

Using Metrics with ODD Specification

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What is an ODD metric (acc. to ASAM OpenODD Concept Document)?

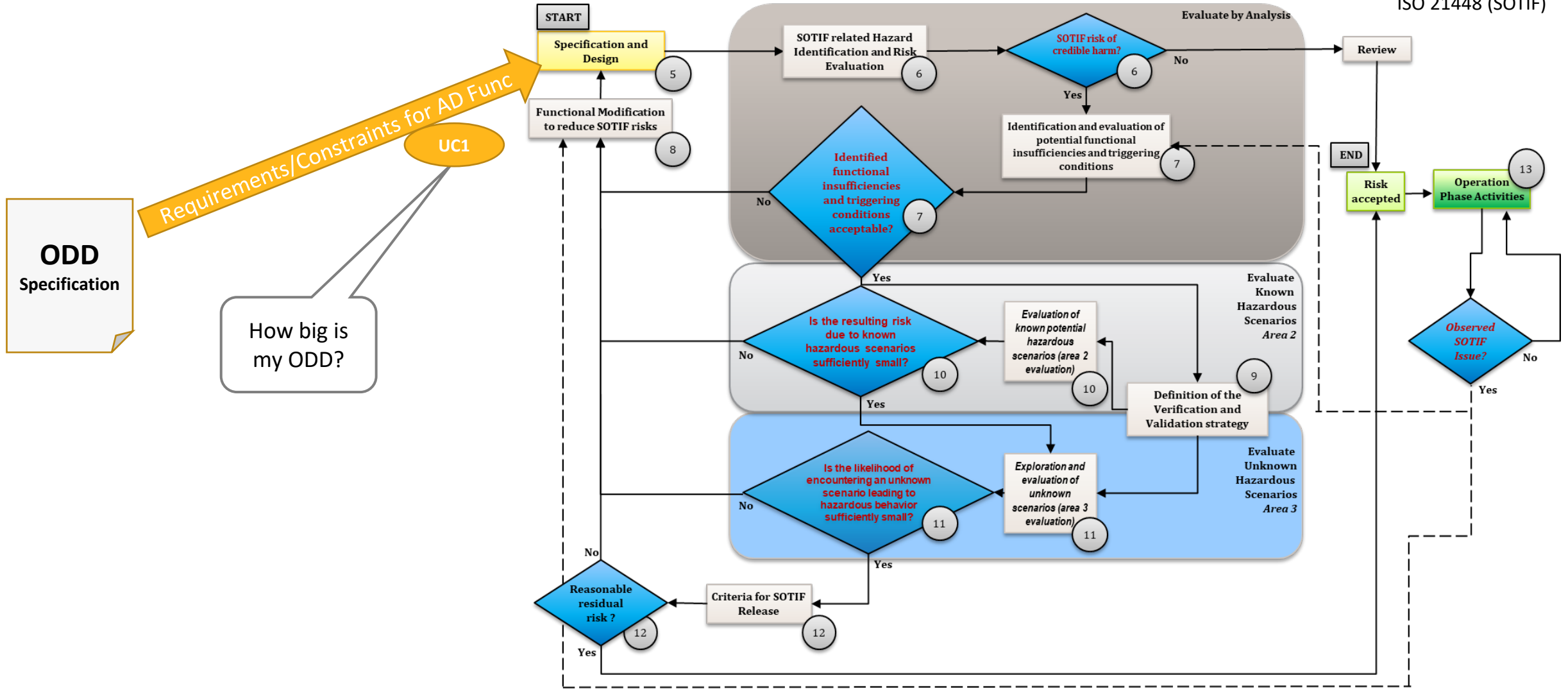
A metric is a function that transforms features or properties of an ODD - alone or in its relation to other ODDs, to scenarios etc. - into a number or an ordered set of qualifiers (e.g. good > medium > bad).

Source: ASAM OpenODD Concept Document (working draft September 2021)

Notes:

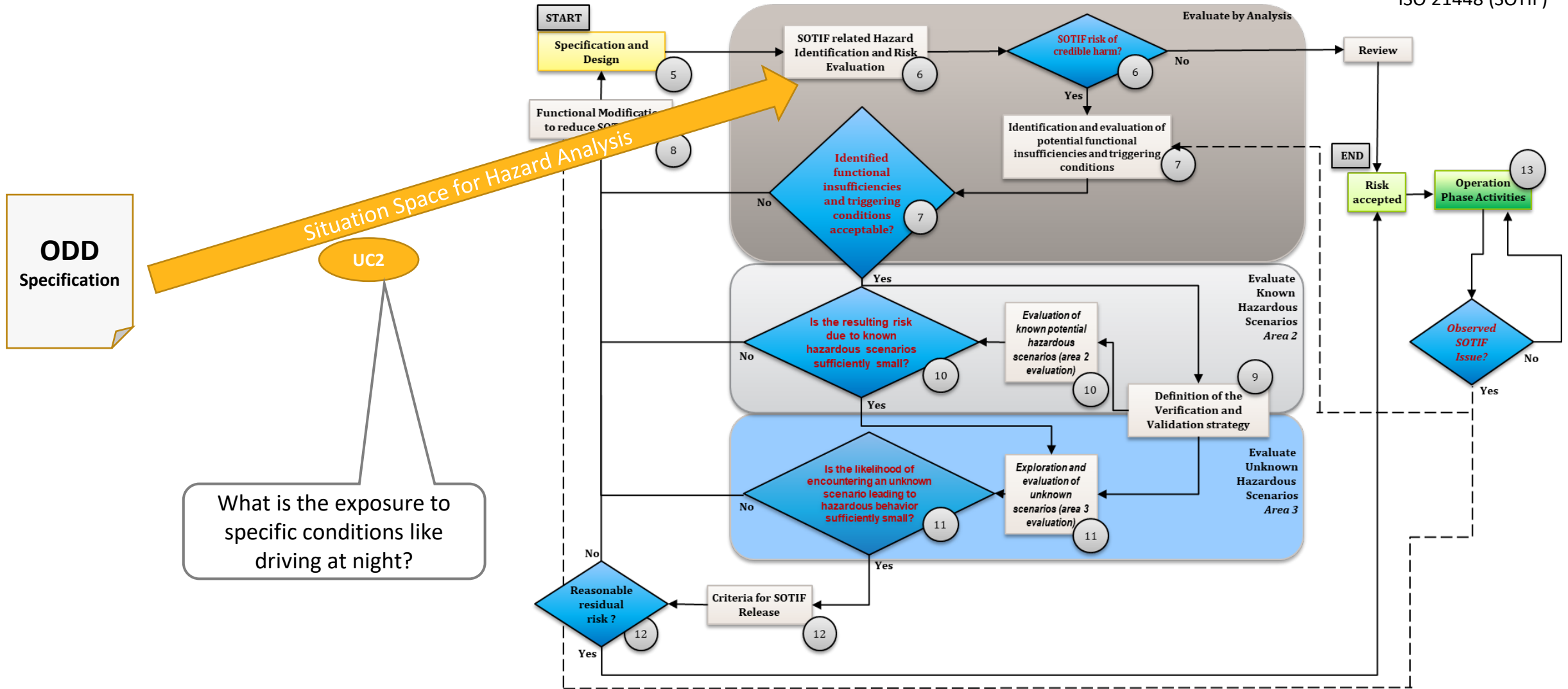
- ODD metrics are not just metrics about ODDs, but also metrics relating ODDs and other things (like an ontology, a set of scenarios, the performance of some piece of software to detect whether we are inside the ODD etc.)
- Metrics computation will often need to refer to external data sources (e.g. a database with road or weather statistics)

Examples for metrics about ODDs



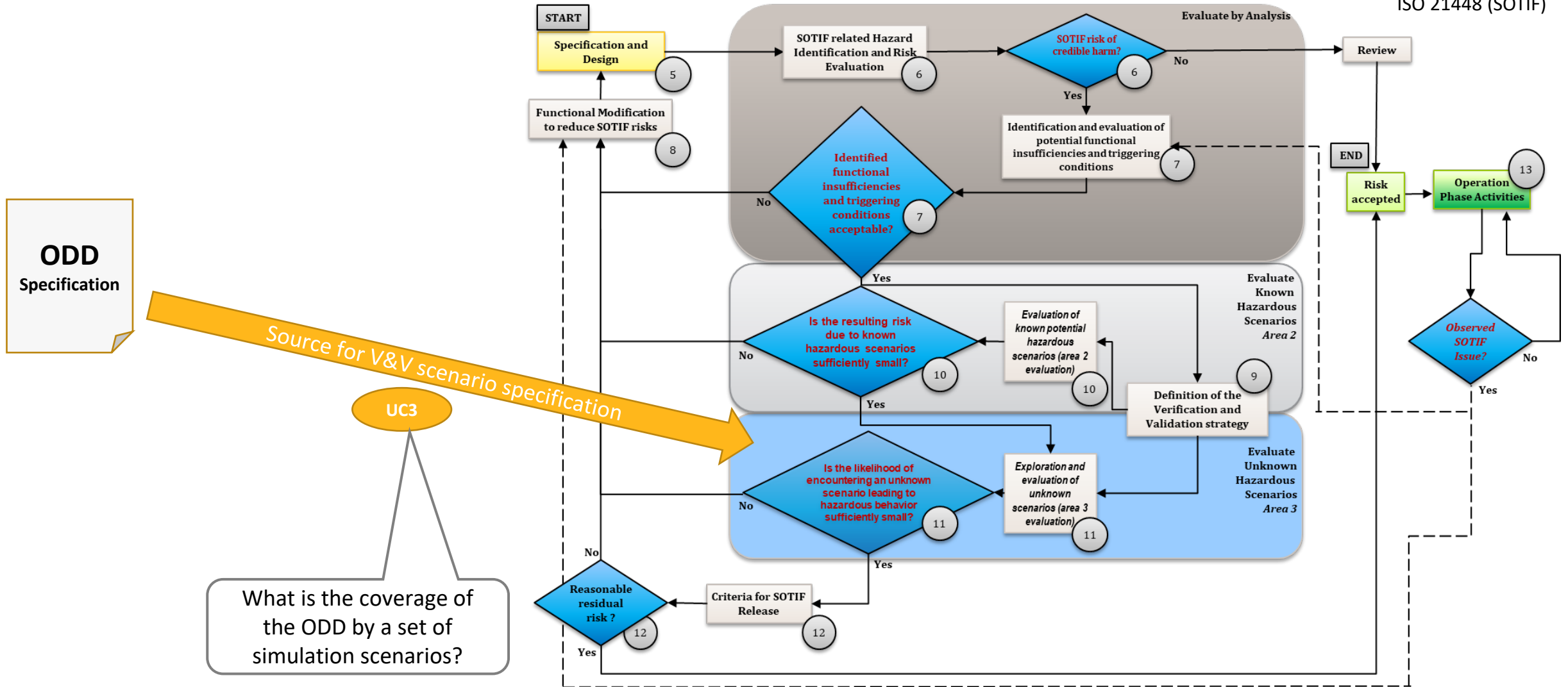
Examples for metrics about ODDs

Process flow acc. ISO 21448 (SOTIF)



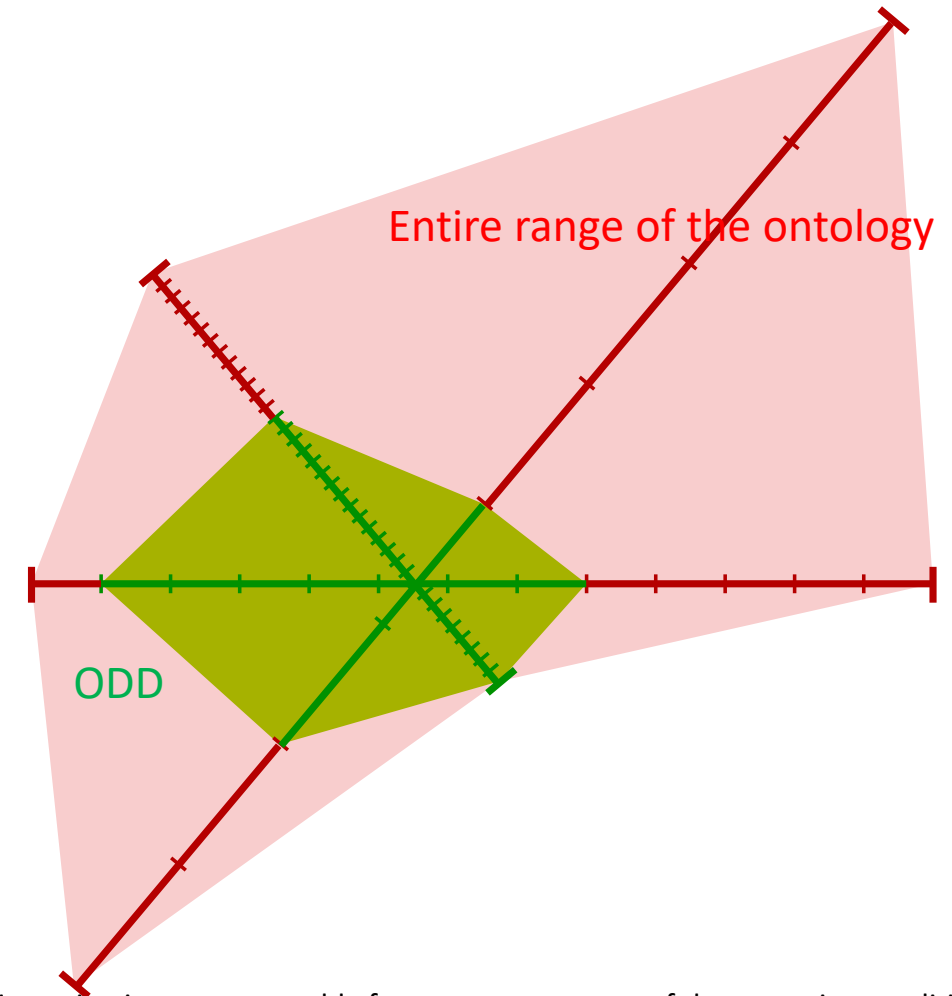
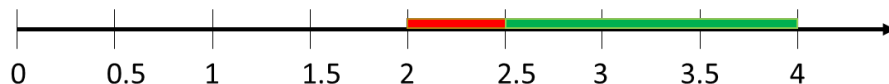
Examples for metrics about ODDs

Process flow acc. ISO 21448 (SOTIF)



Metrics – How could it work?

- Interpret the ontology (on which the ODD is defined) as a multi-dimensional space
- Each dimension (aspect) is a set, e.g.
 - RoadTypes := {highway, country road, city street, offroad}
 - LaneWidths := {2.0 m ... 4.0 m}→ **Ontology = Roadtypes x Weathers x Numbersoflanes x Lanewidths x ...**
- The ODD can be regarded as a multi-dimensional sub-set of the whole ontology, e.g.
 - Only highway and country road is allowed, not city or offroad
 - Lane width must be at least 2.5 m→ **ODD = {highway, country road} x [2.5,4.0] ⊆ Ontology**
- One way to determine certain metrics is to define a measure for the „size“ of such a set and to divide it by the measure of the range delimited by the ontology, e.g.
 - My ADAS function can handle any road with 2.5 m lane width or more
 - That's 75% of the total range of 2..4 m



Each dimension is one measurable feature or parameter of the operating conditions
Green area delimits the authorized operating conditions (ODD)
Red parts are operating conditions not intended for AD operation (i.e. outside ODD)

Metrics – How could it look like in a future OpenODD language?

Setting:

- What percentage of situations in some country (specifically related to the *weather* restrictions from ODD specification) are suitable to switch on automated mode for some vehicle?
- The ODD allows any weather but snowfall.
- We assume that a weather statistics database for selected countries is available and can be accessed via OpenODD extension library (we consider different programming languages for choice to implement this access function).

```
INCLUDE Metrics                # OpenODD Extension Package that defines base class for metrics
INCLUDE ExtDataSource          # OpenODD extension to access
INCLUDE MyOntology;           # This enables the use of all attributes within "MyOntology", e.g. weather

# My simple ODD: Everything except rainfall is suitable

SUITABLE [roadtype.highway roadtype.urban_roads roadtype.parking_lots] EXCEPT WHEN weather.snowfall;

# Statistical Percentage where AD function cannot operate due to weather conditions
MEASURE PercentSnowfall
    TYPE float UNIT "%"
    RANGE [0.0 - 1.0]
    SOURCE ExtDataSource.query(weatherStatistics(['Germany'], ['2020'], 'frequencyPercent', weather));

METRIC PercentageUnsuitableWeather is (max - PercentSnowfall);
```

