AD/CD

Ola Bostrom
VP Research, Innovation and IPR

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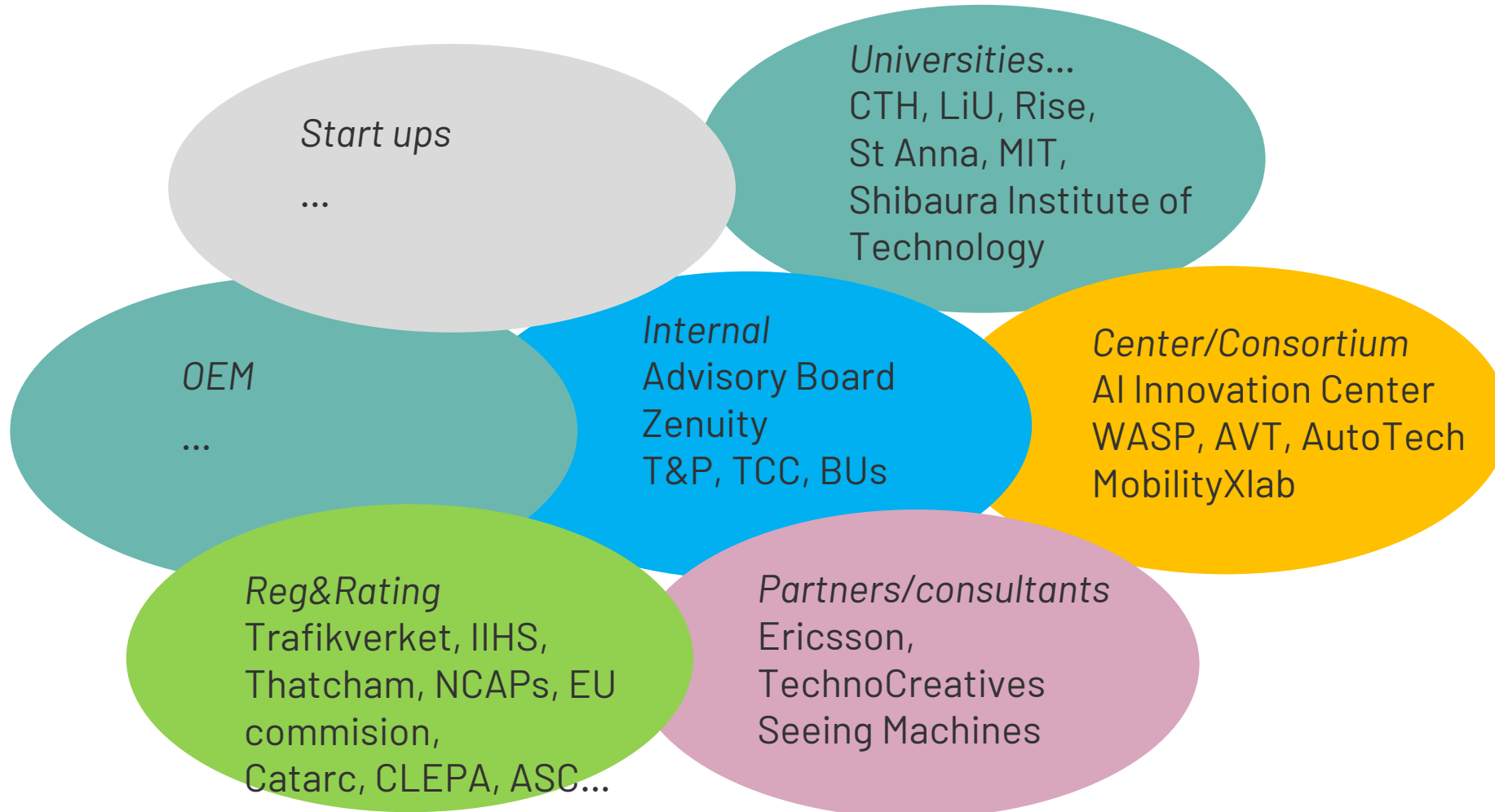
Company facts

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ZENUITY

ADAS ECU
The "brain"

SATELLITE CRASH SENSORS

DRIVER MONITORING SYSTEMS
Detects driver distraction, emotions and reactions

BRAKE SYSTEMS
Advanced braking

VISION SYSTEMS
(Mono and Stereo)
Extra eyes on the road

REAR CORNER RADAR

RADAR
Multimode detection and ranging

NIGHT VISION
Improves detection in challenging visibility conditions

LiDAR
360° imaging for L4 automation

LiDAR
Forward looking 3D imaging with small form factor

RESTRAINT CONTROL SYSTEMS
Reacts when accidents are unavoidable

ROADSCAPE
Knows the road ahead

V2X
Vehicle communicates to everything

FRONT CORNER RADAR

Order Book
>$19B
~80% in the Electronics Segment

Total Engineers
~5,200
of which ~70% in software

Research Eco system

Start ups
...

Universities...
CTH, LiU, Rise,
St Anna, MIT,
Shibaura Institute of
Technology

OEM
...

Internal
Advisory Board
Zenuity
T&P, TCC, BUs

Center/Consortium
AI Innovation Center
WASP, AVT, AutoTech
MobilityXlab

Reg&Rating
Trafikverket, IIHS,
Thatcham, NCAPs, EU
commision,
Catarc, CLEPA, ASC...

Partners/consultants
Ericsson,
TechnoCreatives
Seeing Machines

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2018

3 billion

1

1.4 million

50

Gartner Hype Cycle

Deep Learning → (Peak of Inflated Expectations)

Self-Driving Cars →

VISIBILITY

Peak of Inflated Expectations

Plateau of Productivity

Slope of Enlightenment

Trough of Disillusionment

Technology Trigger

TIME
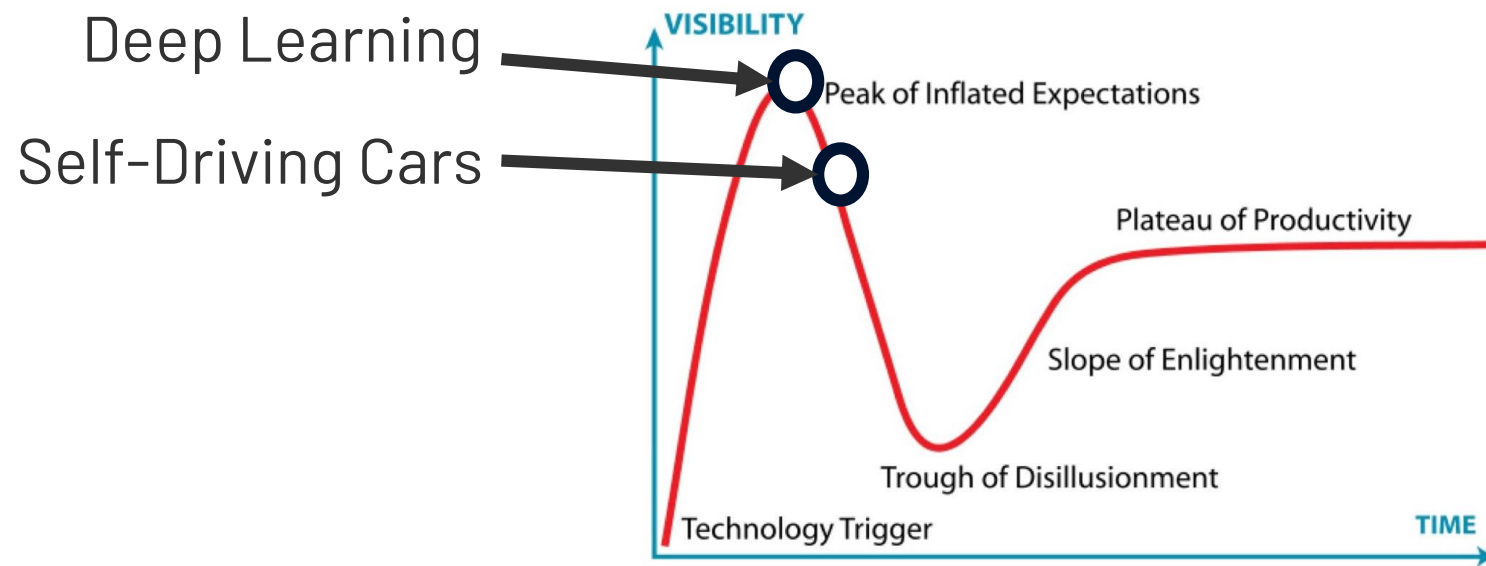
Market to Remain Mainly Focused on L1-2 for the Next Decade

Light Vehicle Production by Level of Autonomy
2020-2030

2020

L0 ▪ L1 ▪ L2 ▪ L3 ▪ L4

2025

L0 ▪ L1 ▪ L2 ▪ L3 ▪ L4

2030

L0 ▪ L1 ▪ L2 ▪ L3 ▪ L4
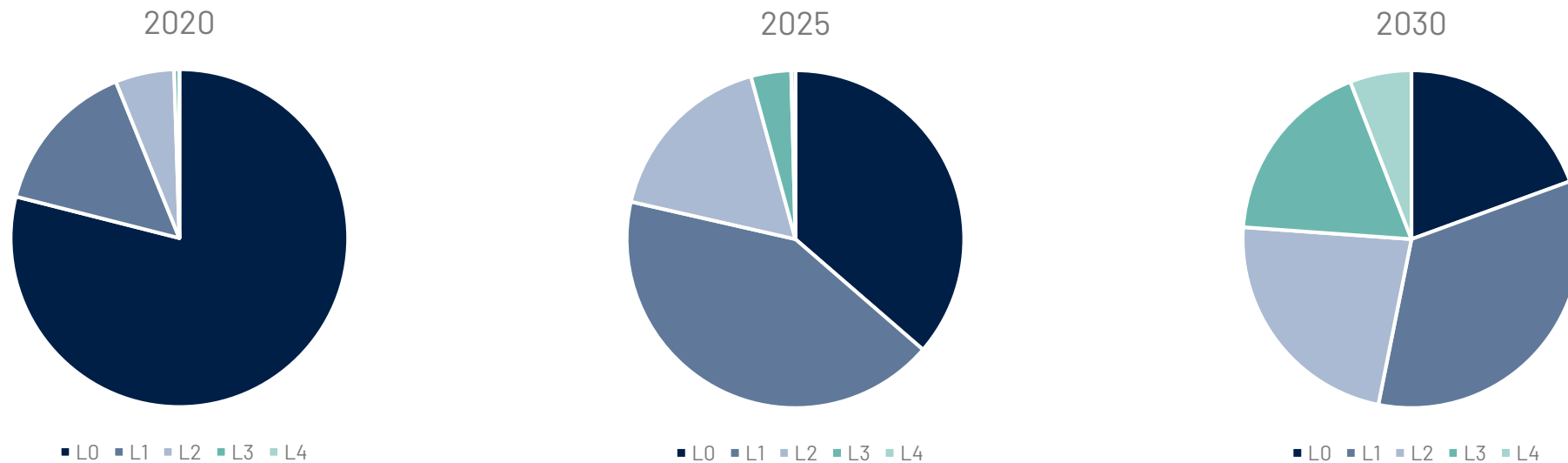
Source: Internal

L4 Volumes split fairly evenly between robotaxi and personal ownership

The History of Driverless is Nearly a Century Old

1926
First experiment with remote control

1980s
Several prototype concepts

2009
Google launched its self-driving car program

Next?

'PHANTOM AUTO' WILL TOUR CITY

A "phantom motor car" will haunt the streets of Milwaukee to-day.
Driverless, it will start its own motor, throw in its clutch, twist the steering wheel, toot its horn, and sass the police.

Milwaukee Sentinel

1950s
GM investments in the topic

2000s
DARPA Challenges

In the **10 years** since, billions of dollars of investment...

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Popular View on AD

- **The driving task is easy**

- **Humans are bad at driving**

- **Humans and automation don't mix well**

State of the Art: **Human** vs **Robot**

State of the Art: Human vs Robot

Q1'19 Comments from Jan Carlson

"The future of transportation belongs to Collaborative Driving. We believe that in the not too distant future, the vast majority of all cars sold will be equipped with advanced driving assistance technology. "

Collaborative Driving

Human and Machine
as a joint cognitive system,
sharing control and
trusting each other

LIV3.0

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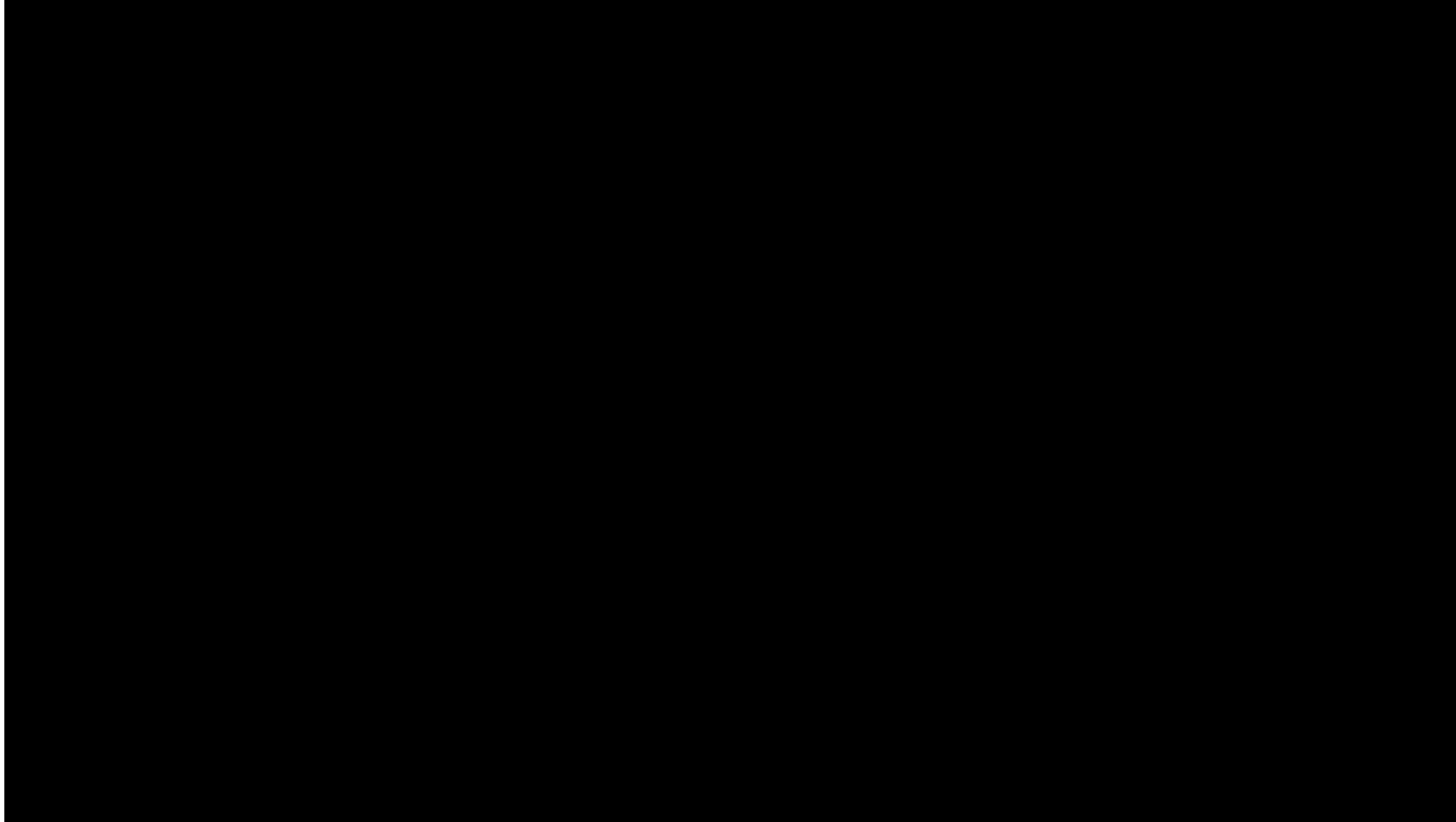
Max 8

Lesson learned according to Steve Casner, research psychologist for Nasa

Max 8
Lesson learned according to Steve Casner, research psychologist for Nasa

"The idea is to prepare aircrews to understand that automation has its limitations... It sometimes does unexpected things. So do human beings. We're two limited, fallible entities in the cockpit."

Financial Times - Autonomous machines: industry grapples with Boeing lessons, Robert Wright

Timeline Safety Regulations & Consumer Ratings

Examples: Key Electronics & Crash Avoidance Requirements in main regions

Consumer Ratings

EURO NCAP (FOR SAFER CARS)
- ESC
- AEB-C2C, LDW, SAS
- AEB Pedestrian, LKA, ISA
- AEB Ped night, AEB Cyclist, RoR
- Junction Assist, AES
- Driver Impairment — Sc. w. PTW, Head-on
- V2X

NHTSA (www.nhtsa.gov) / **INSURANCE INSTITUTE FOR HIGHWAY SAFETY**
- LDW*, FCW*
- Rear View*, AEB C2C
- AHB
- Rear AEB
- NCAP upgrade on hold — AEB**

JNCAP
- AEB C2C, LDW
- Rear View
- AEB Ped day, LKA
- AEB Ped night, Pedal misapplication
- AEB Cyclist
- Junction Assist, Head-on

C-NCAP
- ESC
- AEB C2C, AEB Ped
- LKA, BSD

ASEAN NCAP
- ESC, AEB C2C
- BSD for PTW, Rear View, AHB
- AEB-Ped, Junc.Assist

LATIN NCAP
- ESC
- AEB C2C, AEB Ped, LKA, SAS, BSD

Timeline: 2005 — 2010 — 2015 — 2020 — 2025

Legislation

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE
- BA
- ESC
- ESC, AEB, LDW for heavy trucks
- eCall
- Cyclist BSD for trucks
- AEB C2C, AEB-Ped, ISA, EDR, LKA, Ped. Reverse detection
- AEB-Cyclist, Driver Distraction detection
- Remote Parking
- CSF, ESF, Hands-On Lane Keeping, & Lane Change
- Hands-Off Lane Keeping, & Lane Change

EU General Safety Regulations Roadmap 2018-28

UN ECE ADAS & AD regulations *

USA (flag)
- ESC
- Rear View camera FMVSS 111

China (flag)
- ESC**
- Technical regulations for ADAS and AD (both "any vehicle" and "if fitted")

AEB = Advanced Emergency Braking; AES = Advanced Emergency Steering; AHB = Adaptive Headlamp Control; BA = Brake Assist; BSD = Blind Spot Detection; C2C = Car-to-Car; CSF = Corrective Steering Function: EDR = Event Data Recorder; ESC = Electronic Stability Control; ESF = Emergency Steering Function; FCW = Forward Collision Warning; ISA = Intel. Speed Adaptation; LDW = Lane Departure Warning; LKA = Lane Keeping Assist; PTW = Powered-Two-Wheelers; RoR = Run of Road Protection (LKA on Road Edge detection); SAS = Speed Assistance System; V2X = Vehicle-to-X
*- recommended technologies, not part of rating ** - self commitment from OEMs; *** - if fitted

Simply Adding Automation is Not Necessarily Better

Automation Use by Vehicle and Version
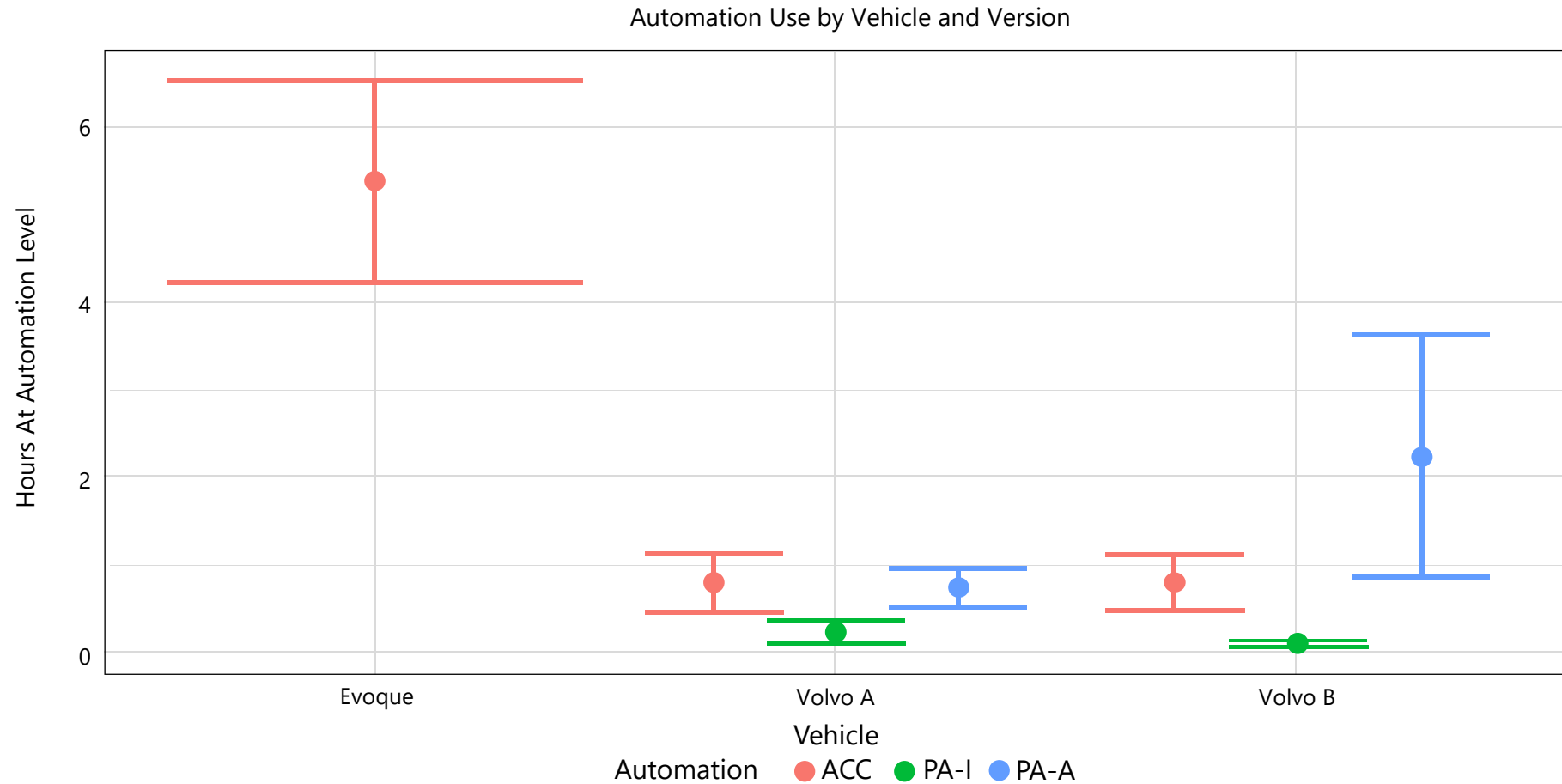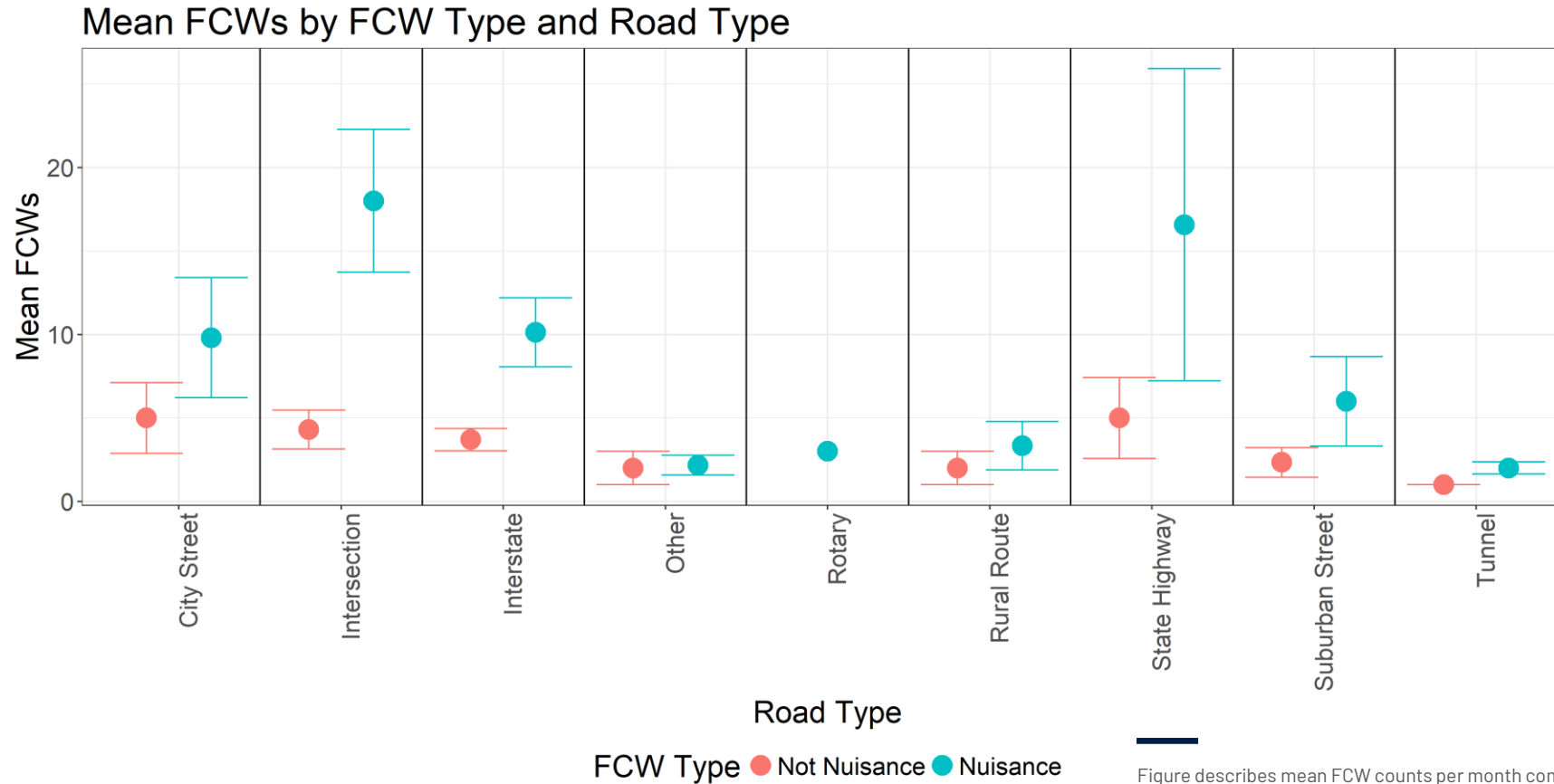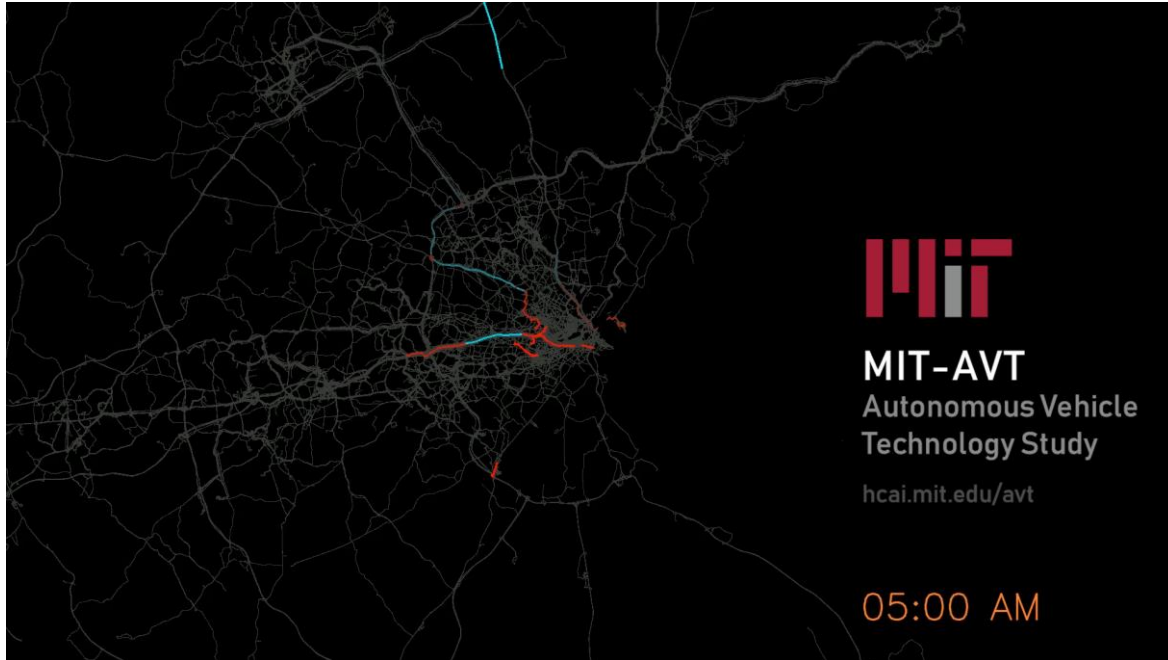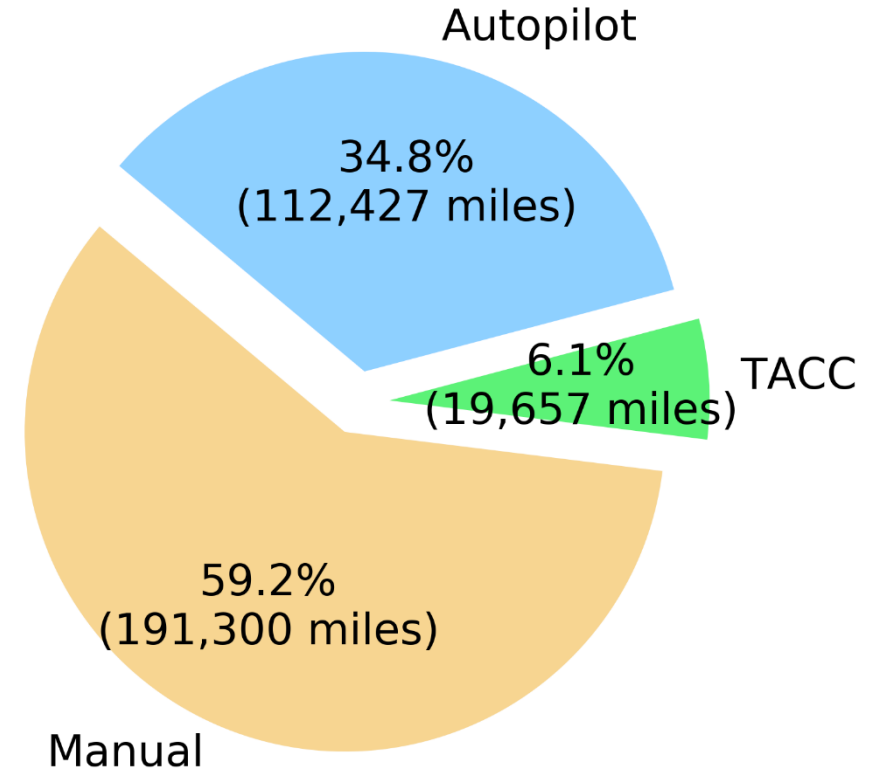
Road Type Impacts Nuisance Alerts

Mean FCWs by FCW Type and Road Type

Figure describes mean FCW counts per month computed as an average across 18 participants..

AVT - Tesla

MIT

MIT-AVT
Autonomous Vehicle
Technology Study

hcai.mit.edu/avt

05:00 AM

GPS points with Autopilot engaged (blue)
overlaid on manual control (red)

Autopilot

34.8%
(112,427 miles)

6.1%
(19,657 miles) TACC

59.2%
(191,300 miles)

Manual

Function Vigilance During Autopilot Driving

Critical Event Category	Disengagement Reason	Description	Human Initiated	Machine Initiated
Tricky Situation Present	Act before tricky situation	Taking control ahead of a tricky situation arises.	7,869	0
	Act right after tricky situation	Immediately respond after tricky situation arises.	813	47
	Act too late after tricky situation	Response delayed by 1+ seconds after tricky situation arises.	0	0
No Tricky Situation Present	Planned Turning or Speed Change	Taking control of the car to make a planned navigation decision.	8,608	68
	Planned Stopping	Stopping for stop sign, yellow/red traffic light.	601	0
	Accidental	Accidentally bumping the wheel or the Autopilot stalk.	38	0
	Annotation Difficult	Image is corrupted or is too bright/dark for accurate annotation.	94	0
	No clear reason	No clearly identifiable reason	777	0
	Hands off wheel	Warning ignored while remaining attentive to the road.	0	13
Total Annotated Disengagement Epochs:			**18,800**	**128**

One tricky disengagement every 9.2 miles of Autopilot driving

Driver Attention with Autopilot

Manual
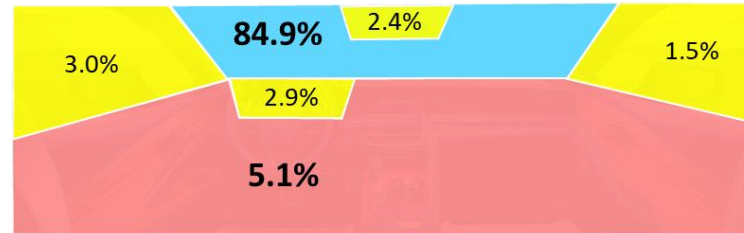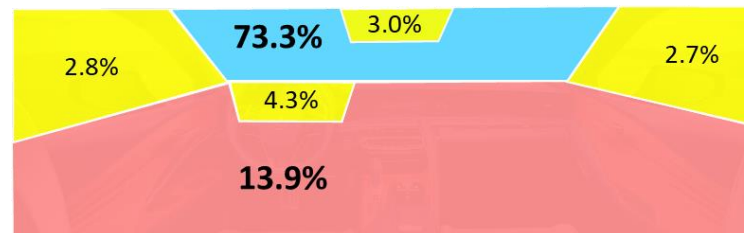
84.9%   2.4%
3.0%   1.5%
        2.9%
        5.1%

Autopilot

73.3%   3.0%
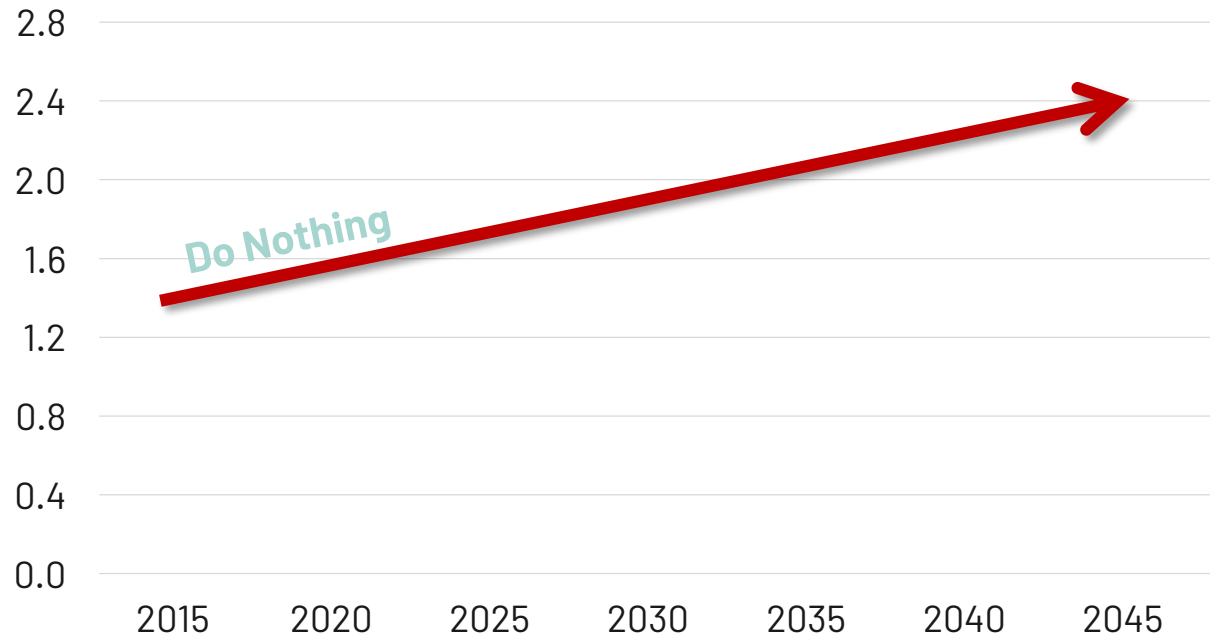2.8%   2.7%
        4.3%
        13.9%

The Road Towards Saving More Lives
Mitigating the Future?
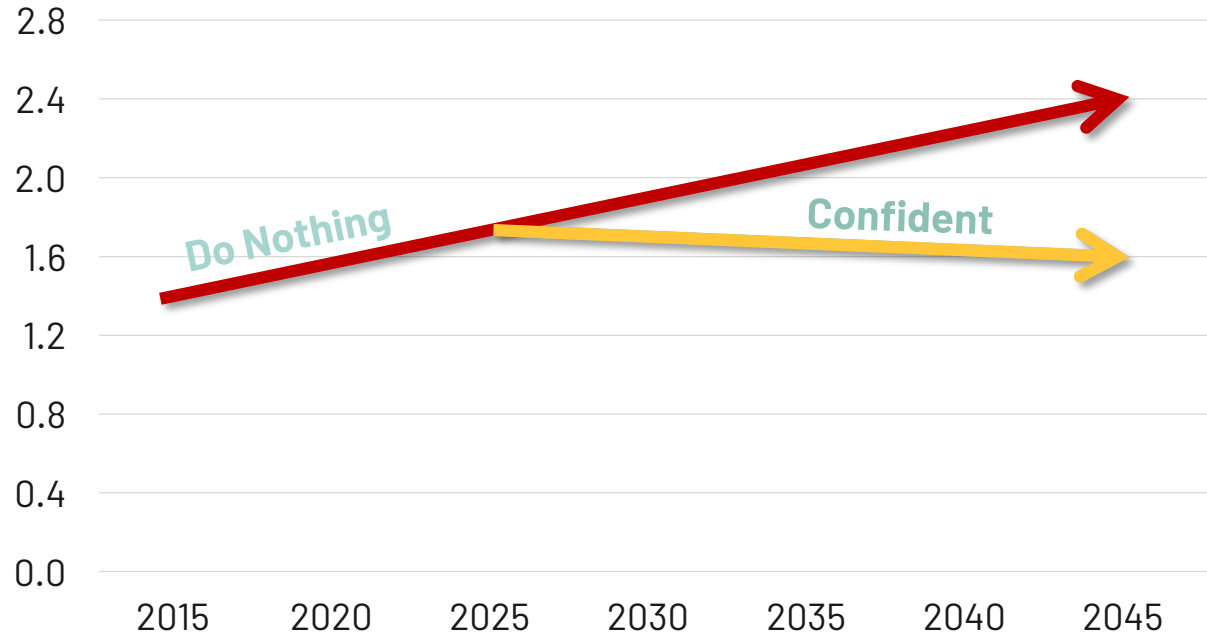
Global Traffic Fatalities (millions)

Do Nothing

There will be a Driver for a Long Time

The Road Towards Saving More Lives
Mitigating the Future?

Global Traffic Fatalities (millions)

Driver Confidence

- Today's safety technology in all new vehicles
- Consumers willingness to buy and use
- Confidence in the vehicles' perception

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ADAS today according to owner's manual

"Action by the driver always has priority. XXX will therefore not react or will react at a later stage with a warning or intervention in situations in which the driver is clearly steering and operating the accelerator pedal, even if a collision is unavoidable."

The Road Towards Saving More Lives
Mitigating the Future?

Global Traffic Fatalities (millions)

(Line chart showing Global Traffic Fatalities in millions from 2015 to 2045. Y-axis from 0.0 to 2.8. "Do Nothing" red line rises from ~1.4 in 2015 to ~2.4 in 2045. "Confident" yellow line stays roughly flat at ~1.6 from 2025 to 2045. "Trusting" black line declines from ~1.7 in 2025 to ~0.7 in 2045.)
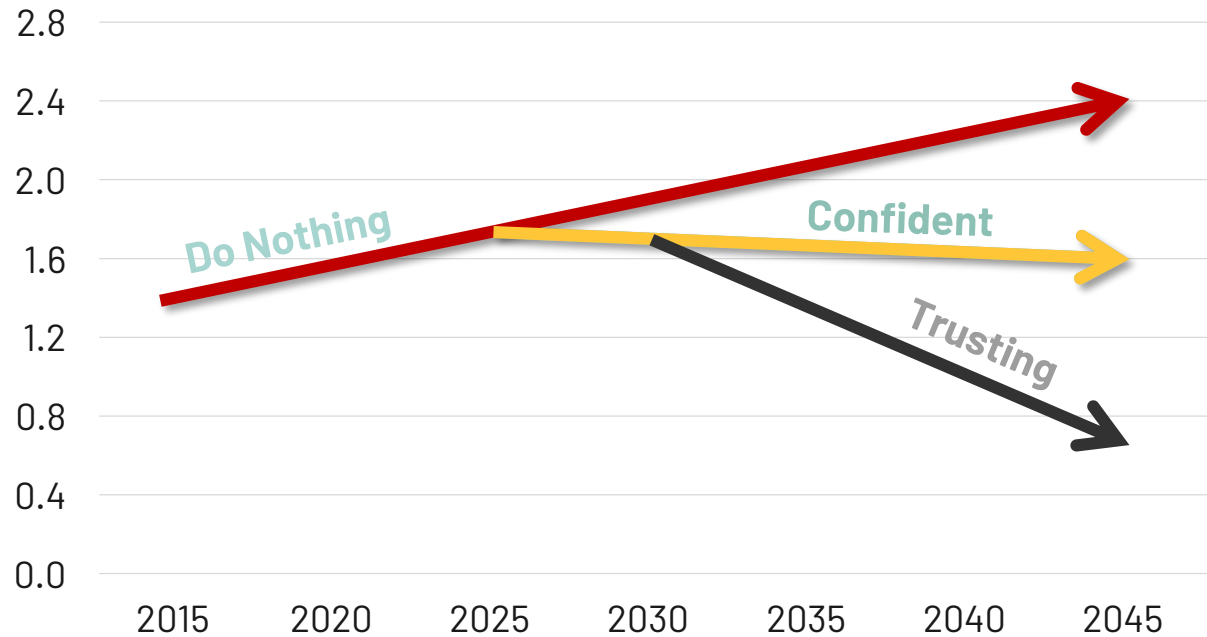
Driver Confidence
- Today's safety technology in all new vehicles
- Consumers willingness to buy and use
- Confidence in the vehicles' perception

Occupant Trust
- Driver co-pilot and shared control
- The driver considers the vehicle intelligent
- Eventually full trust in the vehicle to drive

We need a Human Centric Approach

Human and Machine
as a joint cognitive system,
sharing control and
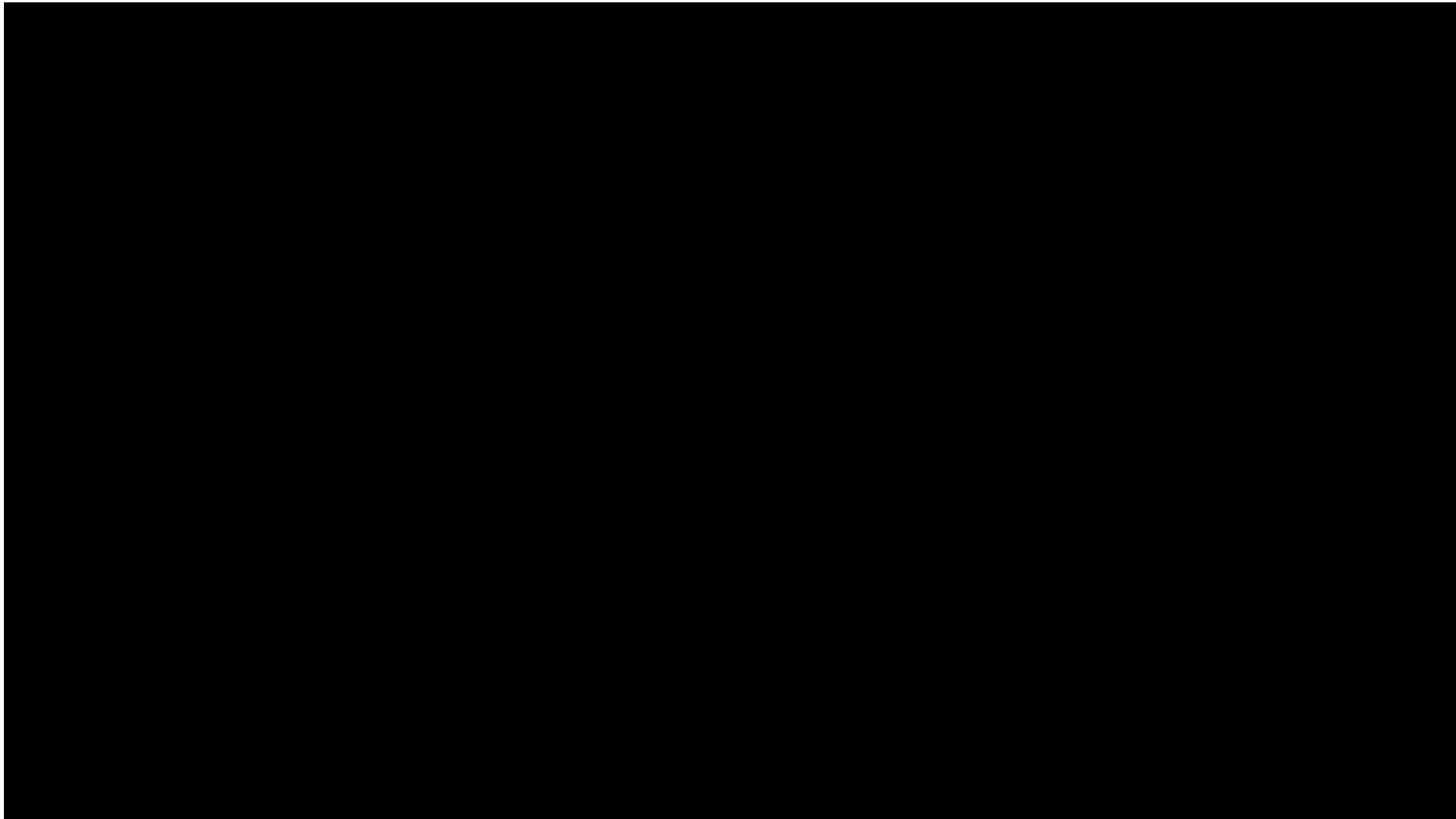trusting each other

UX

Ai

AI and UX – Cognitive Load

AI and UX – Emotions

Name of presentation

Learning

ODD OTA MVP

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Our Purpose
Creating Trust in Mobility

Veoneer Company Presentation