Meeting the EU requirement for freedom from unreasonable risk

Dr Roger Rivett

6th March 2025

Introduction

- Prompted by current work being undertaken with an autonomy company
- How do you show you have met the EU requirement for freedom from unreasonable risk when the design relies on AI?
- EU Regulation 2022/1426
  - type-approval requirements for the automated driving systems (ADS) of fully automated vehicles
  - ensuring they are free from unreasonable risks to occupants and road users compared to competently driven manual vehicles.

Introduction

- Developers face challenges of
  - defining free from unreasonable risk in a manner translatable to engineering requirements
  - validating this definition across all road use scenarios, and demonstrating compliance with these requirements
- Developers have to argue that their interpretation of unreasonable risk aligns with regulatory expectations and real-world safety outcomes
- Not an answer – just thoughts from a work in progress
- Trying to scope the problem

Commission Implementing Regulation(EU) 2022/1426 of 5 August 2022

- *laying down rules for the application of Regulation (EU) 2019/2144 of the European Parliament and of the Council as regards uniform procedures and technical specifications for the type-approval of the automated driving system (ADS) of fully automated vehicles*

- https://op.europa.eu/en/web/eu-law-in-force/bibliographic-details/-/elif-publication/94bfefa8-24e9-11ed-8fa0-01aa75ed71a1

(EU) 2022/1426 mentions of Free from Unreasonable Risk (FFUR)

- Introduction (5)
  - *... automated driving system is free of unreasonable safety risks to vehicle occupants and other road users in the relevant scenarios and during the ADS lifetime*
- Annex I Information document for EU type-approval of fully automated vehicles with regard to their automated driving system
  - 17.6.1: *Manufacturer Statement that the vehicle is free from unreasonable risk*
  - 17.7: *… system is designed in such a way that it is free from unreasonable risk …*
- Annex II Performance requirements
  - 7.1: The measures put in place by the manufacturer shall ensure that the fully automated vehicle is free of unreasonable safety risks

(EU) 2022/1426 mentions of Free from Unreasonable Risk (FFUR)

- Annex III Compliance assessment
  - Part 1 Traffic Scenarios to consider
  - 1.1: *The safety performance metrics and inherent assumptions chosen shall demonstrate that the fully automated vehicle is free of unreasonable safety risks*
    - Part 2 Assessment of the ADS safety concept and audit of the manufacturer safety management system
  - 2 Definitions
    - 2.1 safety concept
      - *A description of the measures designed into the ADS, so that the fully automated vehicle operates for the scenarios and events relevant to the ODD in such a way that it is free of unreasonable safety risks …*
  - *3 Documentation of the ADS*
    - *The type-approval authority shall assess the documentation package which shall show that the ADS*
      - *(a) Is designed and was developed to operate in such a way that it is free from unreasonable risk*
  - *3.5.1: The manufacturer shall provide a statement that affirms that the ADS is free from unreasonable risks for the vehicle occupants and other road users*
  - *3.5.5.4.1: It shall demonstrate that the operation of fully automated vehicle is free from unreasonable risks for the vehicle occupants and other road users in the operational design domain*
  - *3.5.5.7: The documentation shall describe the measures in place to ensure the ADS is free from unreasonable risks to vehicle occupant and other road users when the performance of the ADS is affected by environmental conditions, e.g. climatic, temperature, dust ingress, water ingress, ice packing, inclement weather*

What does FFUR mean?

- ISO 26262 –unreasonable risk
  - *risk judged to be unacceptable in a certain context according to valid societal moral concepts*
- EU 2022/1426 use of freedom from unreasonable risk should not be conflated with 26262 scheme
  - It does not provide a measurement scheme or acceptance criteria
- It is as meaningful as asking for freedom from unreasonable ugliness
- Intentionally ambiguous
  - The regulators do not know how to do this
  - The regulators do not want to stifle innovation

- Each company has to define freedom from unreasonable risk for themselves

What does FFUR mean?

- The benchmark is
  - *compared to competently driven manual vehicles*
- What are the responsibilities of competent drivers of manually driven vehicles?

Before a journey, e.g.	During a journey, e.g.
Ensure vehicle fit for use, e.g. Ensure there are no faults present Ensure tyres at the correct pressure Ensure washer bottle, oil, fuel levels adequate for journey	Maintain control of the vehicle Travel from journey start to destination Do not cause an accident Obey the rules of the road Show courtesy Deal with other road user's behaviour Deal with changes in the condition of the vehicle (including malfunctions) Deal with the conditions in the external environment (including weather)

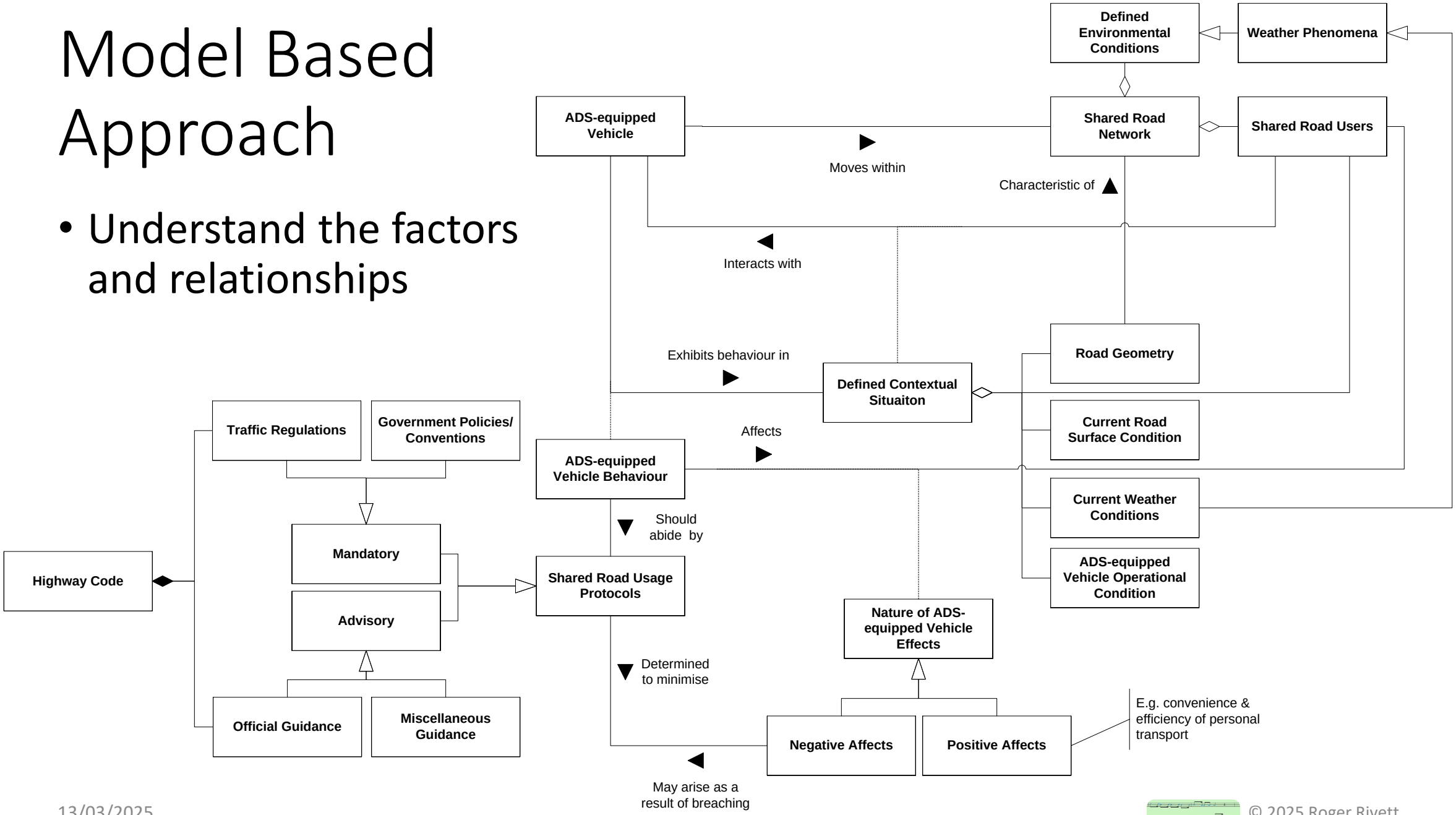
- For a fuller description, see MISRA publication *Historical implicit argument for road safety*

Producing a FFUR Definition

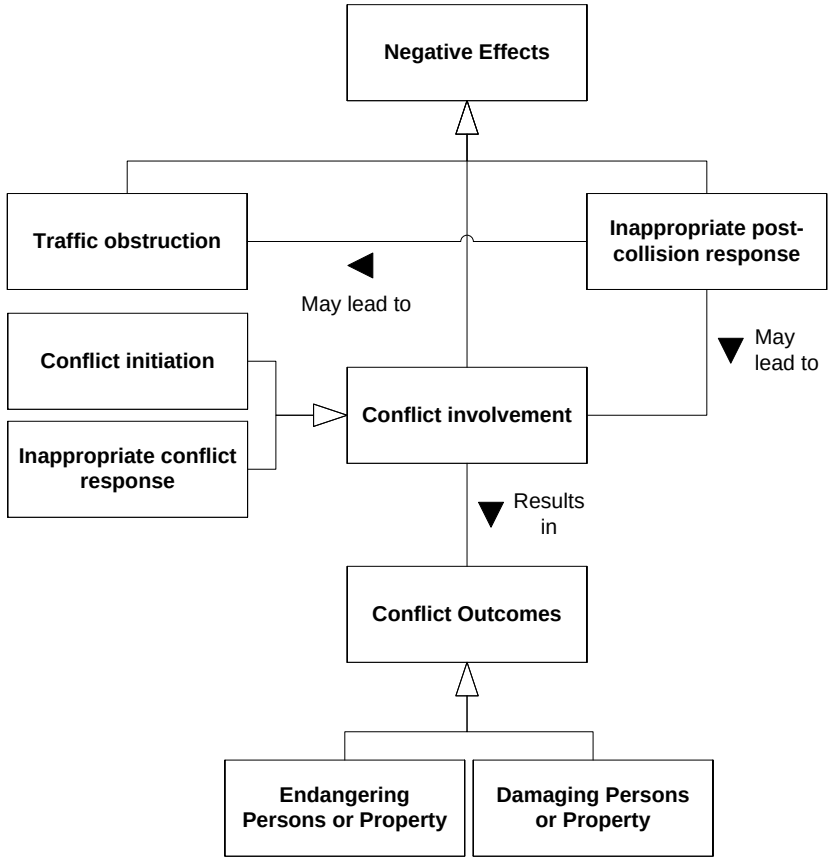
- Model based approach example
- Example just considers the *during-journey* aspects

Model Based Approach

- Understand the factors and relationships



Model of Potential Negative Affects

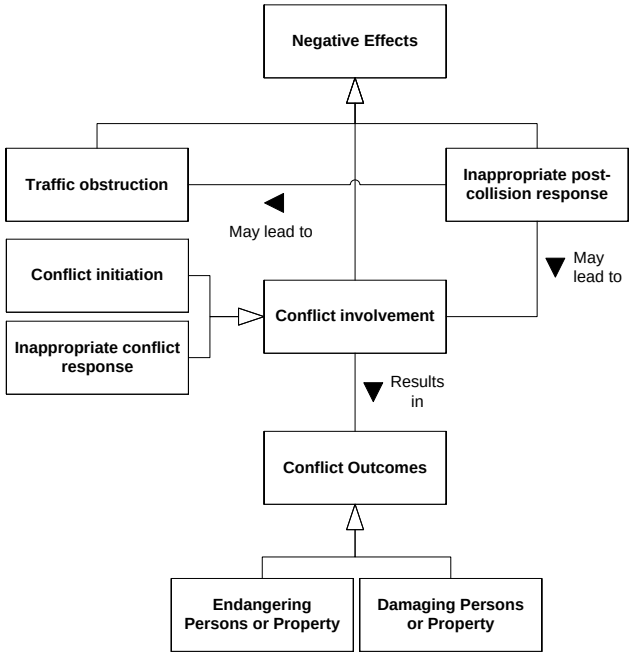


Defining FFUR

- Definition of FFUR could be based on statements around elements of the model
  - Traffic obstruction
  - Inappropriate post-collision response
  - Conflict initiation
  - Inappropriate conflict response
  - Endangering Persons or Property
  - Damaging Persons or Property

Defining FURR

- Could relate negative consequences to the drivers responsibilities



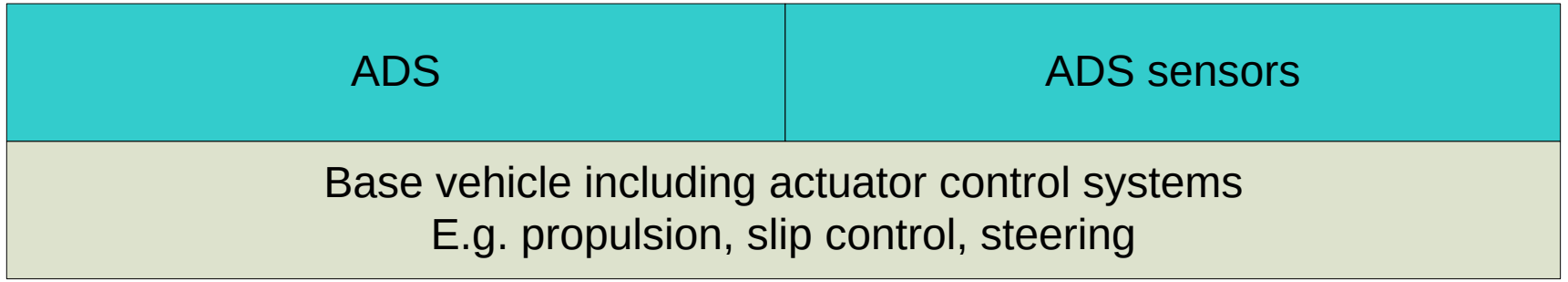
Before a journey, e.g.	During a journey, e.g.
Ensure vehicle fit for use, e.g. Ensure there are no faults present Ensure tyres at the correct pressure Ensure washer bottle, oil, fuel levels adequate for journey	Maintain control of the vehicle Travel from journey start to destination Do not cause an accident Obey the rules of the road Show courtesy Deal with other road user's behaviour Deal with changes in the condition of the vehicle (including malfunctions) Deal with the conditions in the external environment (including weather)

FFUR Definition

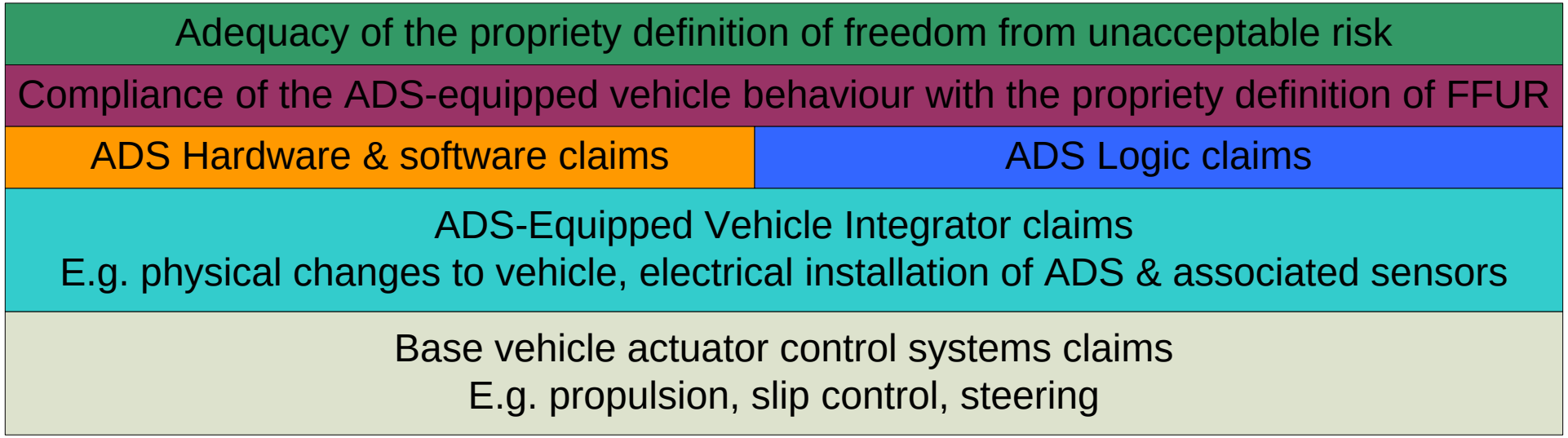
Vehicle behaviours that will be delivered by the ADS-equipped vehicle
How FFUR is defined depends on the vehicle architecture

Claims

- Simple physical model of an ADS-equipped vehicle

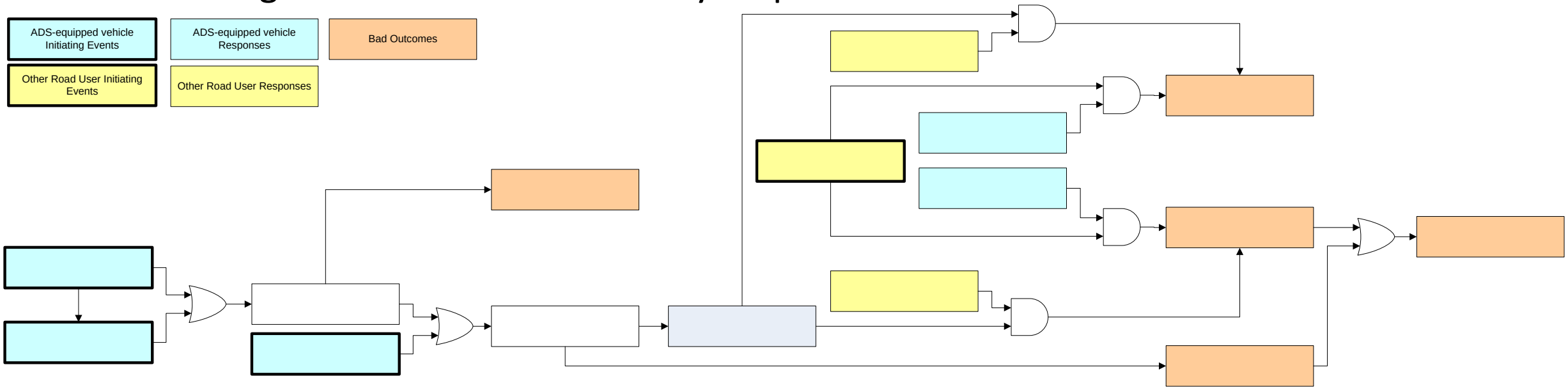


- Scope of potential claims



Possible Claims

- ***The propriety definition of freedom from unreasonable risk is a valid interpretation of the regulations***
  - Argue that the vehicle behaviour given by FFUR definition is based on understanding the negative affects and the responsibilities of the control authority of the vehicle
  - Using a cause-effect model may help



Possible Claims

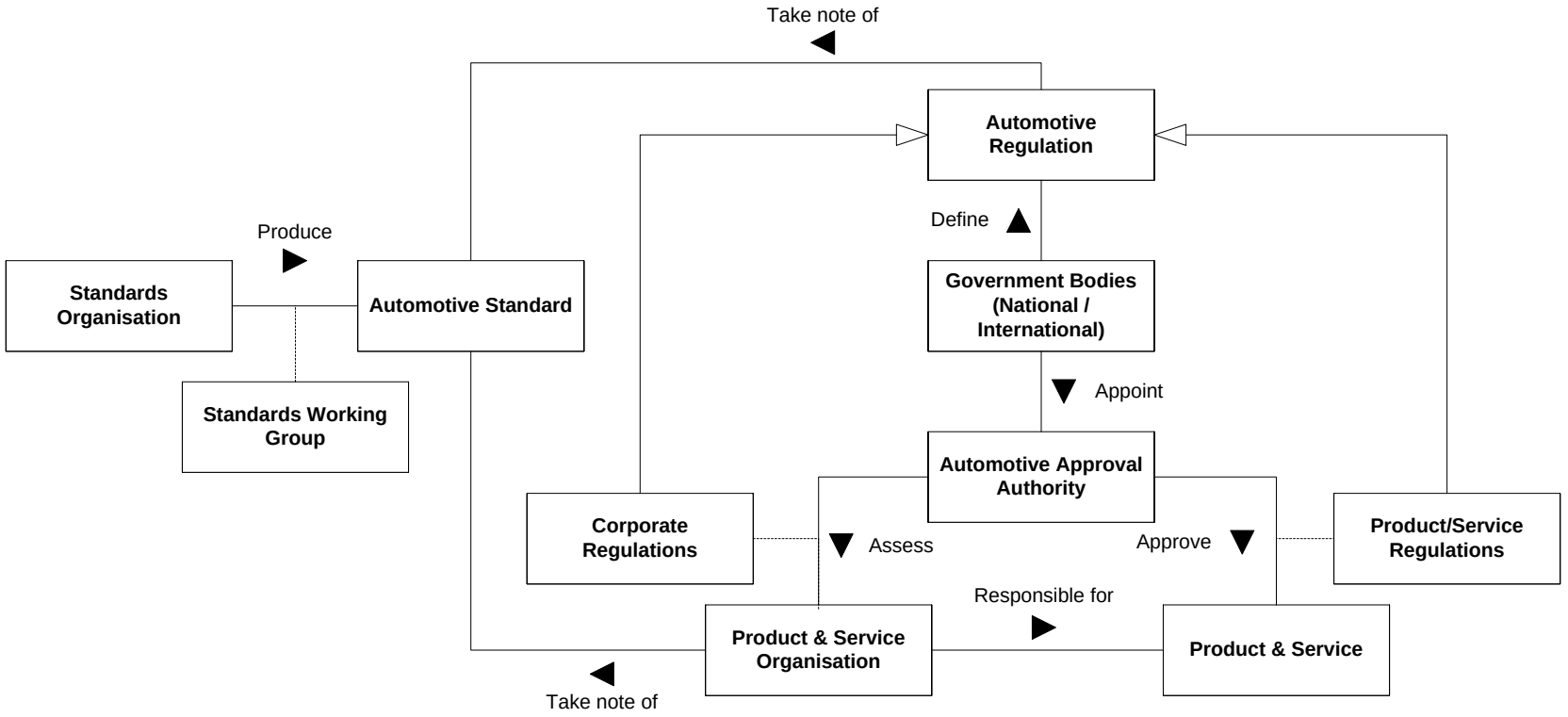
- The ADS-equipped vehicle behaviour compiles with the propriety definition of FFUR
- Failures of the ADS Hardware & software do not violate the definition of FFUR
- The ADS Logic always fulfils the definition of FFUR
- The integration of the ADS and its sensors into the base vehicle does not violate the definition of FFUR
- Failures of the base vehicle actuator control systems do not violate the definition of FFUR

Who needs to make the claims?

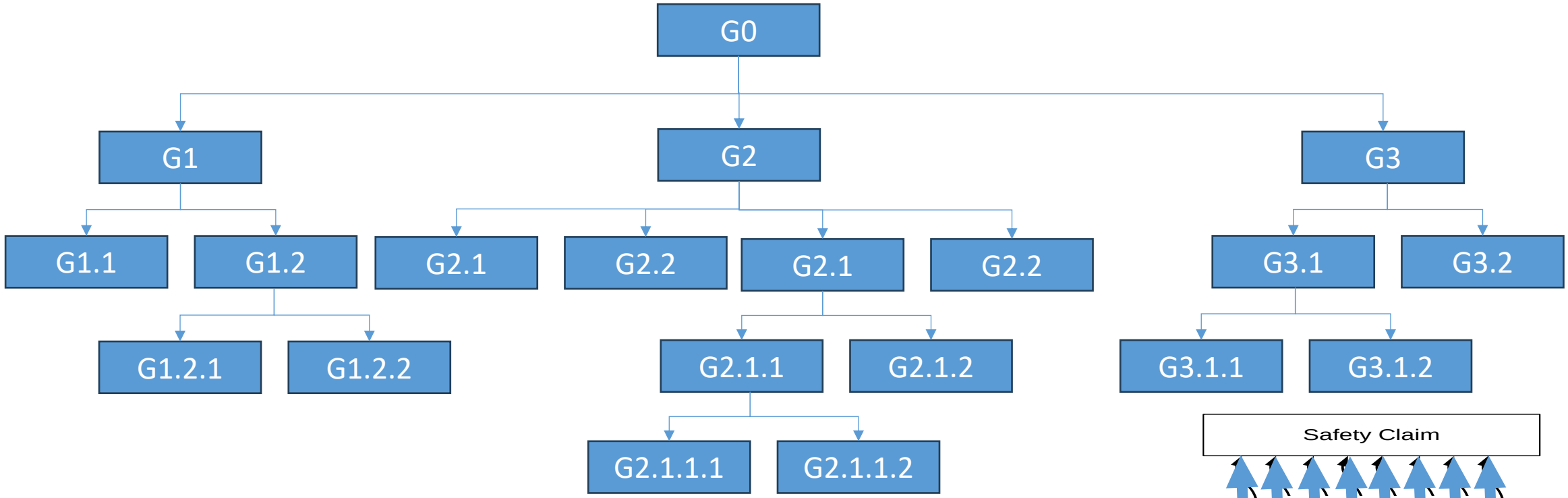
- Depends on scope of the organisation, e.g.
  - Fleet operators
  - ADS-equipped vehicle providers
  - ADS providers
  - Base vehicle providers
  - Actuator control systems providers

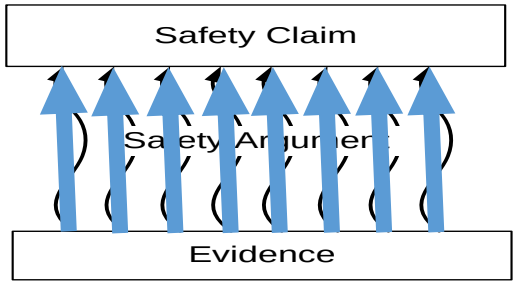
Standards Regulation & Approval

- The regulator will decide which responsibilities apply depending on the scope of the organisation



Safety Argument Frameworks

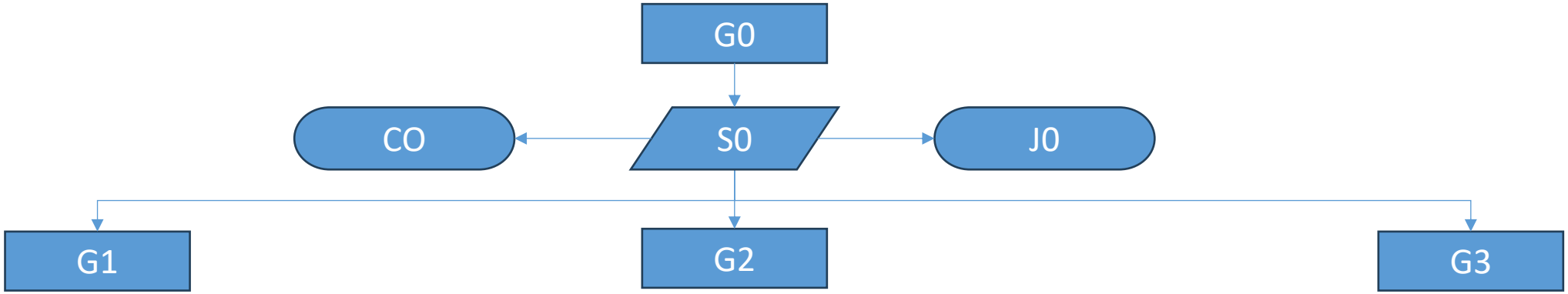




- Not a ***compelling*** safety argument because it does not answer the question
  - "Why should it be believed that G0 is achieved by the subgoal breakdown?"
- It invites the reader to construct the argument for themselves

Safety Argument

- To answer the question “Why should this be believed?”
- Add a strategy and a justification for the strategy



- Strategy S0:
  - The rationale as to why G0 can be broken down into G1, G2, G3
  - Ideally base the strategy on a model (C0)
- Justification J0:
  - The adequacy of the strategy (completeness for demonstrating the prior claim)
  - Why this is preferred over other possible strategies

MISRA SC White papers

- White Paper 1
  - Safety assurance argument context for automated driving
  - https://misra.org.uk/app/uploads/2024/04/MISRA-SC-Safety-assurance-argument-context-for-automated-driving.pdf
- White Paper 2
  - Historical implicit argument for road safety
  - https://misra.org.uk/publications/
- To come
  - White Paper 3
    - Vehicle Movement Assurance Claim Structure
  - White Paper 4
    - Behavioural Competences