Autonomous Vehicles: How Safety Paves the Road to Success

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Welcome & opening [Chris]

Deliver the benefits of self-driving technology safely, quickly, and broadly

OUR MISSION
The Aurora Driver

Self-driving software

Self-driving hardware

Data services & platform

A fully integrated self-driving stack that operates across multiple vehicle types
Deep, strategic relationships support our path to commercialization and scale in trucking.
Industry pain point

Frequency of major collisions

The Aurora Driver will provide

Safer operation
We’re designing our autonomous trucking product to address the industry’s primary pain points BUT the product needs to be safe
“Aurora’s self-driving vehicles are acceptably safe to operate on public roads.”
But that statement begs a lot of questions...

“Can the Aurora Driver detect and respond to emergency vehicles?”

“Can the Aurora Driver safely navigate roads it will travel on?”

“Is the Aurora Driver vulnerable to misuse or abuse?”

“Does Aurora have the processes in place to identify and resolve risks to safety?”

“Can the Aurora Driver safely handle an unexpected hardware failure?”
Aurora’s self-driving vehicles are acceptably safe to operate on public roads

1. Proficient
   The self-driving vehicle is acceptably safe during nominal operation
   - 239 Claims

2. Fail-Safe
   The self-driving vehicle is acceptably safe in the presence of faults and failures
   - 45 Claims

3. Continuously Improving
   All identified potential safety issues posing an unreasonable risk to safety are evaluated, and resolved with appropriate corrective and preventive action
   - 57 Claims

4. Resilient
   The self-driving vehicle is acceptably safe in case of reasonably foreseeable misuse and unavoidable events
   - 79 Claims

5. Trustworthy
   The self-driving enterprise is trustworthy
   - 40 Claims

460 Total Claims
Every question needs to be answered, with evidence

“Can the Aurora Driver safely navigate roads it will travel on?”

“Can the Aurora Driver safely handle an unexpected hardware failure?”

“Can the Aurora Driver detect and respond to emergency vehicles?”
What does evidence look like?

- Validated Vehicle Capabilities
- Safety Management System, Organizational Processes
- Backup plans, Redundancy
- Partnership with regulators, Transparency into safety metrics

EVIDENCE

EVIDENCE MUST BE DOCUMENTED, ASSESSED, AND APPROVED.
V and V as an example for how safety is defined for the Aurora Driver
When validating a self-driving system, one of the challenges is the most dangerous scenarios on the road are also the rarest.
Road-based testing is not enough—Aurora’s Virtual Testing Suite is designed to amplify exposure to rare events.

Scenarios rarely encountered on the road are turned into simulations then augmented/permuted to increase coverage.

On-road events experienced by the Aurora Driver turned into simulations (A)

Scenarios rarely encountered on the road are turned into simulations then augmented/permuted to increase coverage (B)

Scenarios not seen on-road so synthetically created from NHTSA taxonomy then augmented/permuted to increase coverage (C)
We synthetically generate the rarest of events, which the Aurora Driver has not experienced on the road, from the NHTSA collision categorization and amplify them via permutation.

An example of a (passing) simulation replicating a “stopped in lane” scenario

**Red box:** minimum expected response from the Aurora Driver

**Blue truck:** actual response from the Aurora Driver

Example permutations of the same scenario

- Stopped vehicle in a different position
- Cones on the right, moving vehicles on the left
- Cones on both sides
- Cones on the right, moving vehicle on the left, different road curvature
Great Tech also needs great culture and process to truly deliver
Safety Management System

Safety Policy
How we define our commitments, accountabilities, and employee responsibilities for safety

Safety Assurance
How we maintain high-quality and effective safety risk controls and mitigations

Safety Risk Management
How we manage safety risk within the enterprise

Safety Culture
How we measure our safety culture and engage, communicate, and educate employees
Importance of Safety Culture

Boeing’s Safety Culture Faulted by F.A.A. in New Report
The report by a group of experts was commissioned at the behest of Congress and in response to fatal crashes involving 737 Max jets in 2018 and 2019.
By Niraj Chokshi

Regulators Are Investigating Boeing's Safety Culture Amid Complaints By Its Engineers
AUGUST 24, 2021 - 6:05 PM ET
By The Associated Press

Investigative Report: Looking Into Callaway Nuclear Power Plant’s “Safety Culture”
One employee who was not happy with how his concern was dealt with received a $550,000 settlement after he was discriminated against for pursuing safety...
May 24, 2010

C-17 crash report exposes cracks in USAF safety culture
Pilot error is the US Air Force’s official cause for the first fatal crash of a Boeing C-17, but the service’s investigation report has also exposed lax...
Dec 17, 2010

Study: Deepwater Horizon workers were afraid to report safety issues
A confidential report on safety conditions aboard the Deepwater Horizon oil rig, conducted about one month before the rig's explosion, points to widespread...
Jul 22, 2010

Why BP’s failure to mention safety culture is problem
This has surprised safety experts. “The fact that BP has failed to identify its organisational structure as a factor in the accident is itself an indication of...
Sep 14, 2010
The Autonomy Readiness Measure (ARM) illustrates the great progress we are making toward closing the Dallas to Houston Safety Case.