

Evolution of the Reasonable Automated Vehicle

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A question

What is the biggest obstacle to automated vehicles?

- A. Technology?
- B. Law?
- C. Public acceptance?
- D. Something else entirely?



My answer

- Law, engineering, and the marketplace all *reflect* what “we” think is *reasonable*
- When a compelling technology is *reasonably* safe, law will accommodate it
- Law, engineering, and the marketplace can also *shape* what we think is *reasonable*



In short:

REASONABLENESS

- What is a reasonable vehicle?
- What is a reasonable driver?
- What is a reasonable designer?

- *They are not the same*
- *They will change over time*

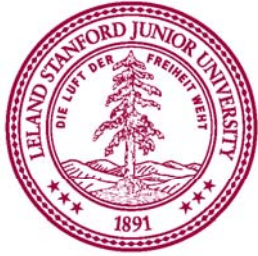


Or even shorter:

REASONABLENESS

REASONABLE

REASON



Which means:

REASONABLENESS

propriety, rightness,
justness, fairness,

loch ness?





It's elusive!

- US state tort law: Companies are liable if their product designs are not **reasonably** safe
- US state traffic law: Drivers must drive **reasonably**
- ISO 26262: “Safety” is the absence of **unreasonable** risk



Who decides?

Engineers?

Consumers?

Lawyers?

Managers?

Politicians?

Regulators?

Voters?

Reporters?

Drivers?

Judges?

Prosecutors?

Juries?



How?

Cost-benefit analysis?

Intuition?

Private values?

Money?

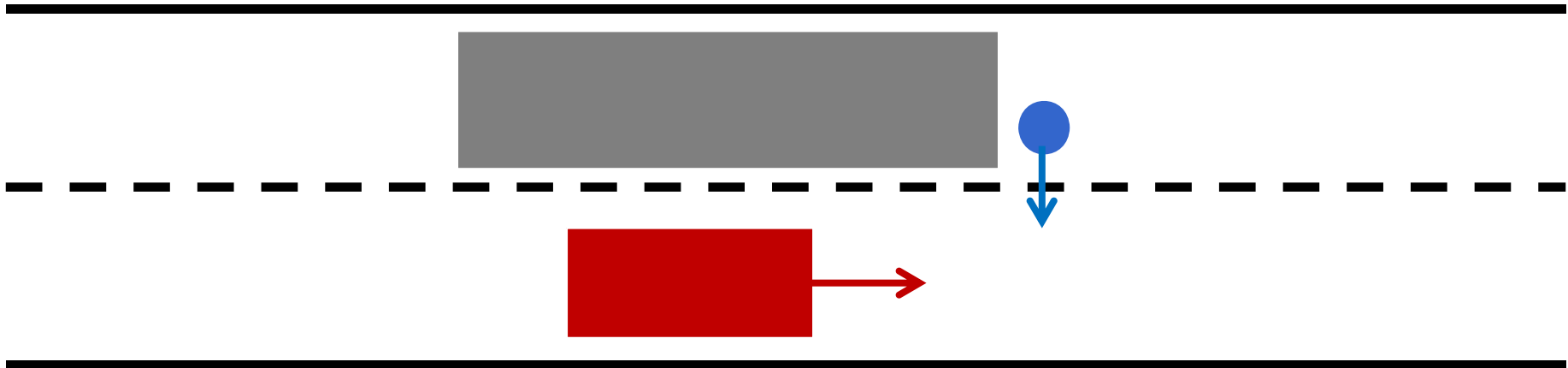
Community norms?

Industry standards?

Consensus?



The reasonable vehicle



100% chance that a pedestrian will step out in front of the car



0% chance that a pedestrian will step out in front of the car



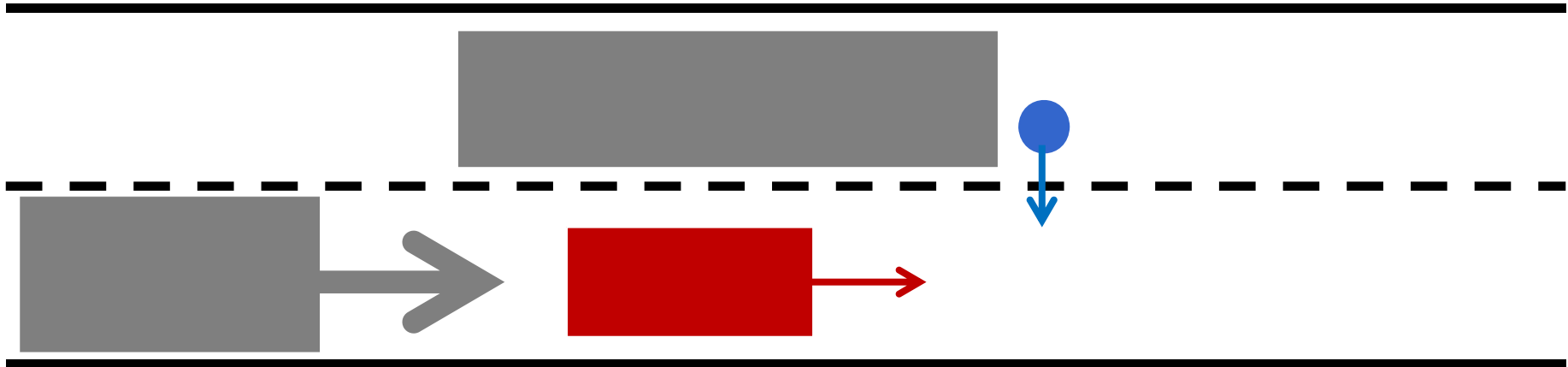
What's it to you?

Chance of a crash	Expected benefit of slowing down	
10%	\$1,000,000	¥100,000,000
1%	\$100,000	¥10,000,000
0.1%	\$10,000	¥1,000,000
0.01%	\$1,000	¥100,000
0.001%	\$100	¥10,000
0.0001%	\$10	¥1,000
0.00001%	\$1	¥100
0.000001%	\$0.10	¥10
0.0000001%	\$0.01	¥1

(assuming one pedestrian fatality at \$10,000,000 (¥1,000,000,000))
(a 50x increase since 1973 in the assumed value of a life)



The full *A* slightly fuller picture





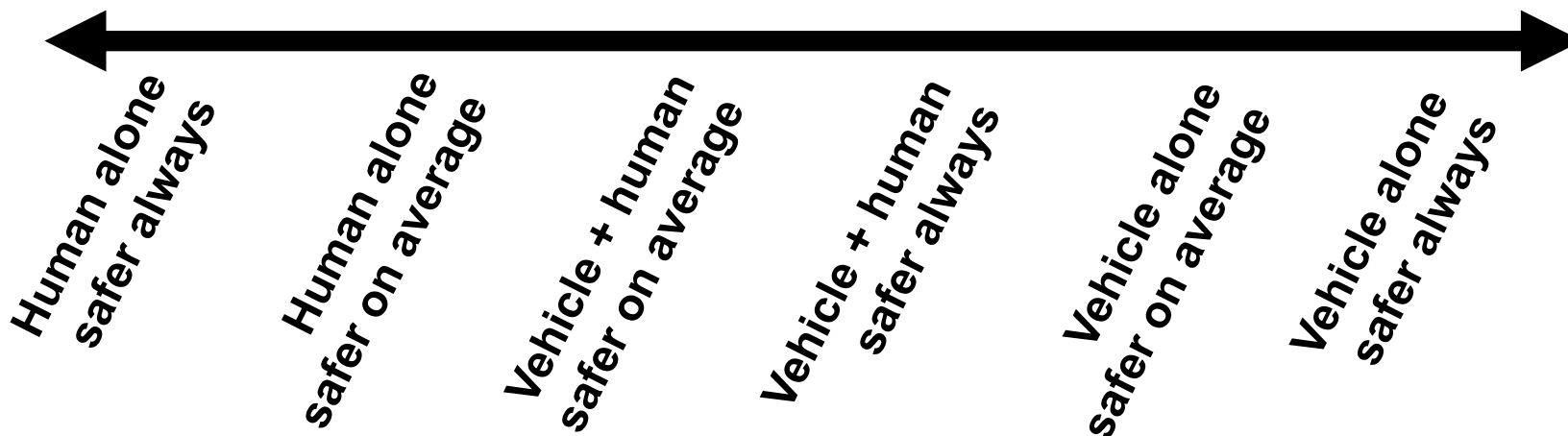
The reasonable driver

- Do you *actually* drive that cautiously?
- The net safety gains from antilock brakes were less than expected, perhaps because antilock brakes reduced driver caution
- Following the September 11th attacks, a switch from flying to driving resulted in ~1,000 new roadway fatalities



The reasonable designer

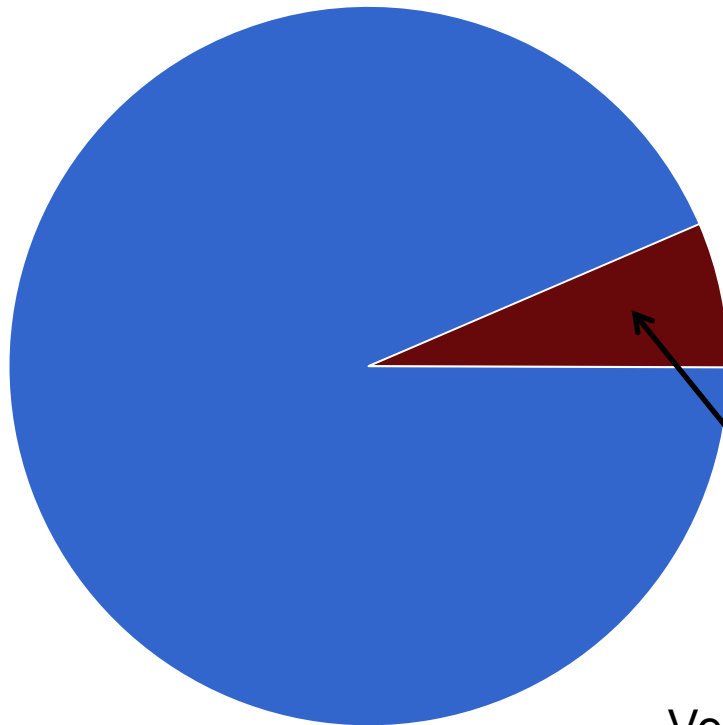
- Claim 1: “Automated vehicles could save lives even if they are not perfect.”
- Claim 2: “Automated vehicles could save lives even if they are *worse* than humans.”



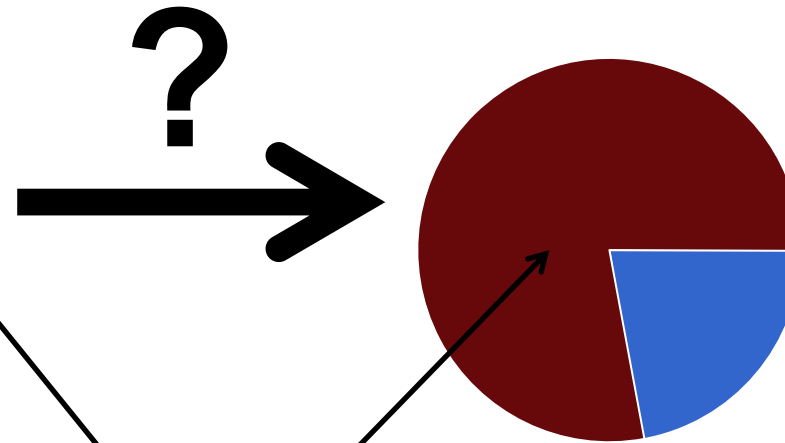


“Automated vehicles could save lives even if they are not perfect.”

Crashes today



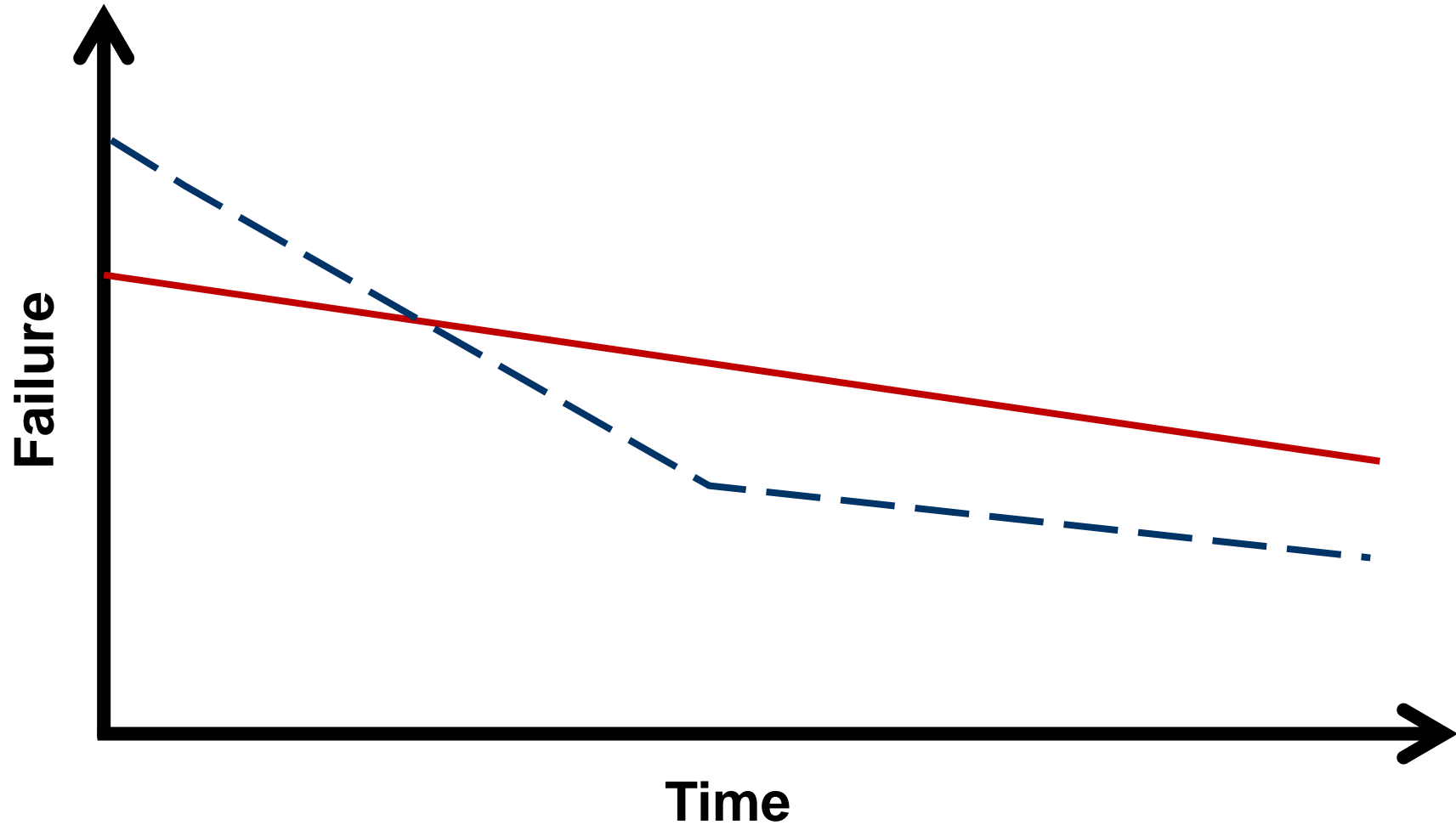
Crashes tomorrow?



Vehicle as contributing factor

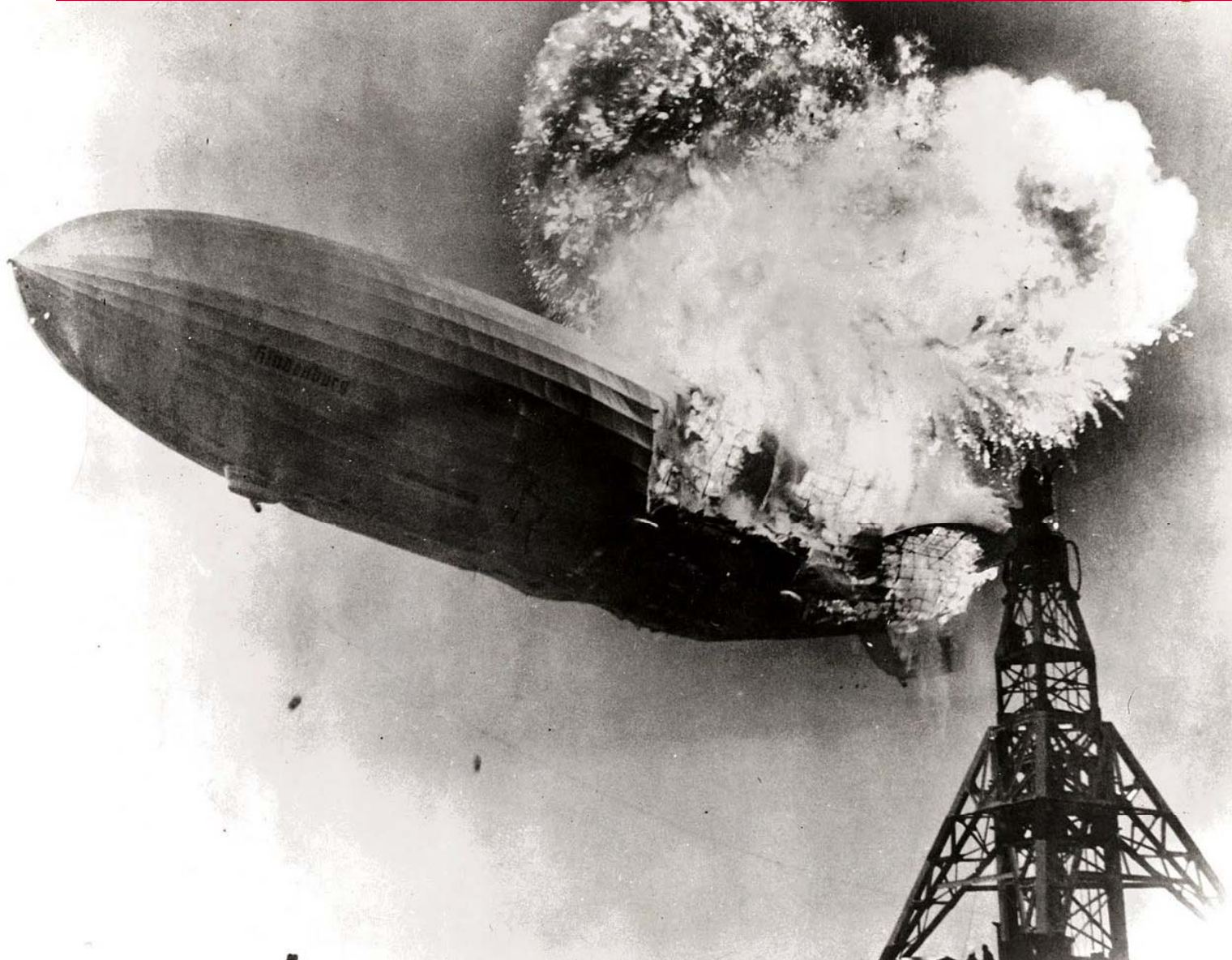


“Automated vehicles could save lives even if they are *worse* than humans.”





Impacts of a crash?





Therefore:

REASONABLENESS

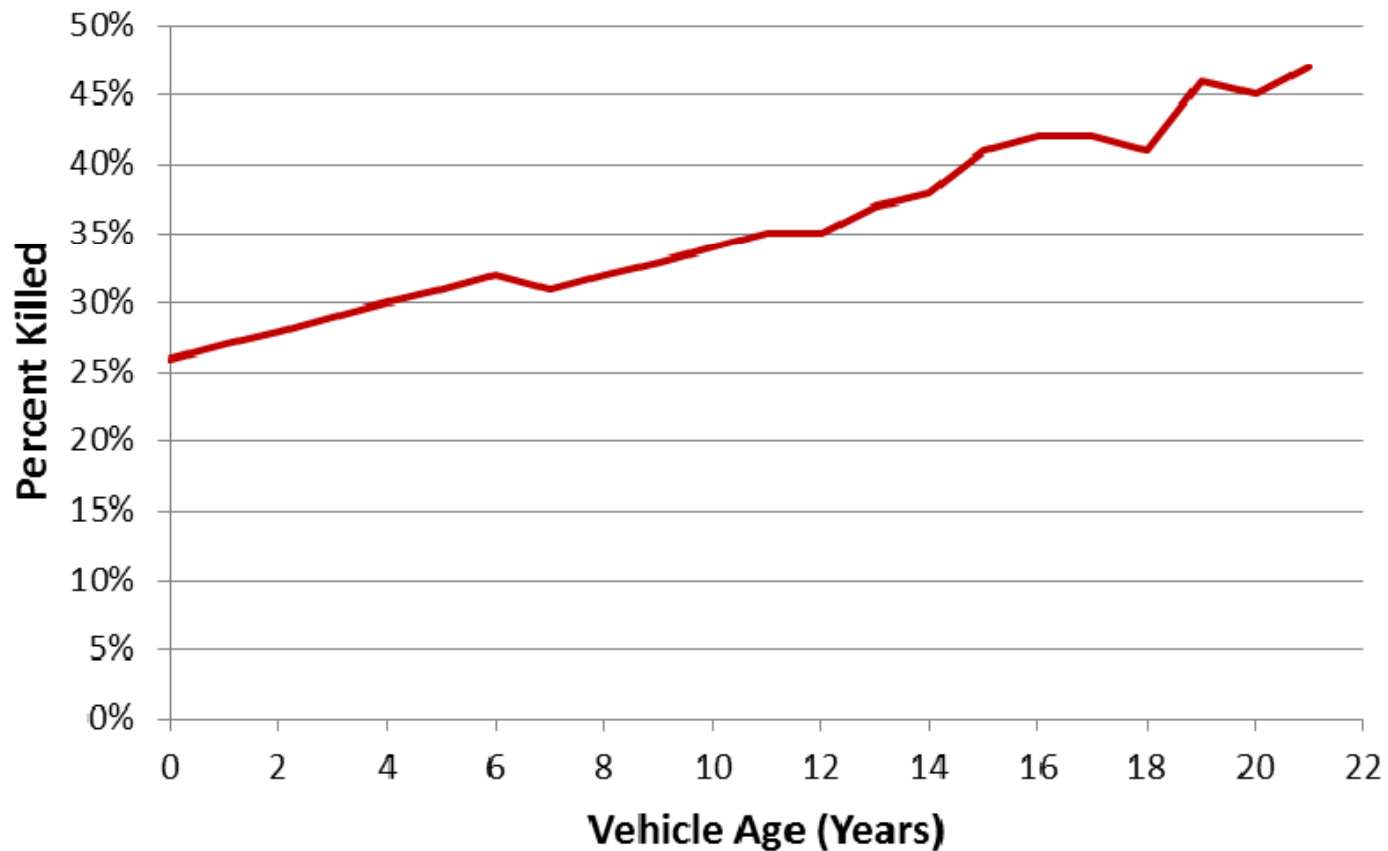
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What is reasonable will change

Percent of Belted Drivers Killed in Fatal Crashes by Vehicle Age



Adapted from www-nrd.nhtsa.dot.gov/Pubs/811825.pdf



Plan for obsolescence now

Provide the technical and legal ability for automakers and regulators to remotely update vehicles (“virtual recalls”)

- Technical capability (including security)
- Legal right (contract, statute, or regulation)
- Legal obligation (statute or common law)?