KI ABSICHERUNG

Safe AI for Automated Driving

23.2.2021, Safetrain Project Meeting

Experiences from KI-Absicherung

Michael Mock (Fraunhofer IAIS)

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Project vision and goals

KI ABSICHERUNG

Safe AI for Automated Driving

Consortium Lead: Volkswagen AG

Co - Lead: Fraunhofer IAIS

Budget: €41M

Funding: €19.2M

24 Partners

Duration: 36 months

01.07.2019 – 20.06.2022

https://www.ki-absicherung-projekt.de

Partner

External techonolgy partners

https://www.ki-absicherung-projekt.de/fileadmin/KI_Absicherung/KI_Absicherung_Zwischenpraesentation/KI-A_Zwischenpraesentation_Einfuehrung_final.pdf

https://www.ki-absicherung-projekt.de/fileadmin/KI_Absicherung/KI_Absicherung_Zwischenpraesentation/KI-A_Zwischenpraesentation_Einfuehrung_final.pdf

https://www.ki-absicherung-projekt.de/veroeffentlichungen/ki-absicherung-zwischenpraesentation

Challenge

AI Land

Promising new technology with unimagined possibilities

Established safety processes cannot be applied

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Safe AI for Automated Driving

Safety Land

Safe, trustworthy driving function

Industry consensus (Safe AI): Methodology for joint safety argumentation

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Methodology for a Safety Argumentation

Der »konsensfähige« Projektansatz

An Integrated Approach to a Safety Argumentation for AI-based Perception Functions in Automated Driving

Michael Mock[1], Stephan Scholz[2], Frédérik Blank[3], Fabian Hüger[2], Andreas Rohatschek[3], Loren Schwarz[4], Thomas Stauner[4]

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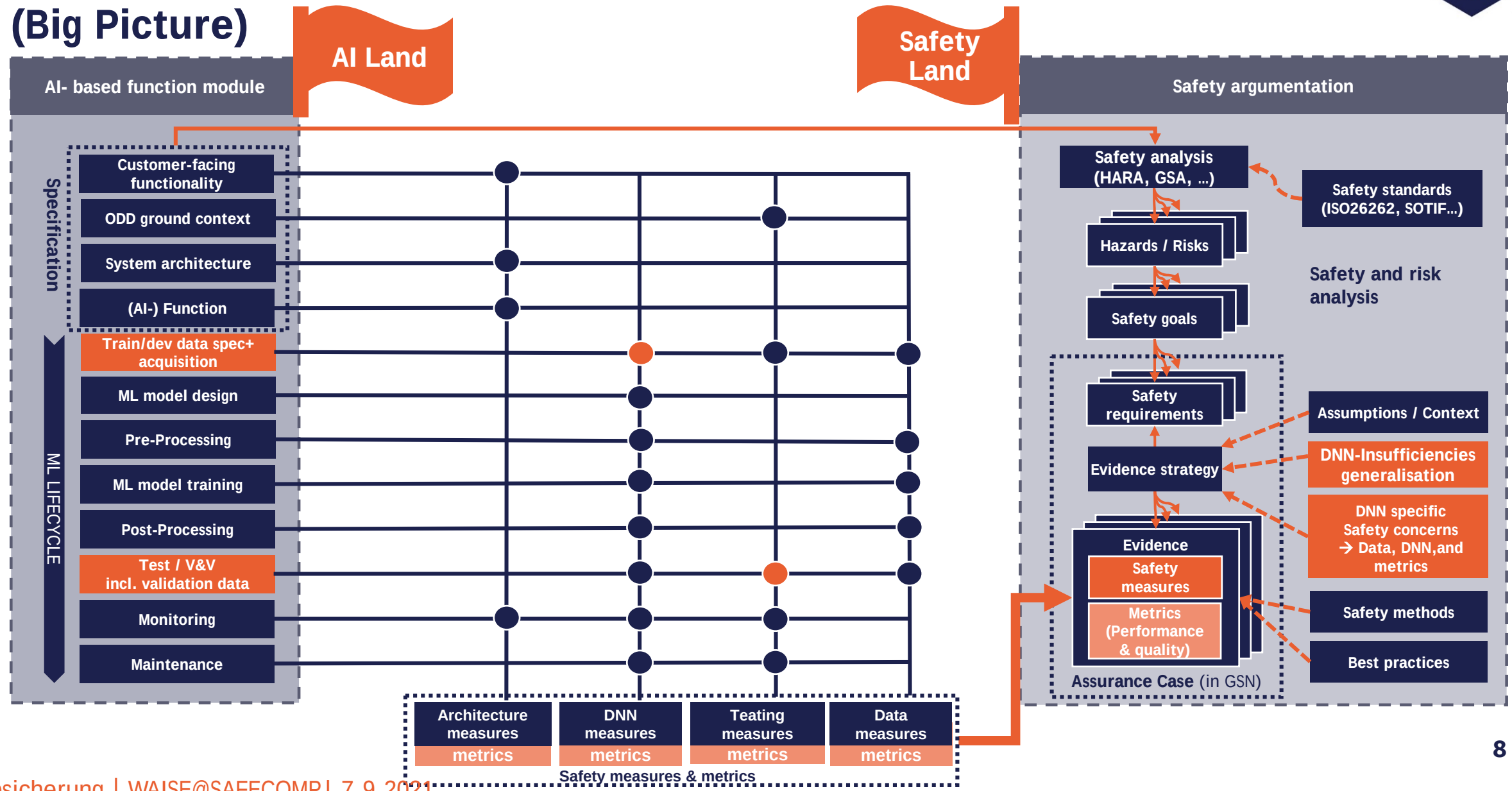
An Integrated Approach to a Safety Argumentation for AI-Based Perception Functions in Automated Driving, Mock, Michael; Scholz, Stefan; Blank, Frederik; Hüger, Fabian; Rohatschek, Andreas; Schwarz, Loren; Stauner, Thomas, Computer Safety, Reliability, and Security. SAFECOMP 2021 Workshops

https://ki-familie.vdali.de/ki-newsletter-nr-1/ki-absicherung-proof-of-project-concept
https://www.ki-absicherung-projekt.de/fileadmin/KI_Absicherung/KI_Absicherung_Zwischenpraesentation/KI-A_Zwischenpraesentation_PoPC_final.pdf

Project Approach to a Safety Argumentation for AI-based Functions (Big Picture)



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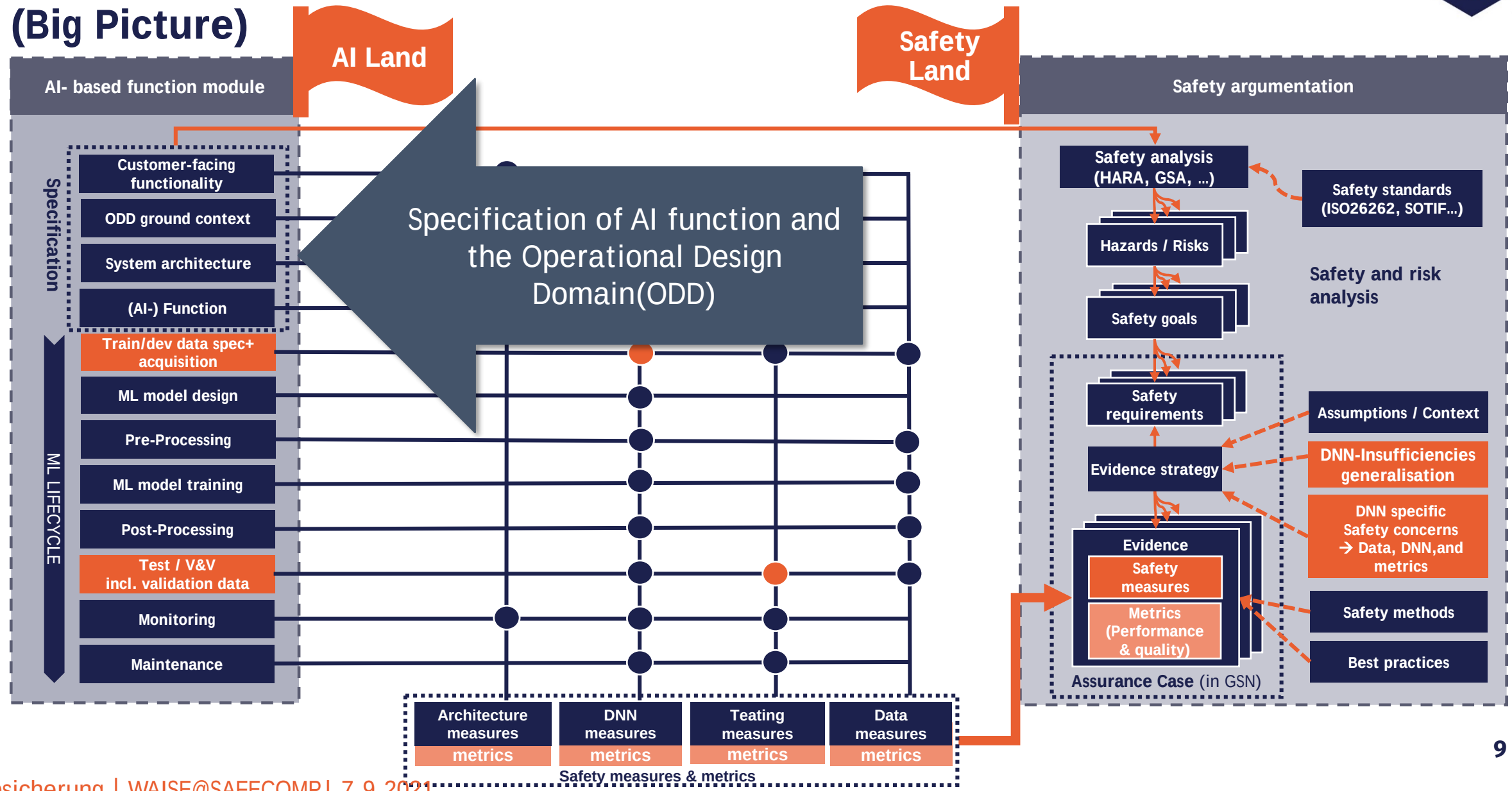

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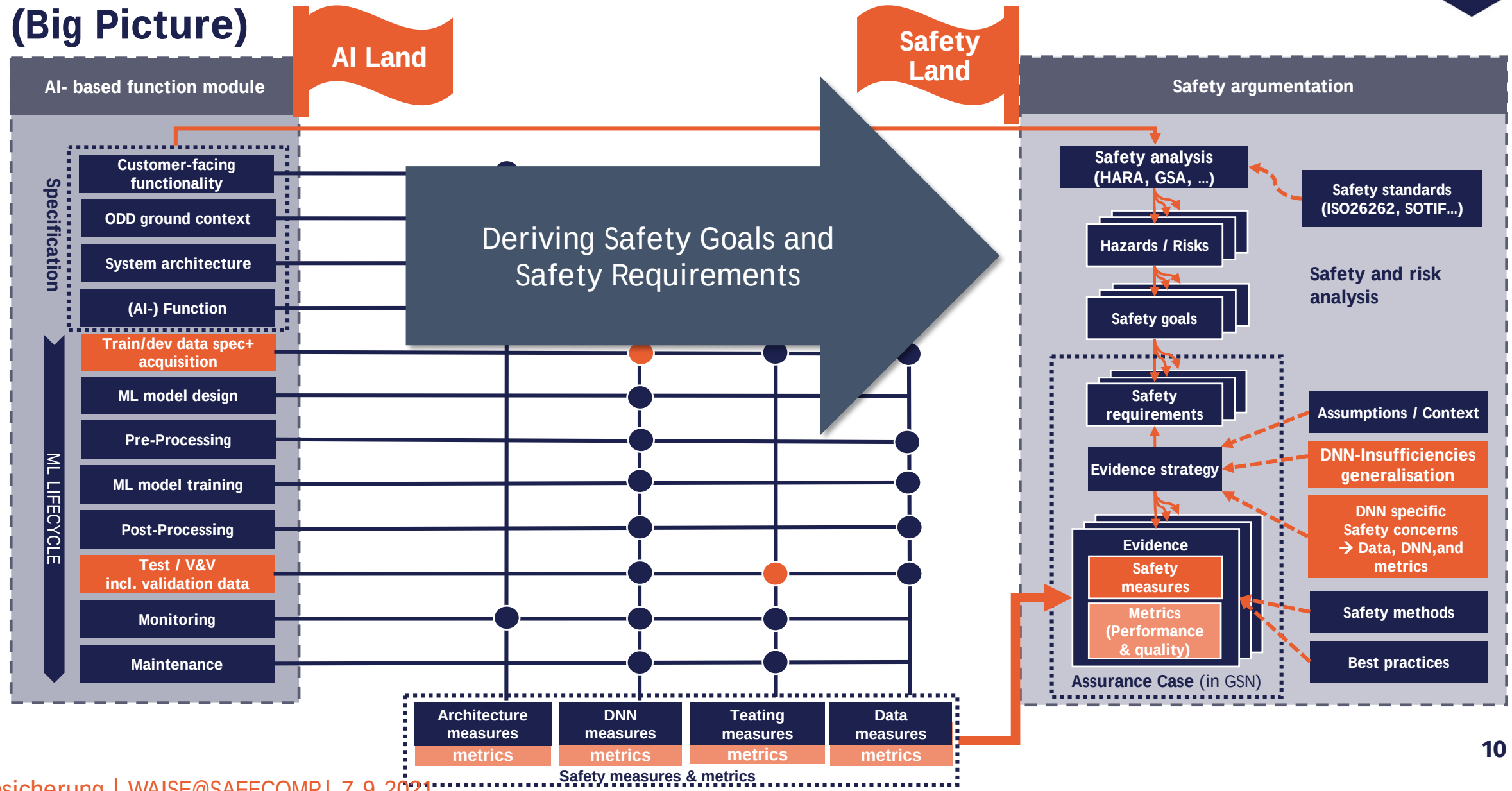

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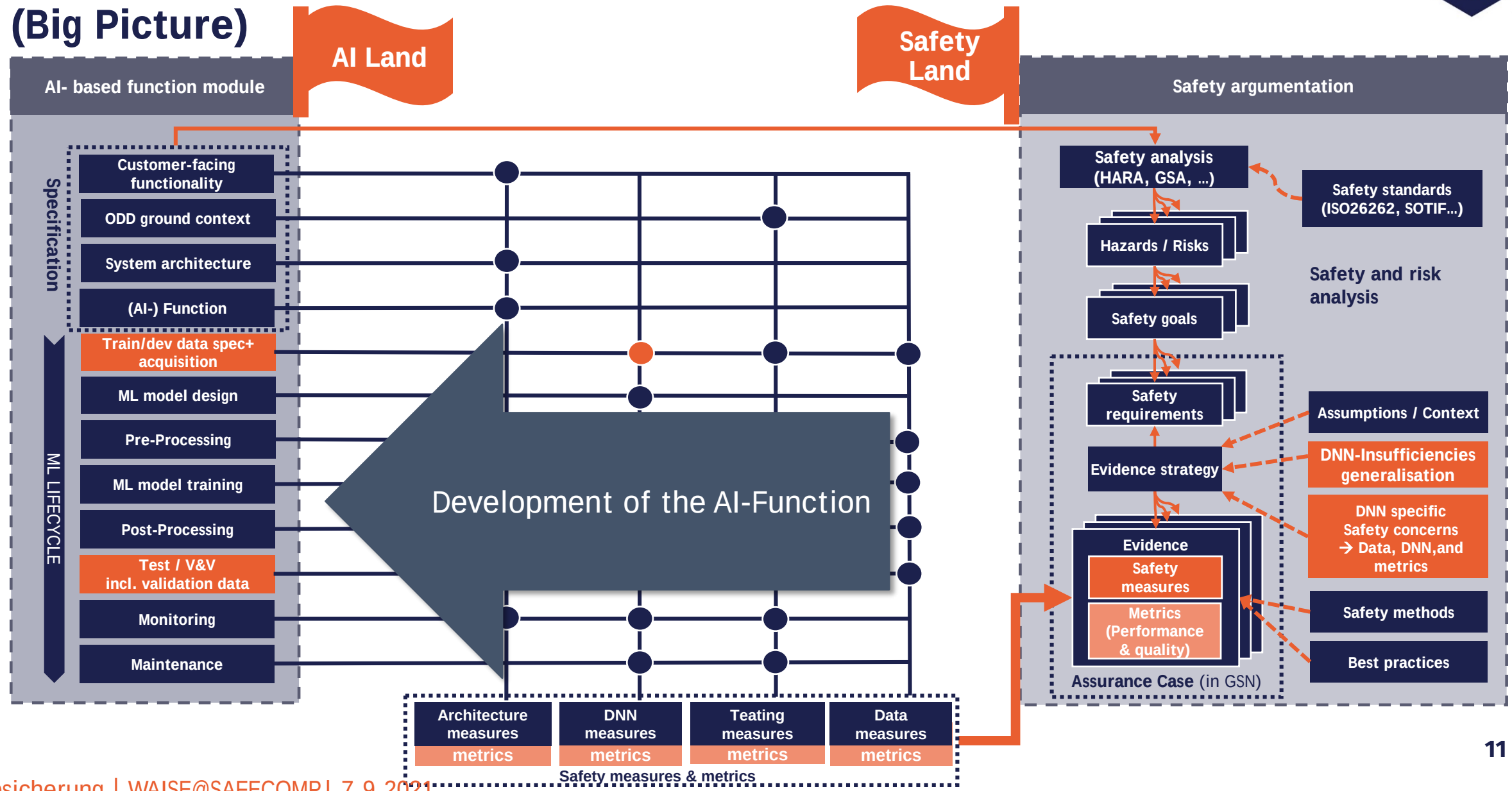

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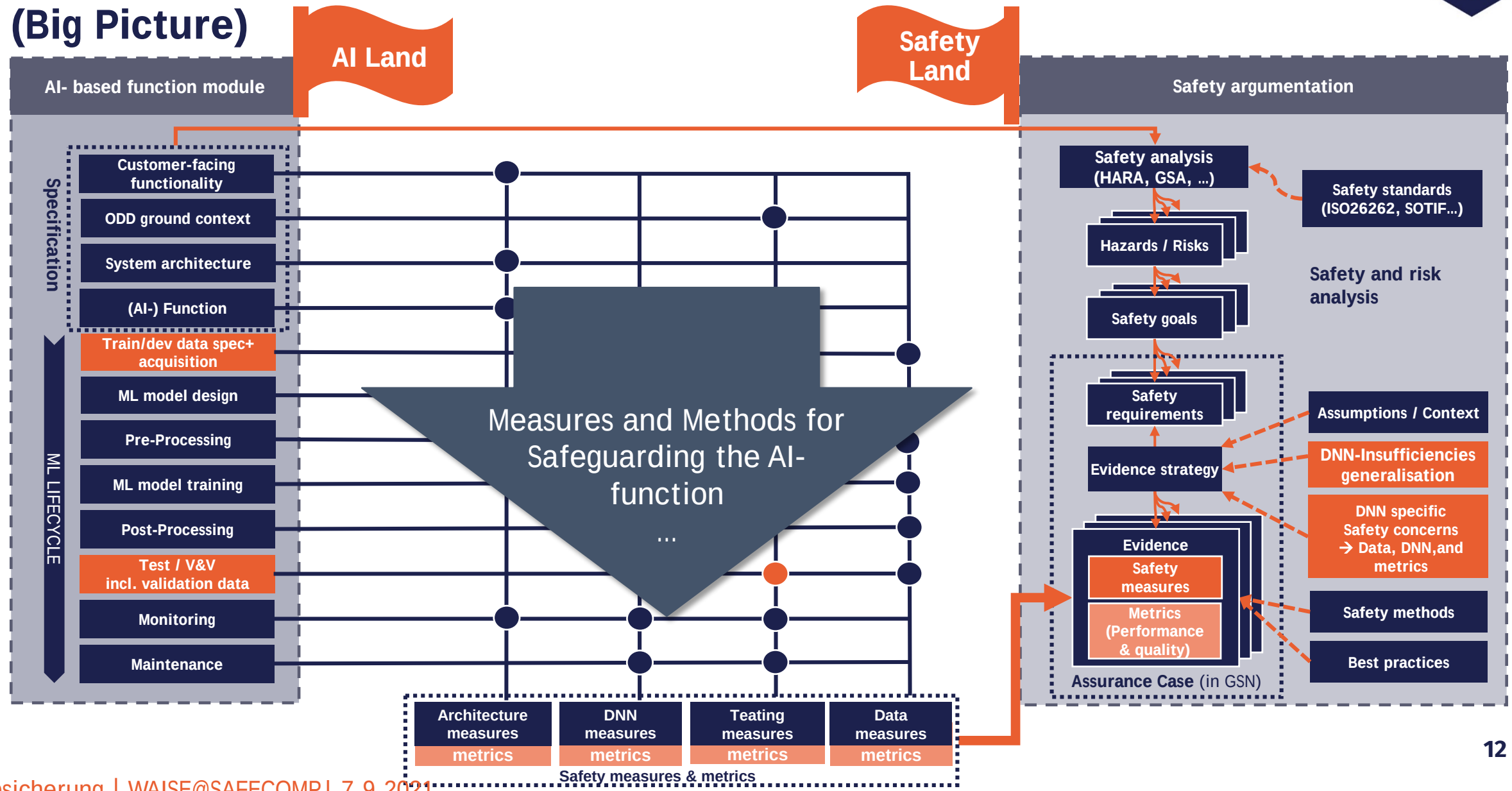

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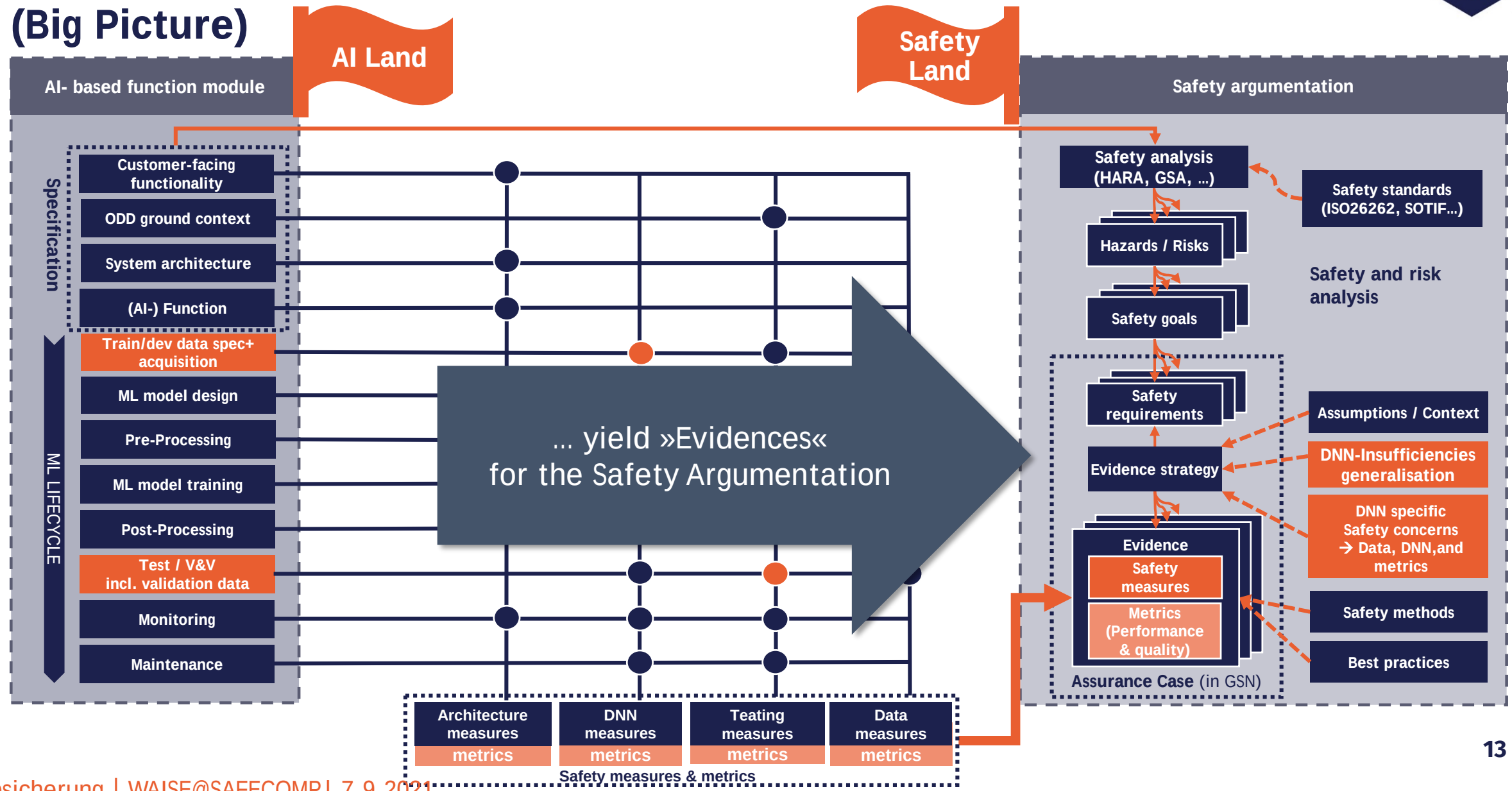

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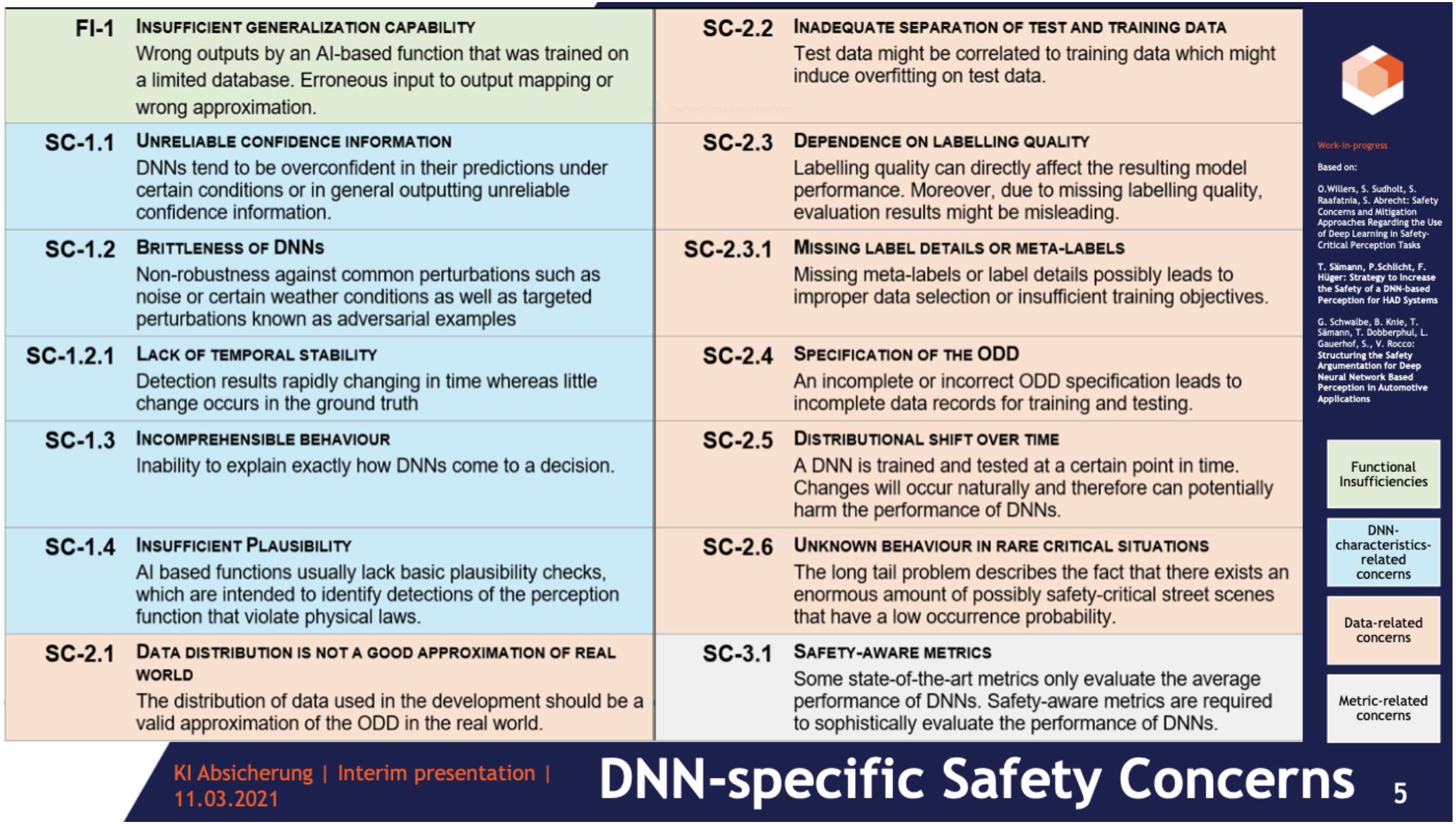
Assurance Case Definition



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https://ki-familie.vdali.de/ki-newsletter-nr-2/ki-absicherung-dnn-specific-safety-concerns

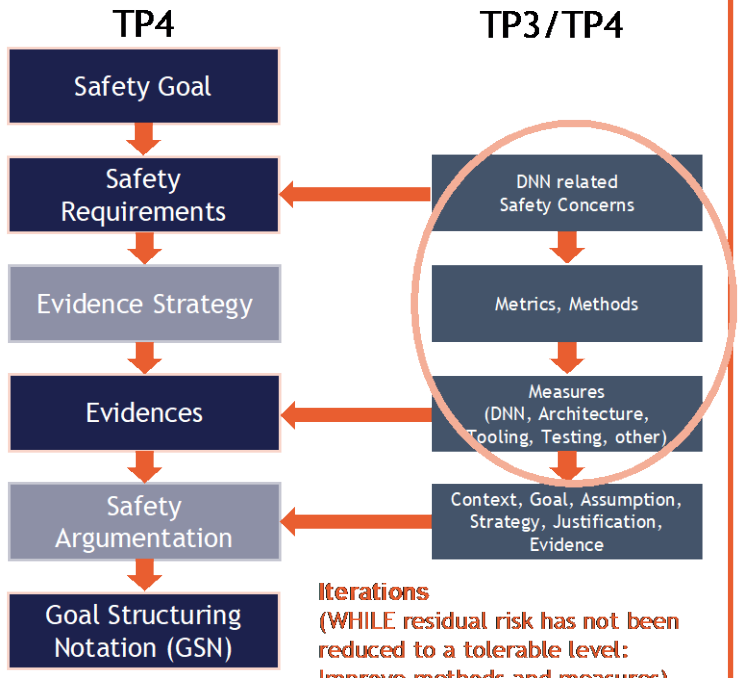
Assurance Strategy for AI

Assurance Case Strategy for AI-based Perception

The path to an evidence based Safety Argumentation

- Identify potential causes of insufficiencies in the function (in KIA: “DNN related safety concerns”)
- Introduce metrics or some form of judgment to argue that insufficiency was mitigated
- Develop methods to mitigate the insufficiencies
- Argue that the residual risk associated with the causes has been reduced to a tolerable level
- Create the evidence based safety argumentation in a Goal Structuring Notation

Assurance Case Development



What are the causes of insufficiencies and what sources of evidence can be used to make this argument?

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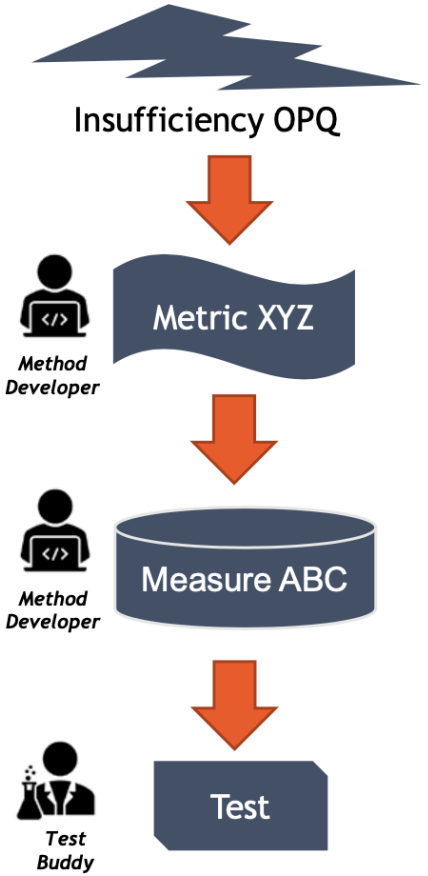
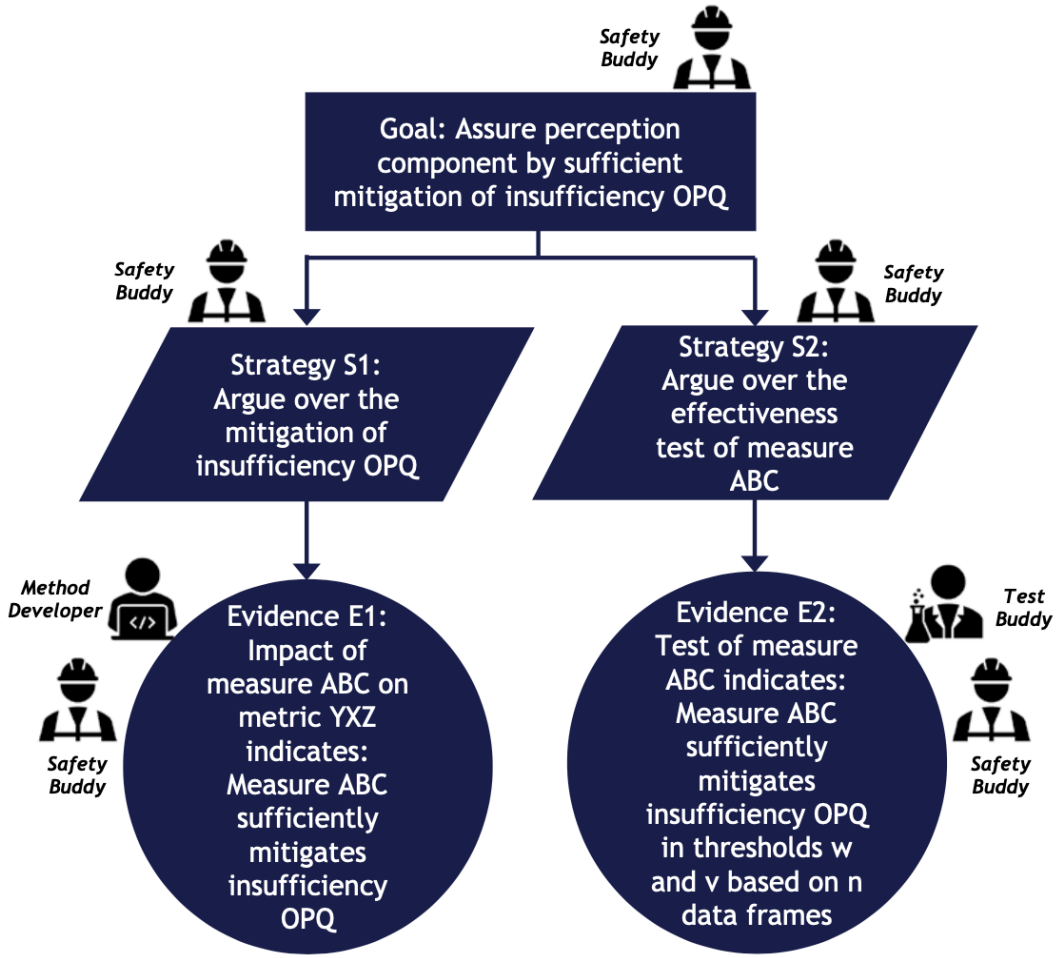
Assurance Strategy for AI
How to create Evidences from Methods and Tests





Interaction of Method Developer, Safety Buddy and Test Buddy leads to evidences for the safety argumentation

https://www.ki-absicherung-projekt.de/fileadmin/KI_Absicherung/KI_Absicherung_Zwischenpraesentation/KI-A_Zwischenpra__sentation_TP4_final.pdf

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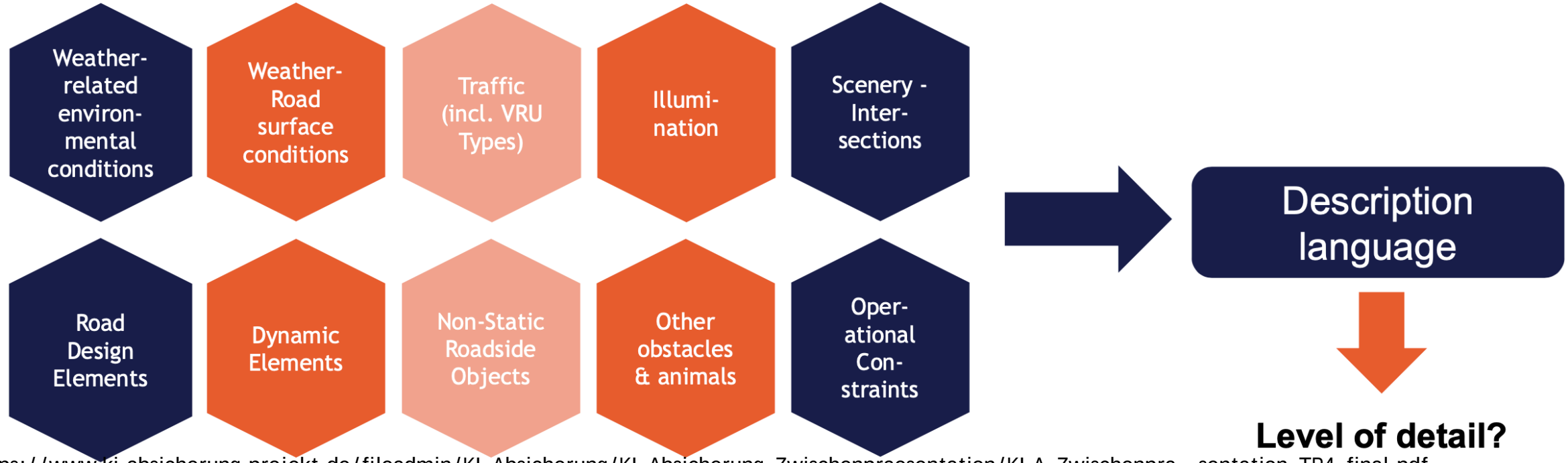
ODD & Data Definition

Assurance Strategy for AI
Existing Taxonomy as of PAS 1883:2020

- An ODD describes / specifies operating conditions under which a given driving automation system or feature is specifically designed to function […]
  - Taxonomy and Definitions for Terms Related to Driving Automation Systems (examples)



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Assurance Strategy for AI
"No relevant pedestrian shall be overlooked within defined ODD*"

A description language & input space modeling is needed to…

Complexity of language

be able to describe / specify operating conditions (and edges of ODD*)
as of PAS 1883:2020 and others

systematically capture important knowledge and describe the (expected)
key input space dimensions and their possible variations having an
influence on the functional performance of a DNN-based function
(→ Zwicky Boxes & Ontology)

perform training and assurance data coverage estimations
for data driven AI-based systems

describe Corner cases / rare critical situations to be considered
in training / test data sets

for synthetic perception data production & meta-data: describe data
dimensions that should be variated & incrementally generate new data
by analyzing coverage and generating missing combinations

DNN-specific Safety Concerns (examples)

Data distribution is not a good approximation to real world

Unknown behavior in rare critical situations

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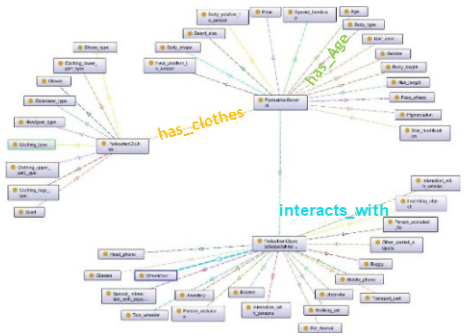
*) ODD = Operational Design Domain

Assurance Strategy for AI
Data representations of the data input space aligned to ontology

Ontology Graph (Relations)



Excerpt of ontology

Representations of variations

Daytime	morning	day	evening	night
Haze/Fog	no		yes	
Street condition	dry	wet	icy	snow	broken
Sky	cloudy	no	clear	
Rain	no		yes	
Reflection on road	no		yes	
Shadow on road	no		yes	
VRU type	adult		child	
VRU pose	pedestrian	jogger	cyclist	
VRU contrast to BG	low		high	

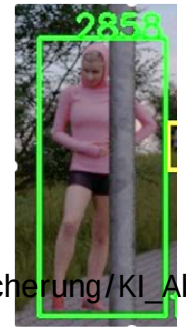
Zwicky Box - Discretized variations of important dimensions

Asset & Object descriptions for data analytics

Source: Mackevision

PedestrianGeneral
PedestrianGeneral::Age "adult"
PedestrianGeneral::Gender "female"
PedestrianGeneral::Body shape "normal"
PedestrianGeneral::Body type
PedestrianGeneral::Body height "160cm-200cm"
PedestrianGeneral::Pigmentation "low"
PedestrianGeneral::Skin modification "no"
PedestrianGeneral::Hair length "short"
PedestrianGeneral::Hair color
PedestrianGeneral::Beard size "no"
PedestrianGeneral::Special handicap "nothing"

Object Annotations for DNN-Training



Occlusion_level: medium
Occluded_body_part: arm
Occlusion_object: lamp

Source: BIT Technology Solutions

Systematic Combination of variations

Dimension	Person1	Person2	Person3	...
Age	Child	Teenager	Adult	
Gender	Male	Female	Male	
Body height	80-120 cm	120-160 cm	160-200 cm	
Pose	Running	Lying	Walking	
Pedestrian Location	Middle of street	Left side walk	Right side walk	
...	...	...	...	

Systematically identify and describe the (known / expected) key input space dimensions and their possible variations & combinations having an influence on the functional performance of a DNN-based function

https://www.ki-absicherung-projekt.de/fileadmin/KI_Absicherung/KI_Absicherung_Zwischenpraesentation/KI-A_Zwischenpra__sentation_TP4_final.pdf

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KI ABSICHERUNG

Safe AI for Automated Driving

PD Dr. Michael Mock, Fraunhofer IAIS

Consortium Co-Lead and Scientific Coordinator

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KI Absicherung ist ein Projekt der KI Familie und wurde aus der VDA Leitinitiative autonomes und vernetztes Fahren heraus entwickelt.

KI FAMILIE

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