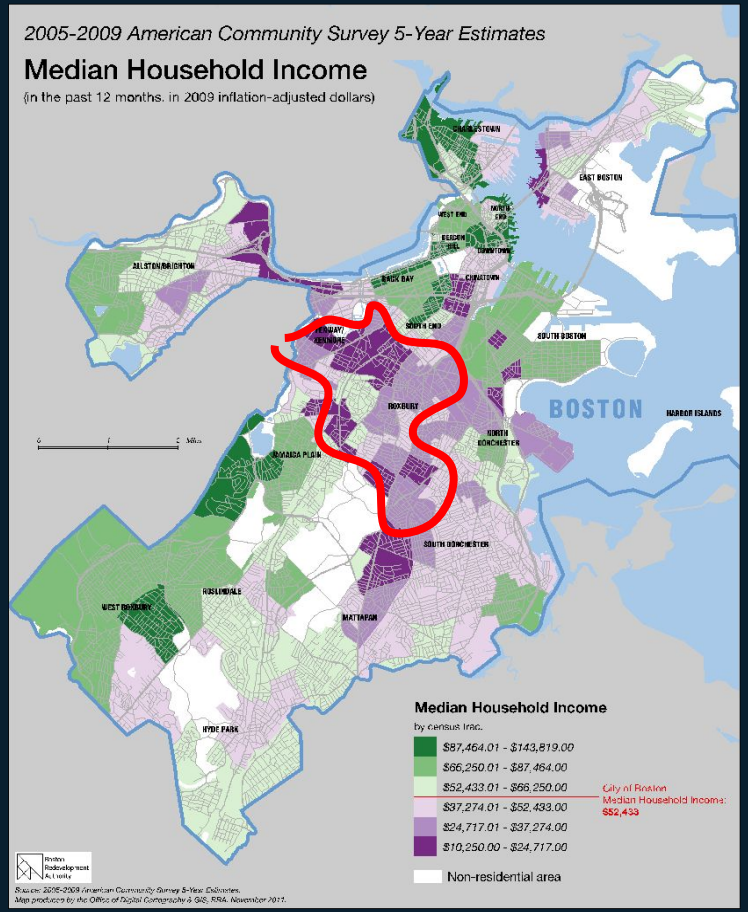


Unofficial Winter 2015 Snow Map

Source: MBTA Snow Map, Sara Morrison

ENSURE EQUITY

Who should ensure that algorithms are not biased?



If you’re not at the table, you’re on the menu

***Wenn Sie nicht am Tisch sind, sind Sie auf der Speisekarte**

*from google translate

MAYOR WALSH SIGNS EXECUTIVE ORDER ON AUTONOMOUS VEHICLES

"...that our expected preferred deployment will be **fleets of autonomous vehicles that are electric and shared**...**ensure equitable access to opportunity** for those least well served by transportation options today, including seniors, youth, and those with physical disabilities."

All documents available at Boston.gov/boston-av

Testing: Goals stated in Executive Order

putting city needs at the center of testing

- ❑ Expand transportation choices to more neighborhoods
- ❑ Complement mass transit services
- ❑ Reduce single occupancy car trips
- ❑ Ensure equitable access for seniors, youth, and those with disabilities
- ❑ Reinforce the importance of walking, biking, and mass transit
- ❑ Reduce the use of carbon emitting vehicles

Our Plan: Build trust between citizens, city, and companies

Self-driving cars attacked by angry San Francisco residents

Uber Says It Will Resume Self-Driving Tests; Pittsburgh Is Peeved

City's mayor upset over being left in the dark.

Boston's Three Part Process

1. **Memorandum of Understanding** (Shared Risk = Shared Rewards)
   a. Between City, State, and Company on shared goals and commitment to learning together

2. **Application**
   a. Documenting experience and safety protocols
   b. Details type of vehicles and objectives of testing

3. **Testing Plan**
   a. Use case focused
   b. Geographically and ODD constrained

Testing: *Current Testing Partners*

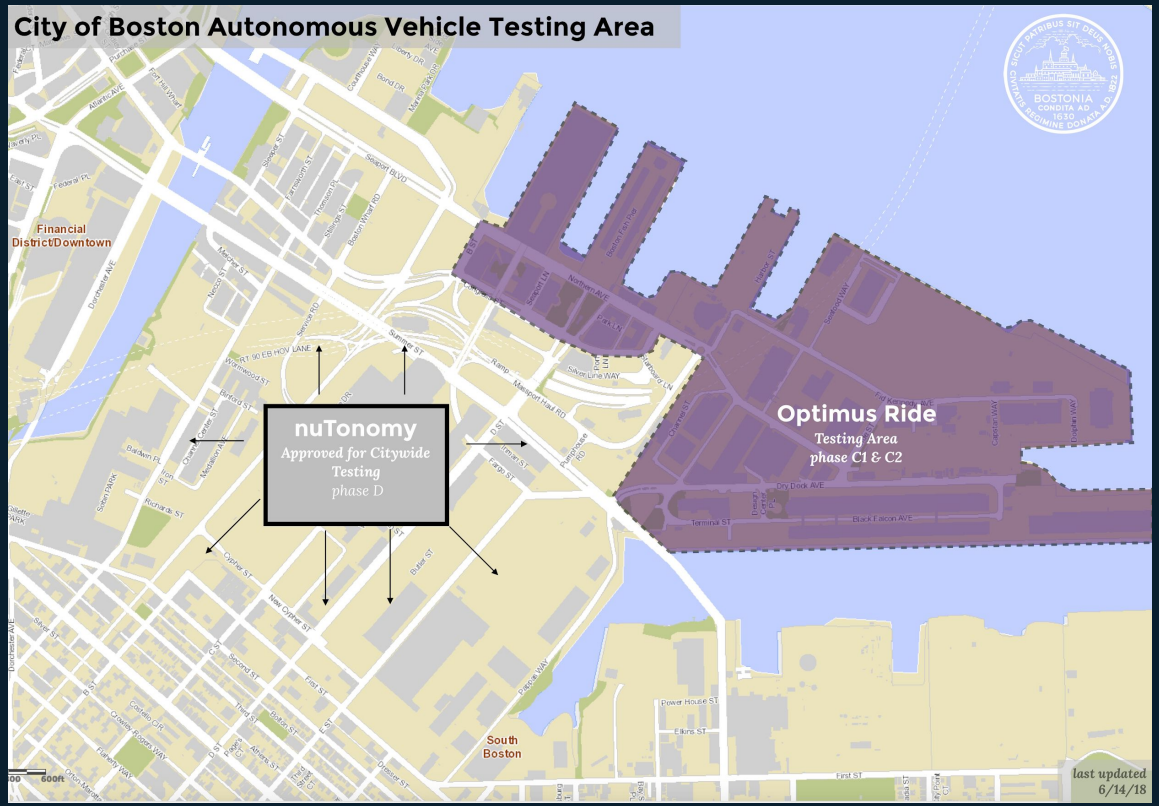
nuTonomy

"full-stack" & ride-hailing

Optimus Ride

"Super TOD"
first/last mile

Testing: *Phased Approach*



Generic Example (individual plans vary)

Full documentation of testing plans and approvals are in the "related documents" section at www.boston.gov/Boston-AV

City of Boston
Mayor Martin J. Walsh

Testing: *Quarterly Reports*

Traffic signal solar glare, roadway ponding, snow removal, left turns, and other issues highlighted for further discussion & research. Not much quantitative data.

Passenger pilots require 15% of people have mobility impairments

Each Quarterly Report can be viewed at www.boston.gov/boston-av
The report referencing passenger pilots from nutonomy can be found: https://www.boston.gov/sites/default/files/document-file-02-2018/q4_report.pdf

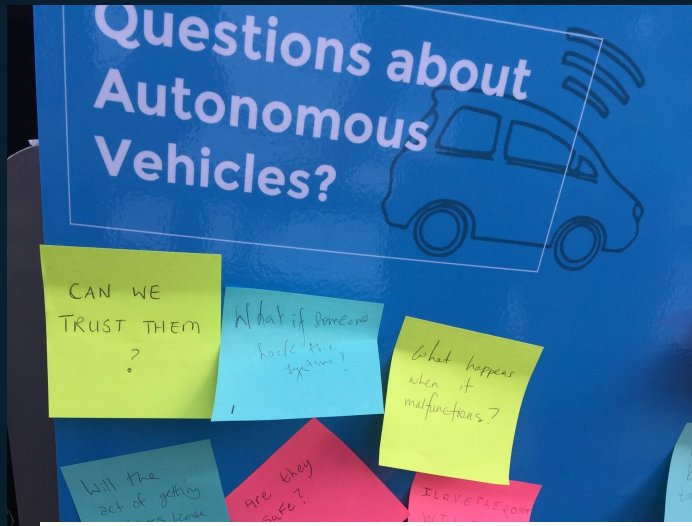
Infrastructure Learnings

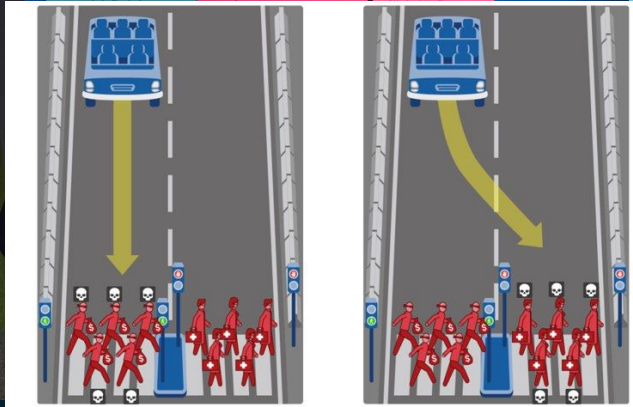
One Observation from testing in Boston

Early Learnings from Boston

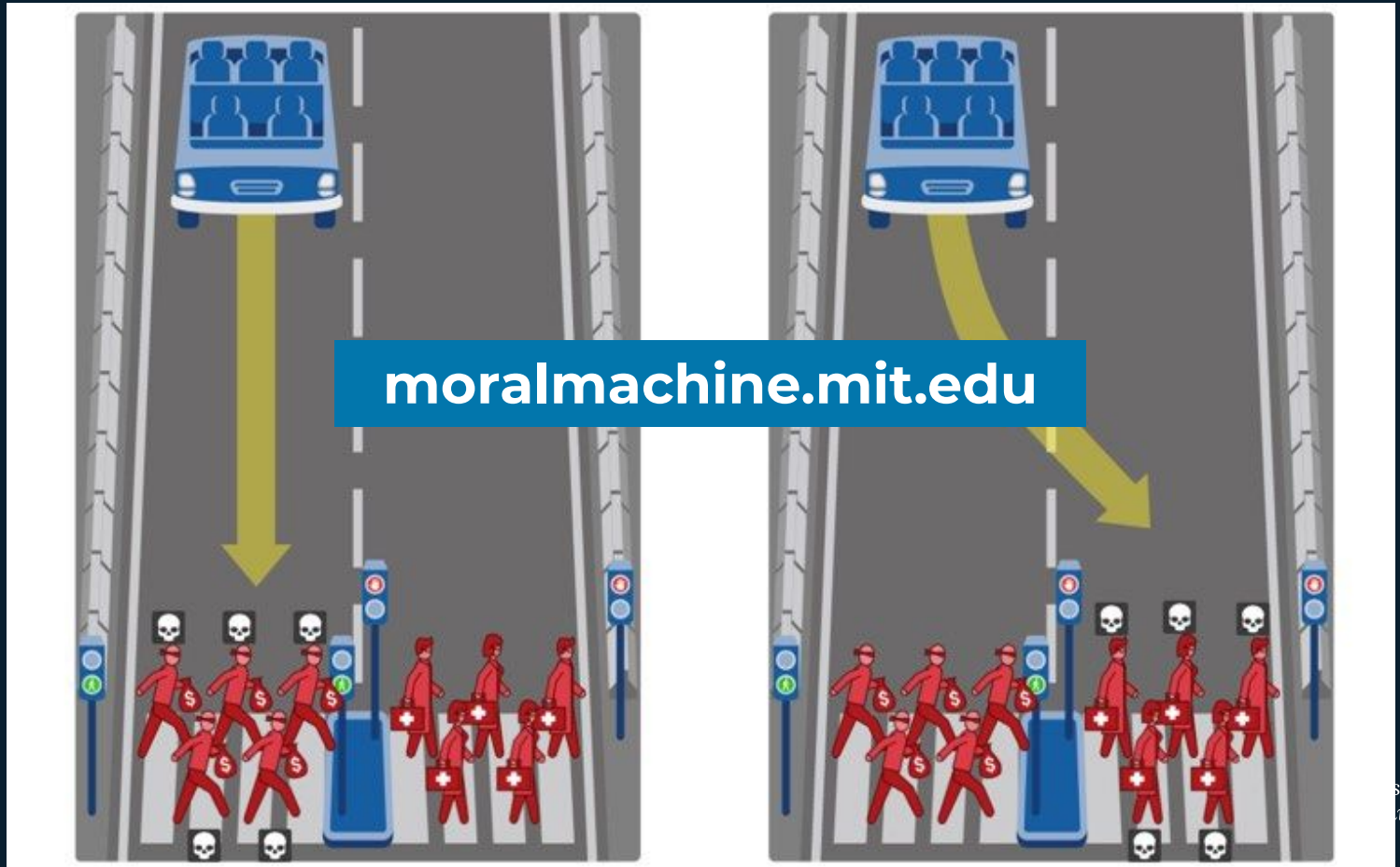
1. Cities need to set a clear mobility vision
2. Strong relationships are critical for trust and collaboration
3. Don’t let the perfect be the enemy of the good
4. Iterate (*you will get things wrong*)

Community Engagement: *AV Petting Zoo & Robot Block Party*

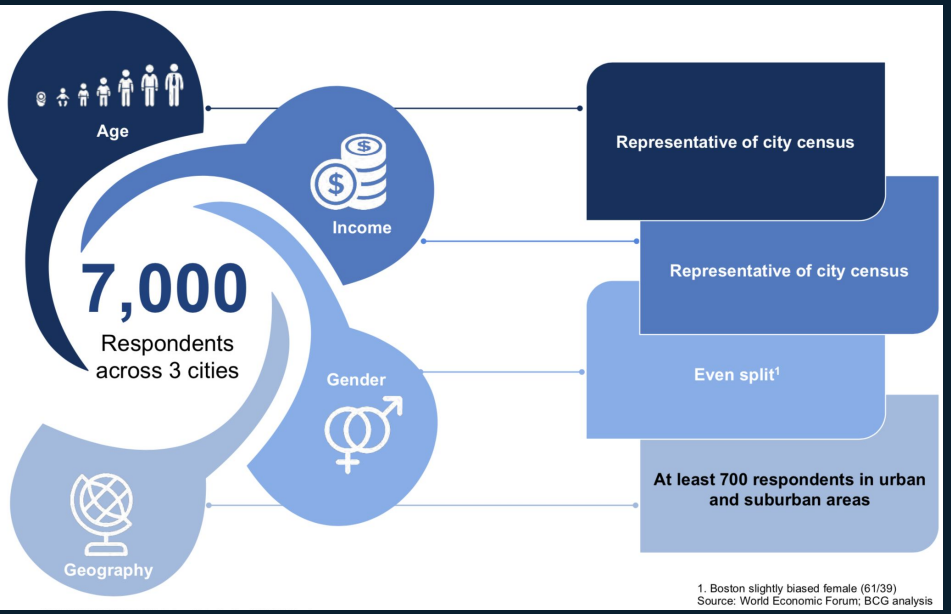


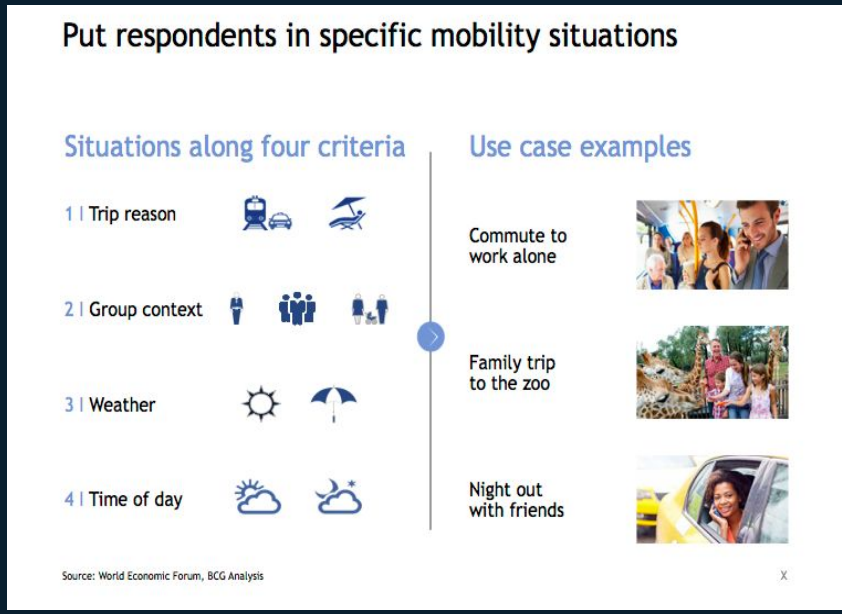


Community Engagement: *AV Petting Zoo & Robot Block Party*



Research: *AV Impact Study*





Full Report: http://www3.weforum.org/docs/WEF_Reshaping_Urban_Mobility_with_Autonomous_Vehicles_2018.pdf
source: World Economic Forum & BCG analysis, 2018

What Else Did They Learn About Boston & *Berlin*?

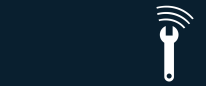
1. Higher AV adoption in urban areas than suburban
2. 20% of people will use a personal car no matter what
3. The shorter the trip, the higher the AV adoption

source: World Economic Forum & BCG analysis, 2018

Awesome...let's model it on Boston Streets!

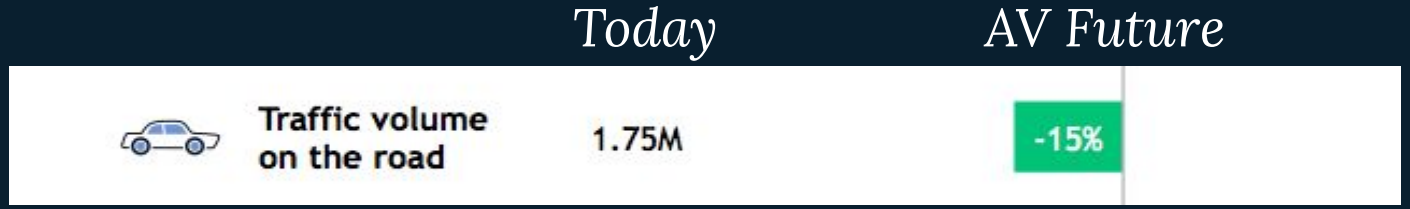
54 mi^2 | 1144 miles of streets | 114 Bus Routes
2M daily Trips | 37% autonomous vehicles
Commercial Delivery Traffic and Passenger Traffic data

source: World Economic Forum; BCG analysis, November 2017



Research: *Modeling a future AV Boston*

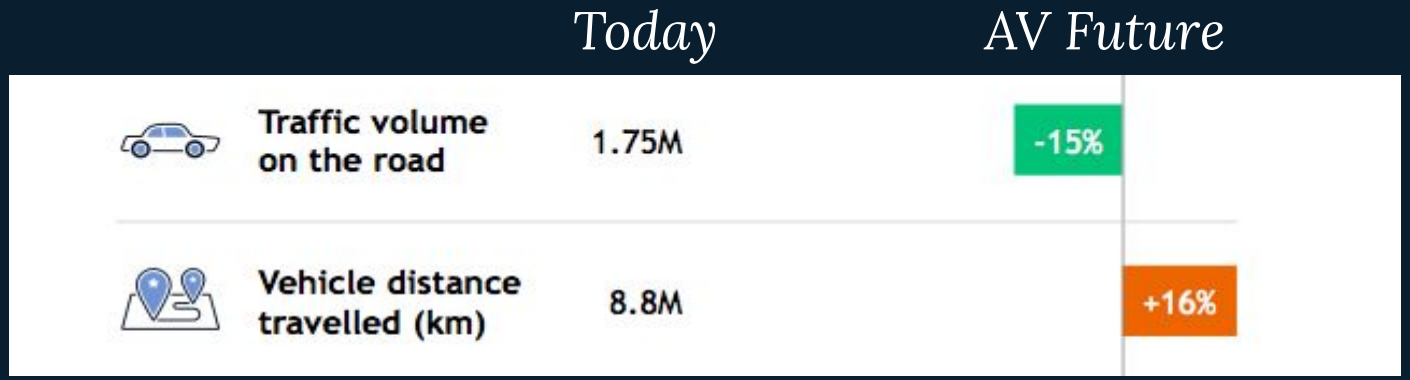
At 37% AV mix and 6.3% traffic efficiency



Source: WEF; BCG & MIT *Analysis*; 2018
http://www3.weforum.org/docs/WEF_Reshaping_Urban_Mobility_with_Autonomous_Vehicles_2018.pdf

Research: *Modeling a future AV Boston*

At 37% AV mix and 6.3% traffic efficiency



Source: WEF; BCG & MIT *Analysis*; 2018
http://www3.weforum.org/docs/WEF_Reshaping_Urban_Mobility_with_Autonomous_Vehicles_2018.pdf

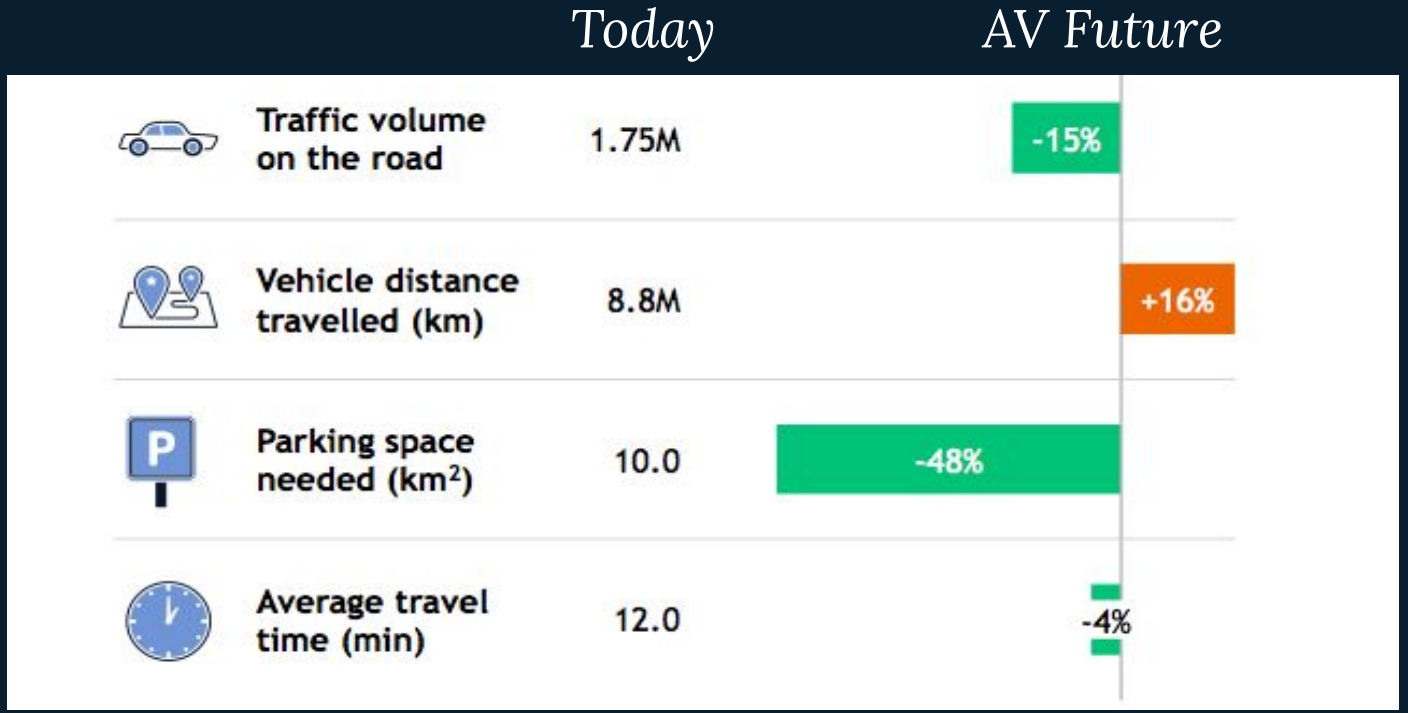
Research: *Modeling a future AV Boston*

At 37% AV mix and 6.3% traffic efficiency

Source: WEF; BCG & MIT *Analysis*; 2018
http://www3.weforum.org/docs/WEF_Reshaping_Urban_Mobility_with_Autonomous_Vehicles_2018.pdf

Research: *Modeling a future AV Boston*

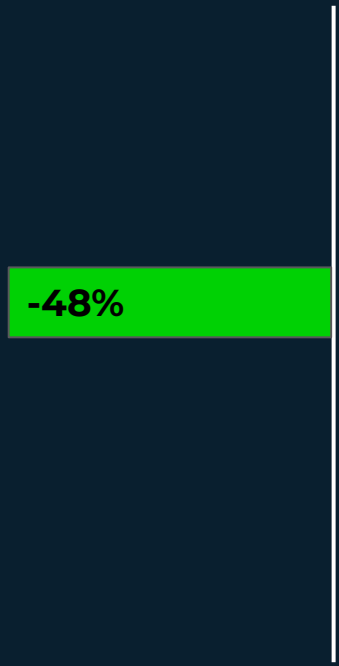
At 37% AV mix and 6.3% traffic efficiency



Source: WEF; BCG & MIT *Analysis*; 2018
http://www3.weforum.org/docs/WEF_Reshaping_Urban_Mobility_with_Autonomous_Vehicles_2018.pdf

Once in a lifetime opportunity to remake a city for people

Parking spaces needed



https://www.bcg.com/en-us/industries/automotive/bcg-wef-shaping-future-urban-autonomous-mobility.aspx
http://www3.weforum.org/docs/WEF_Reshaping_Urban_Mobility_with_Autonomous_Vehicles_2018.pdf

One Final Thought

We shape our buildings; thereafter they shape us.

-Winston Churchill

One Final Thought

Streets

We shape our ~~buildings~~; thereafter they shape us.

-Me

Thank You

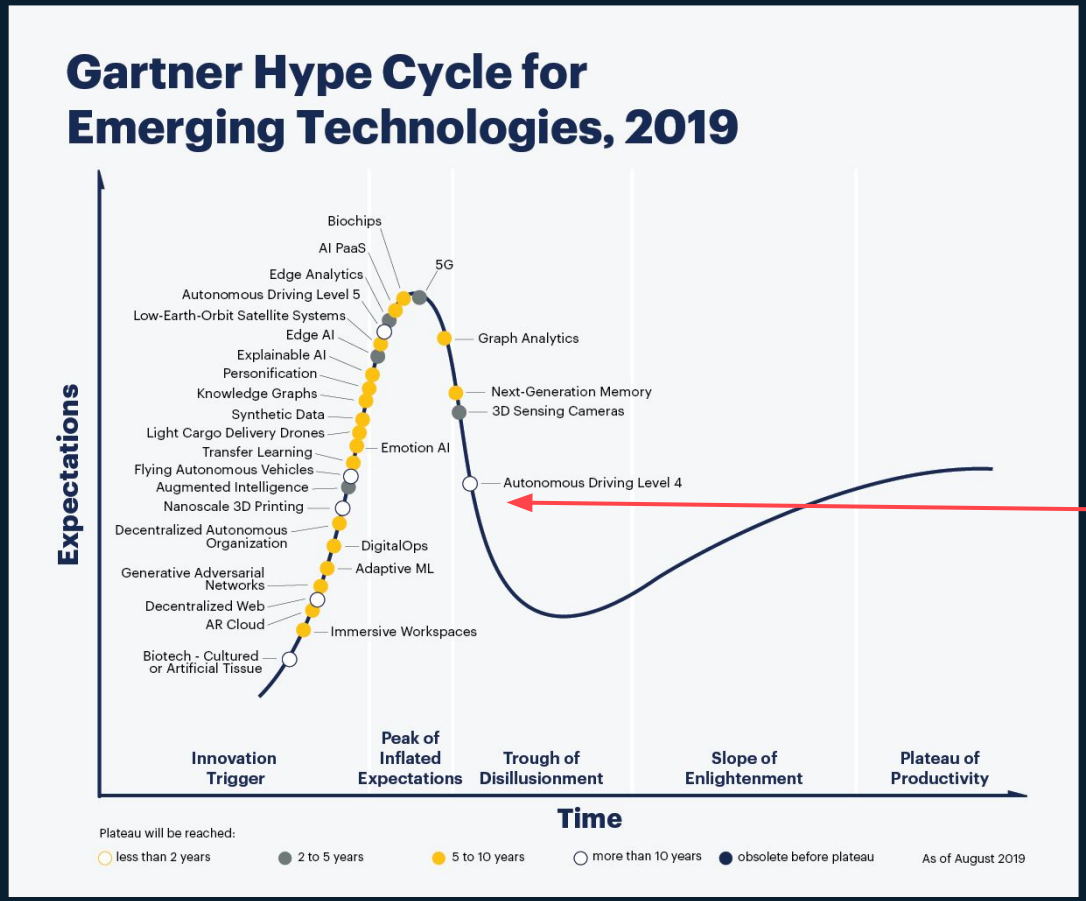
@newurbanmechs
@Kris_W_Carter
Kristopher.Carter@Boston.gov

Boston.gov/Mechanics
Boston.gov/Boston-av

Appendix

Where are we now in 2019?

Firmly in the "trough of disillusionment"



The Perfect time for policy?

Research: *Baseline analysis Boston & Berlin*

City Differences

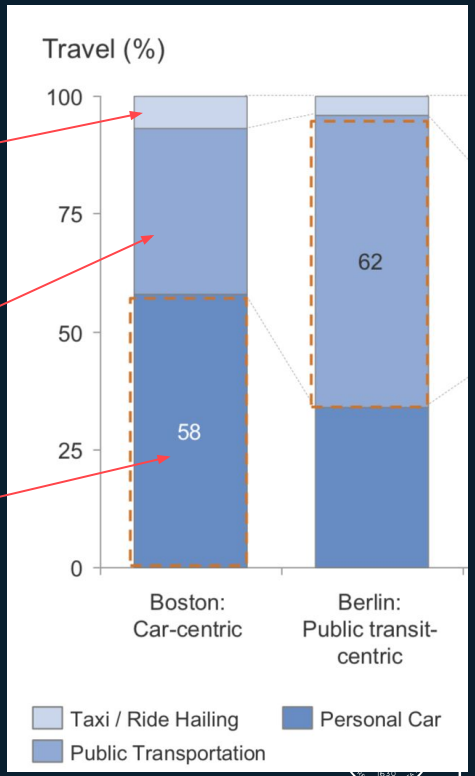
	Boston	Berlin
Population (M)	0.7	3.5
Density (K per square mile)	13.9	11
Quality of life ranking[1]	35th	13th
Car ownership	Have few barriers to ownership	Have a "greener" mindset

Baseline Modal Mix

Taxi/Uber

Public Transit

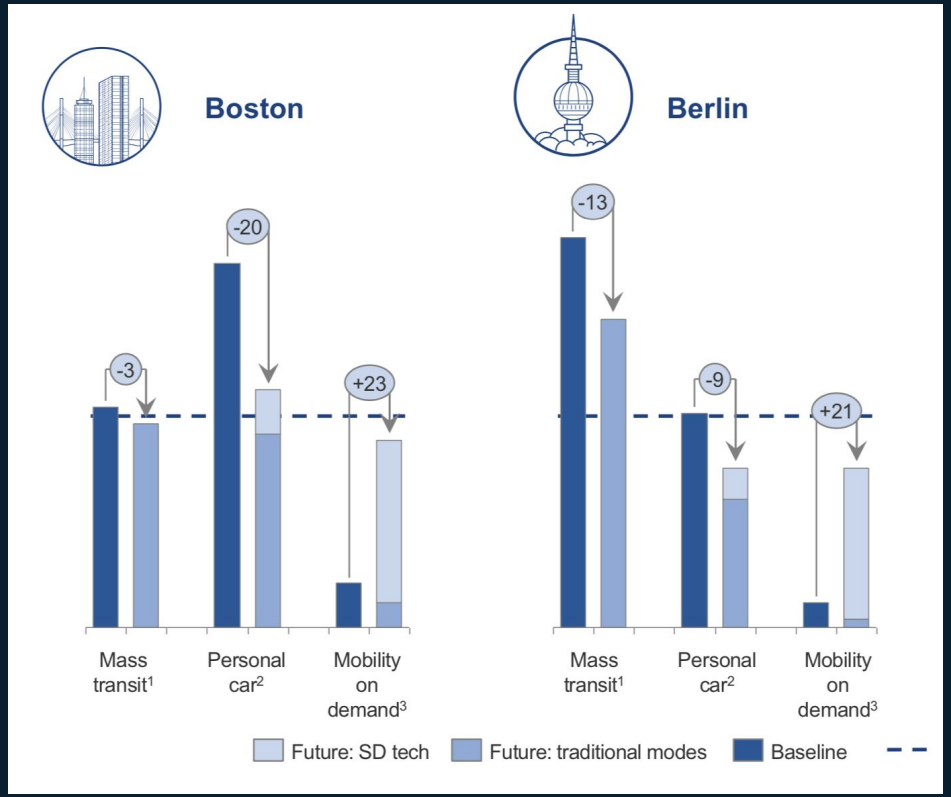
Personal Car



source: *World Economic Forum & BCG analysis, 2018*

City of Boston
Mayor Martin J. Walsh

Research: *Cities Convergence in an AV world*



Boston *- less personal car use*

Berlin *- less mass transit use*

Even with different baseline modal mixes, cities start to have a more similar modal mix with AVs

source: World Economic Forum & BCG analysis, 2018