Automated Vehicle Safety Cases: Scope & Structure

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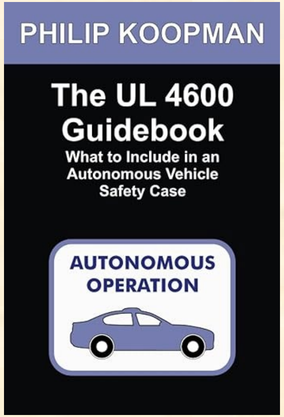

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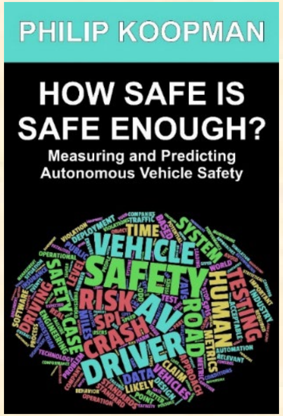
The UL 4600 Guidebook

What to Include in an Autonomous Vehicle Safety Case

AUTONOMOUS OPERATION



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HOW SAFE IS SAFE ENOUGH?

Measuring and Predicting Autonomous Vehicle Safety

Assurance Arguments To Support Safety

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- Safety case:
  - Logical argument + Evidence → Safety Claim
- Scope:
  - What do you mean by acceptably “safe”?
  - Why do you think you are safe?
  - Why do <u>you</u> believe your argument?
  - Why should <u>we</u> believe your argument?
- There is no “One True Safety Case” structure

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Scope of "Acceptably Safe" Claim

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- Net statistical safety (safer than average driver?)
  - Establishing a baseline is very complex!
- Tolerance for risk transfer
  - What if pedestrian risk doubles? (etc.)
- Tolerance for negligent behavior
  - What if breaking a traffic rule results in harm?
- Fine-grain absence of unreasonable risk
  - Recalls tend to be for specific behaviors
- Ethical behavior & equity concerns
  - Consequences of testing & deployment decisions

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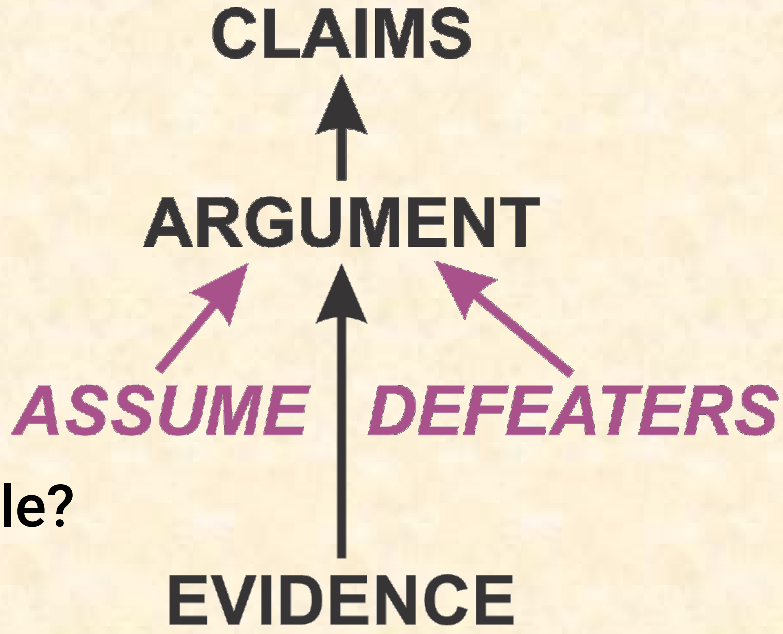
Reference: Redefining Safety for AVs https://arxiv.org/abs/2404.16768

Why Do You Think You Are Safe?

- Claims + well reasoned argument
  - Claim true because A and B and C
  - No rhetoric allowed
- Potential defeaters considered
  - Why might this argument be false?
- Identify assumptions
  - Why are these assumptions reasonable?
- Supported by evidence
  - Engineering rigor, simulations, test

Reference: UL 4600 Chapter 5



Safety Case

Why Do *YOU* Believe Your Argument?

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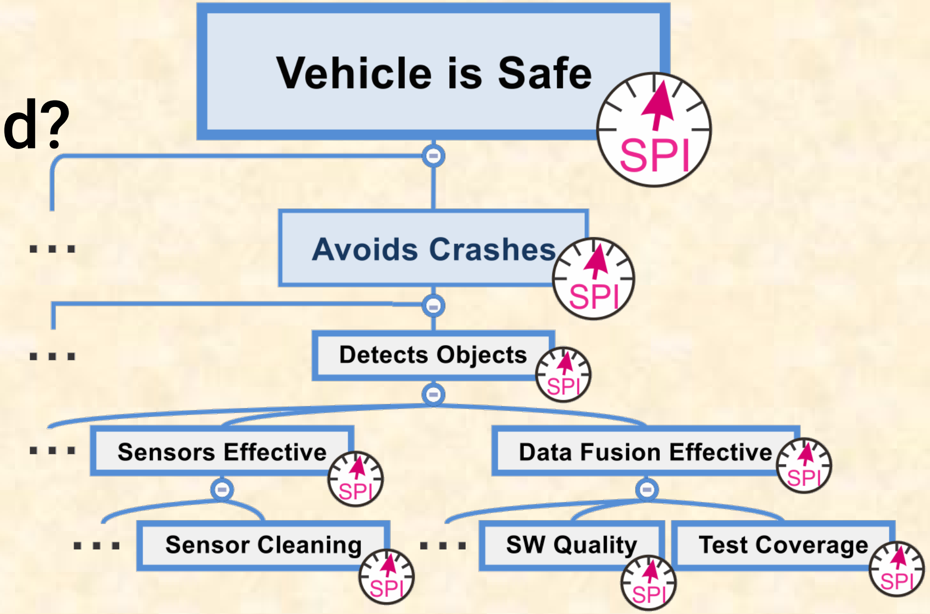
- Safety case review
  - Tool checks for consistency, no loose ends
  - Peer review by internal teams
- What if the argument is unsound?
  - Safety Performance Indicators
    ➔Instrument safety case claims
- Reviewer independence
  - What happens to a safety reviewer who says “no”?



Reference: UL 4600 Chapters 16 & 17

Why Should *WE* Believe Your Argument?

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- Credibility of safety case
  - What exactly are the claims?
  - Expose some of the safety case
  - Integrity of independent review process
- Public SPI metrics
  - How do they trace to your safety case?
- Conformance to UL 4600
  - A standard for *assessing safety cases*
  - #DidYouThinkofThat?
    - Argument completeness, validity

SPI: Safety Performance Indicator

Searching For The One True Safety Case

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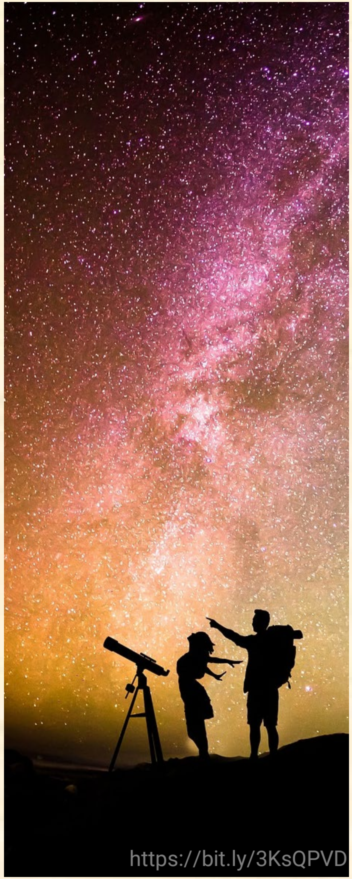
There is no One True Safety Case!

- Claims might vary by operational concept
- Argument strategies vary
  - Operational environment, role of remote support
  - System architecture & development strategy
  - Depth / assumption scope will vary
  - Notation approach will vary (graphical vs. textual)
- Evidentiary needs vary by argument strategy
  - SPI instrumentation enables broader assumptions
- The act of creating the case has significant value



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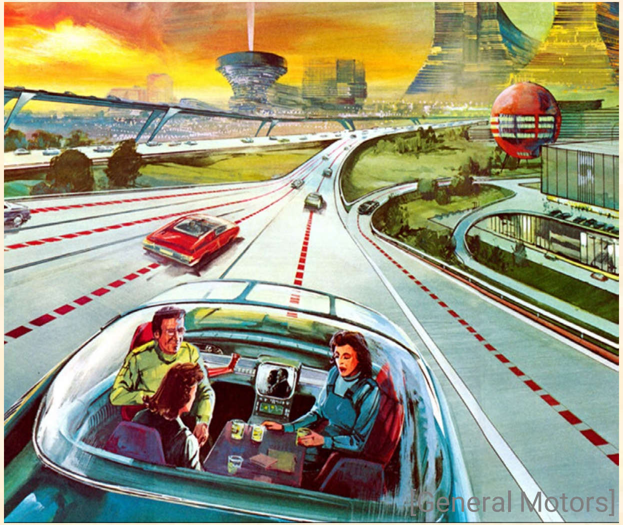
Summary

- Safety case:
  - Logical argument + Evidence → Safety Claim
- Scope:
  - What do you mean by acceptably "safe"?
  - Why do you think you are safe?
  - Why do <u>you</u> believe your argument?
  - Why should <u>we</u> believe your argument?
- Structure
  - Quality of argument matters, not notation



[General Motors]

FREE view UL 4600 launch page: https://bit.ly/ul4600