


ASQT 2021 Virtual Conference

Engineering Smart Ecosystems – Herausforderungen & Lösungen

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ENGINEERING SMART ECOSYSTEMS

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Digital Transformation

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Technology changes
Media & Data
with **Digital Products**

Technology changes
Markets & Industries
with **Digital Processes**

Technology changes
Economy & Society
with **Digital Business Models**

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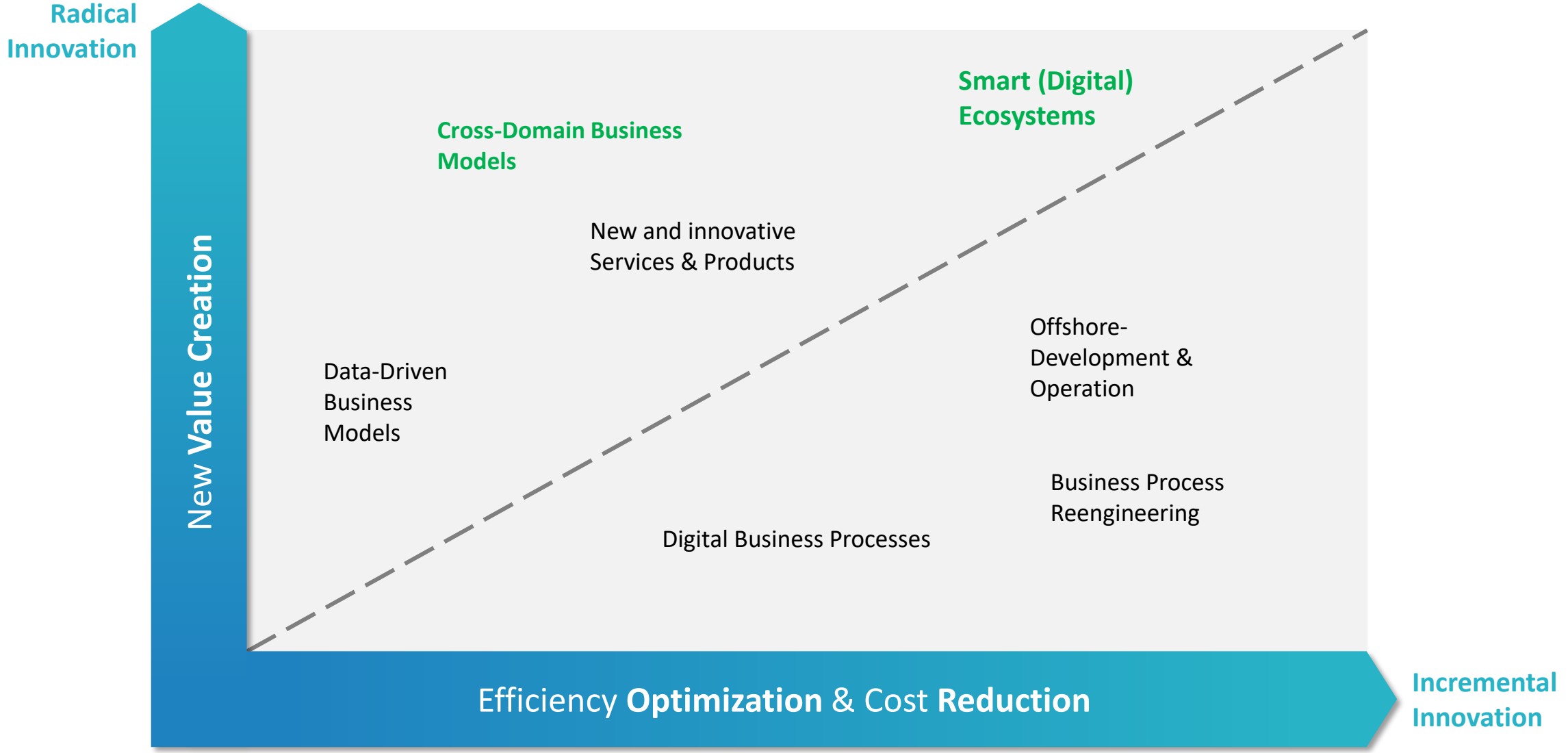
Digitization | Digitalization | Digital Transformation



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Industry 4.0

Smart Farming

Smart Mobility

SMART Ecosystems

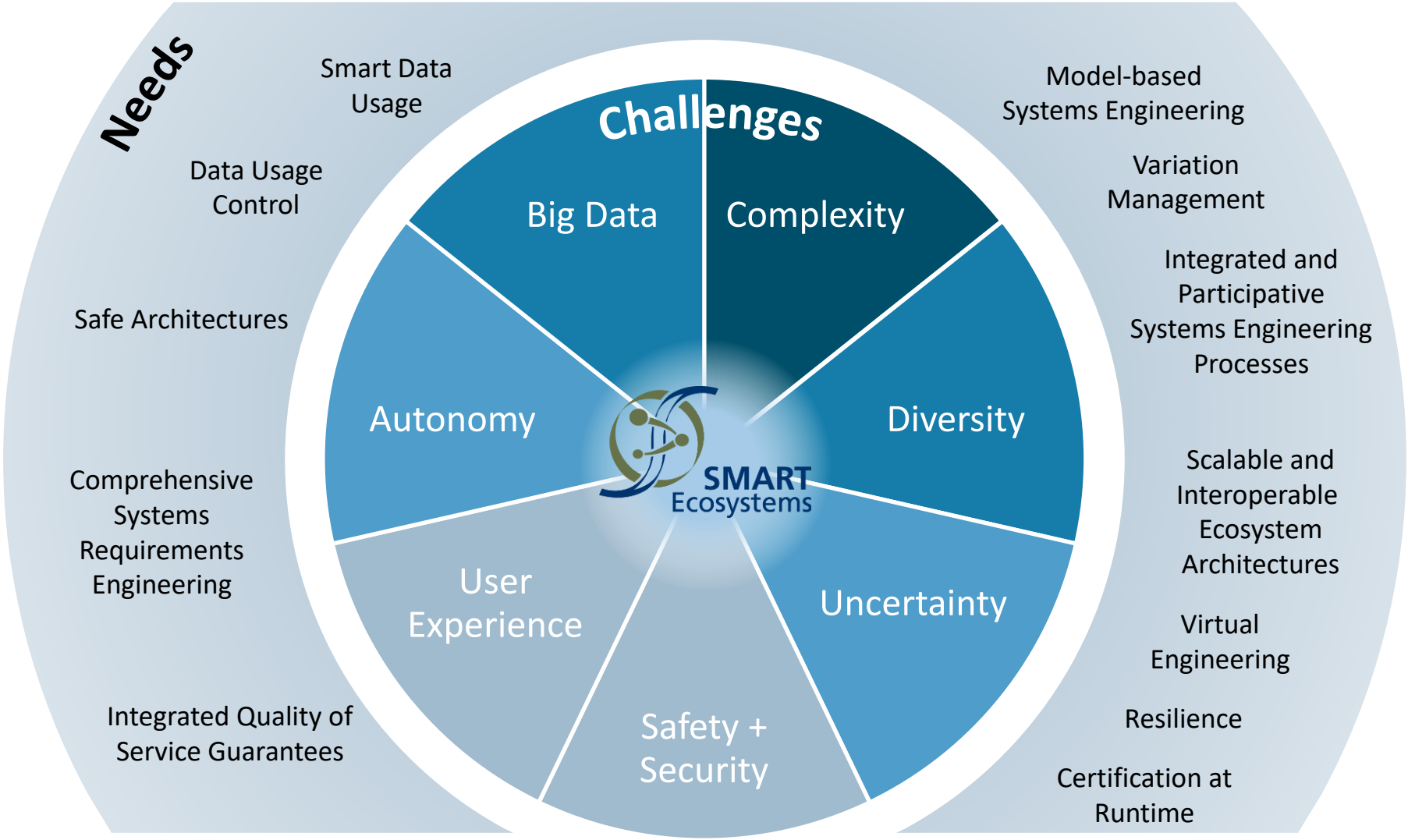
Smart Health

Smart Energy

Smart Rural Areas

Smart X

Example Challenges and Needs for Smart Ecosystems

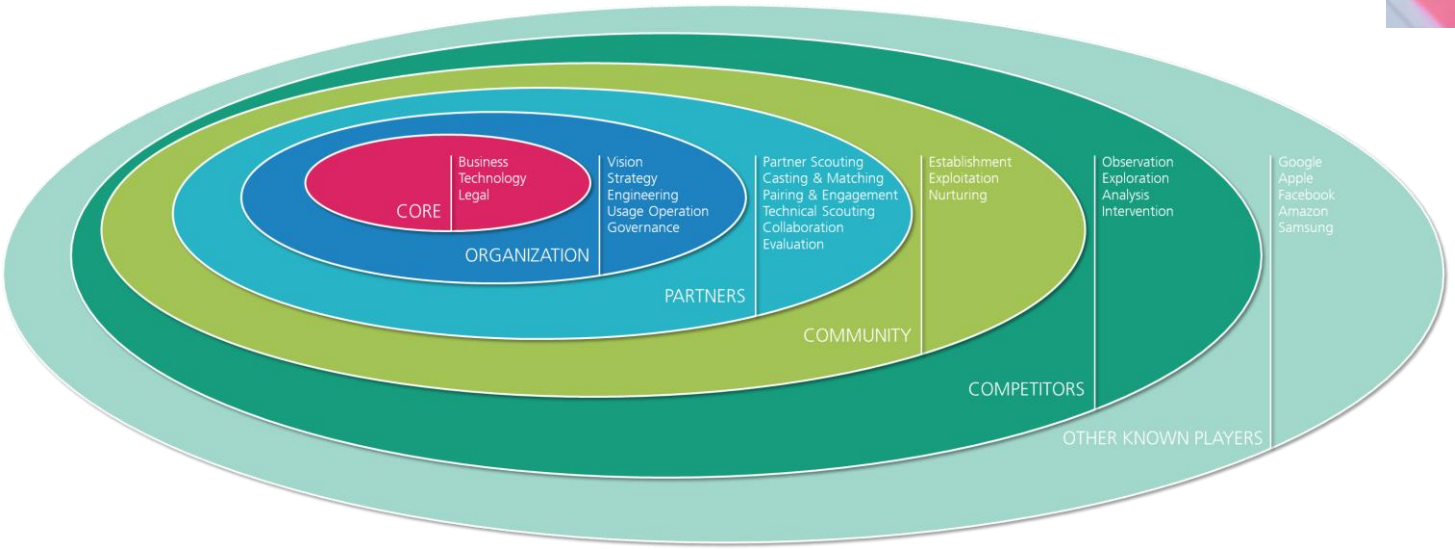


- Software is an ***enabler of new, innovative services and business models*** in all sectors of industry and society
- Being able to ***establish appropriate Software and Systems Engineering practices*** in the organization is crucial
  - for staying competitive and
  - for developing innovative products on time, within budget, and with a high level of quality

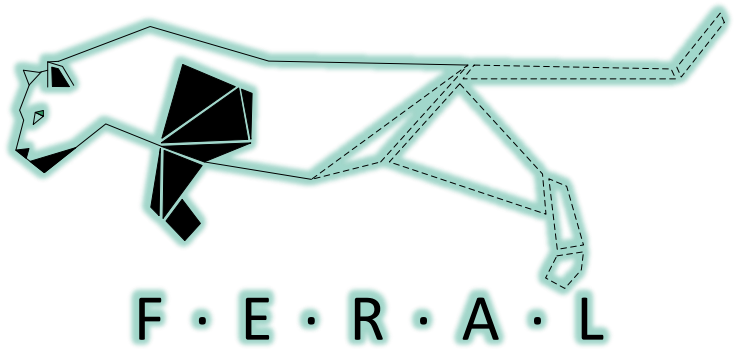
Challenge1: Complexity, Diversity, Uncertainty, User Experience
Shaping & Simulating Ecosystems

1. Initial ***Shaping*** of Ecosystems

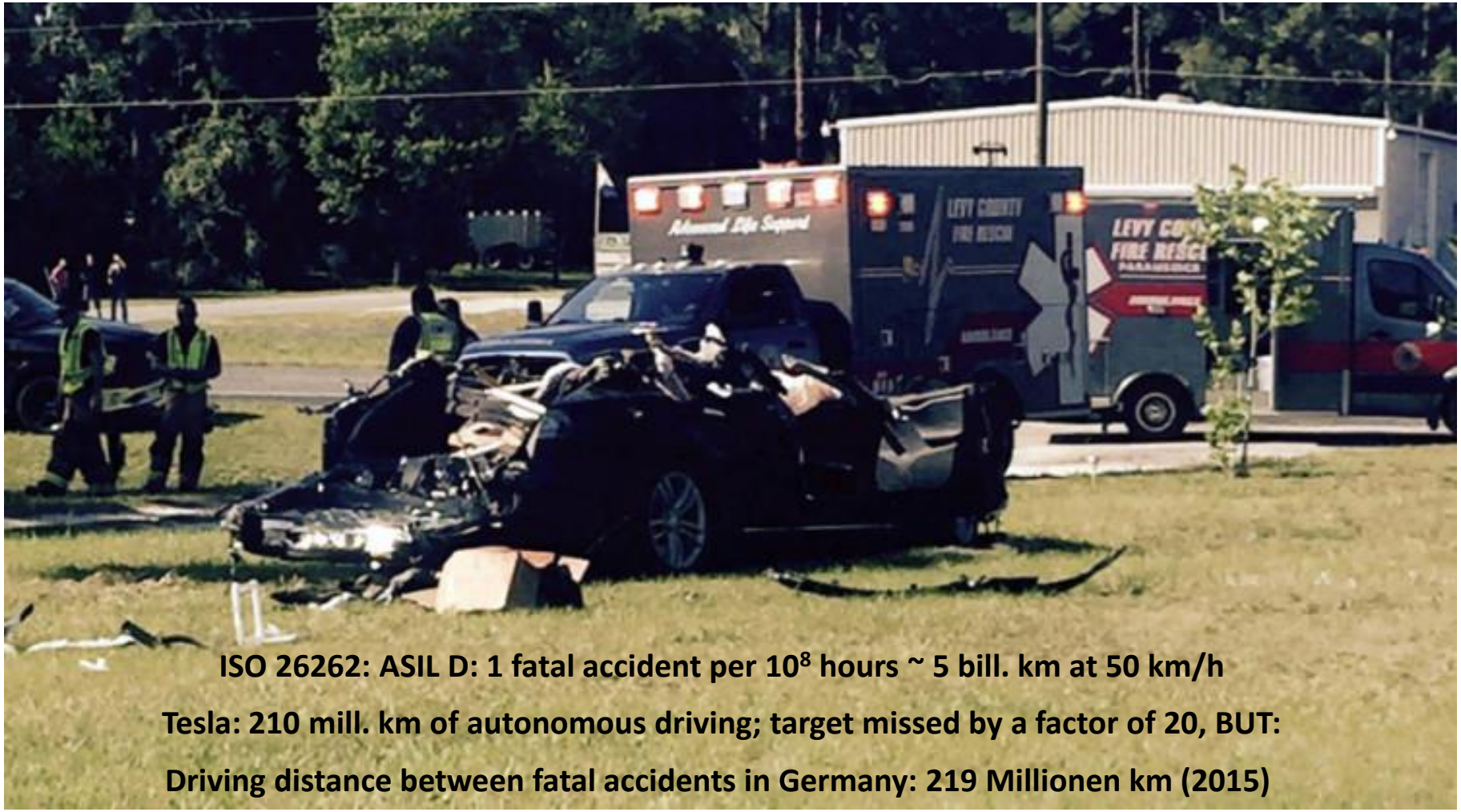
2. Holistic Modelling of ***Ecosystems Facets***



3. Continuous ***Simulation*** of Ecosystems



Challenge 2: Autonomy, Safety
Runtime-Adaptivity and Certification at Runtime



ISO 26262: ASIL D: 1 fatal accident per 10^8 hours ~ 5 bill. km at 50 km/h

Tesla: 210 mill. km of autonomous driving; target missed by a factor of 20, BUT:

Driving distance between fatal accidents in Germany: 219 Millionen km (2015)

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Three categories of autonomous systems:

1: Manual operation possible; autonomy as an improvement of comfort

2: Manual operation possible; autonomy necessary for acceptance

3: Manual operation is impossible (from a technical or economical viewpoint); system requires autonomous solution

Autonomy requires to balance availability and risks (e.g., safety) in order to maintain acceptance

Autonomous systems

that are available and unsafe will not be accepted,

that are unavailable and safe will not be accepted,

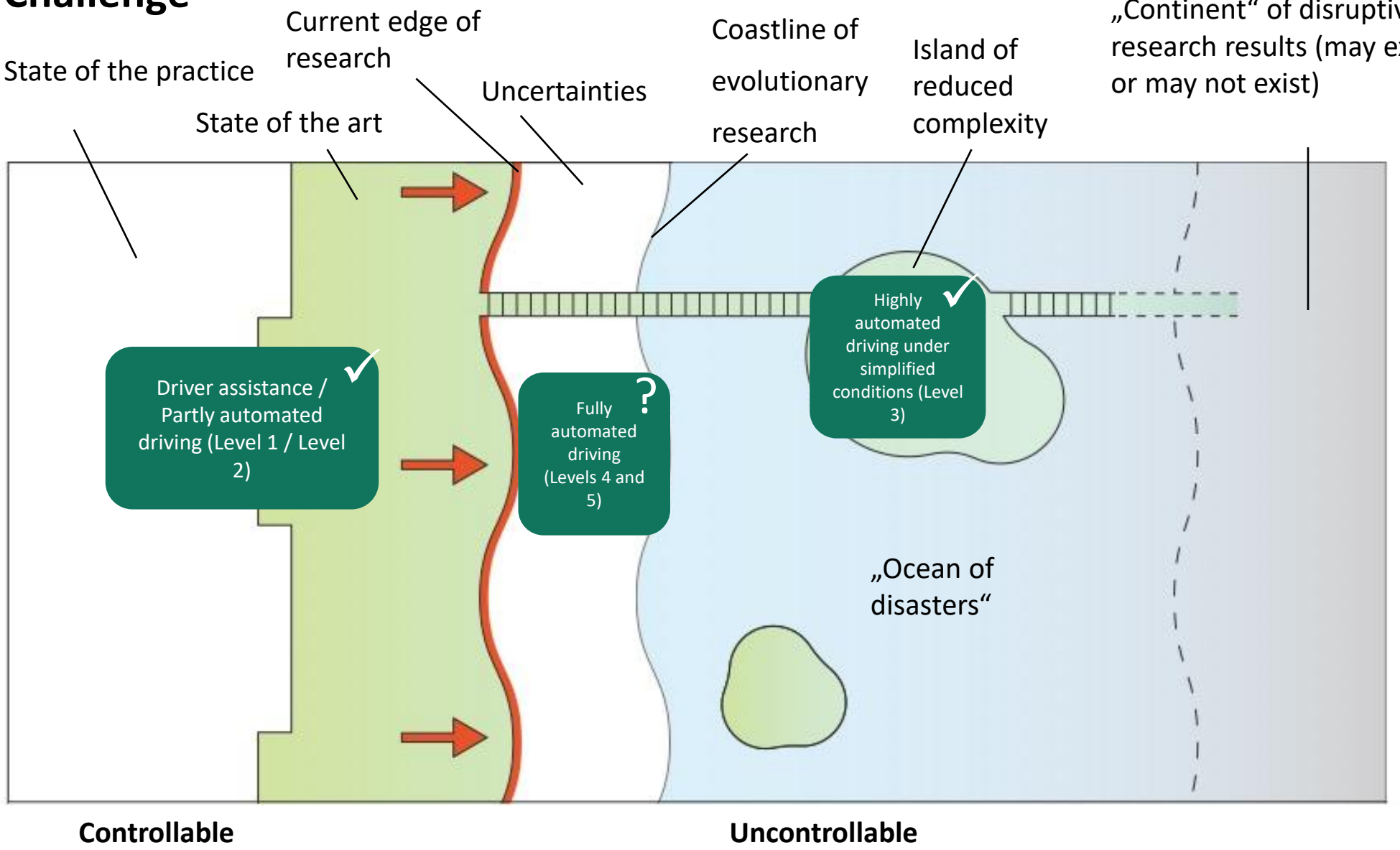
that are available and safe might be accepted,
if certain additional preconditions are fulfilled (privacy, usability, …).

Vision of Dynamic Risk Management

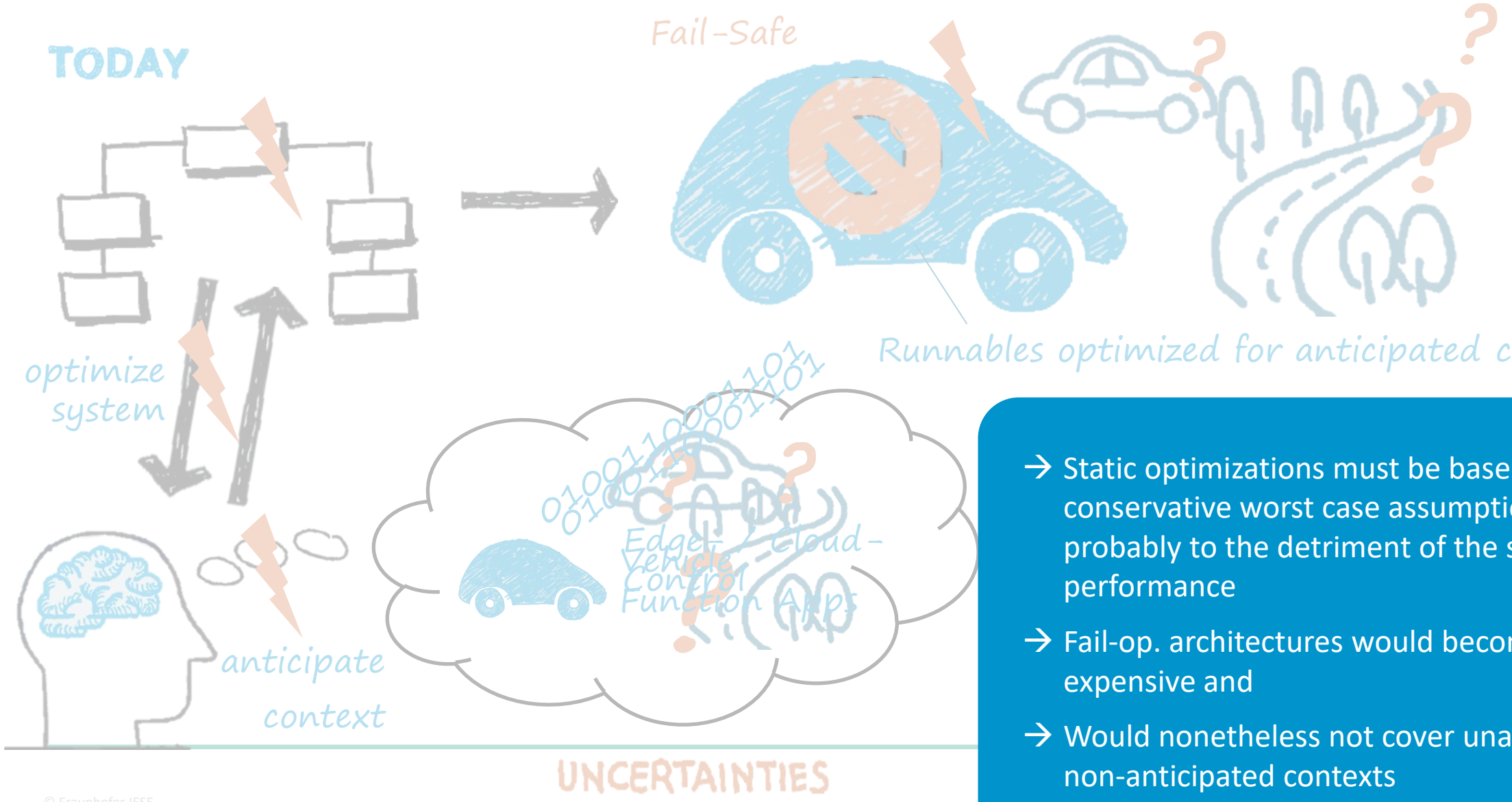
Autonomous systems have to consider the right balance of properties in their algorithmic decision making.

Due to dynamic adaptation at runtime, this cannot be done completely at design time. Risks are to be estimated, assessed, and controlled at runtime.

The Research Challenge

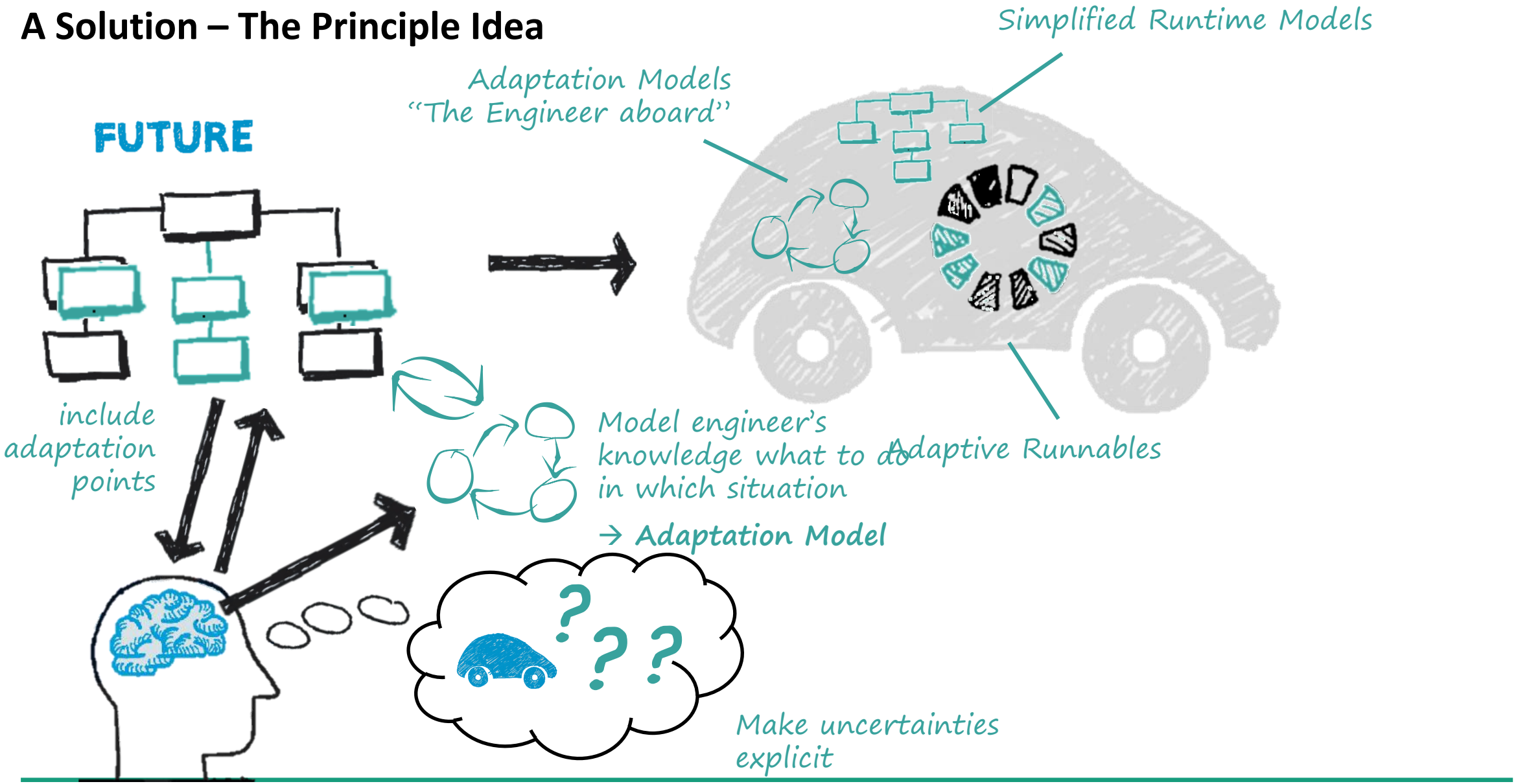


The Challenge – From an Engineering Point of View



- → Static optimizations must be based upon conservative worst case assumptions, probably to the detriment of the system performance
- → Fail-op. architectures would become too expensive and
- → Would nonetheless not cover unavoidable, non-anticipated contexts

A Solution – The Principle Idea



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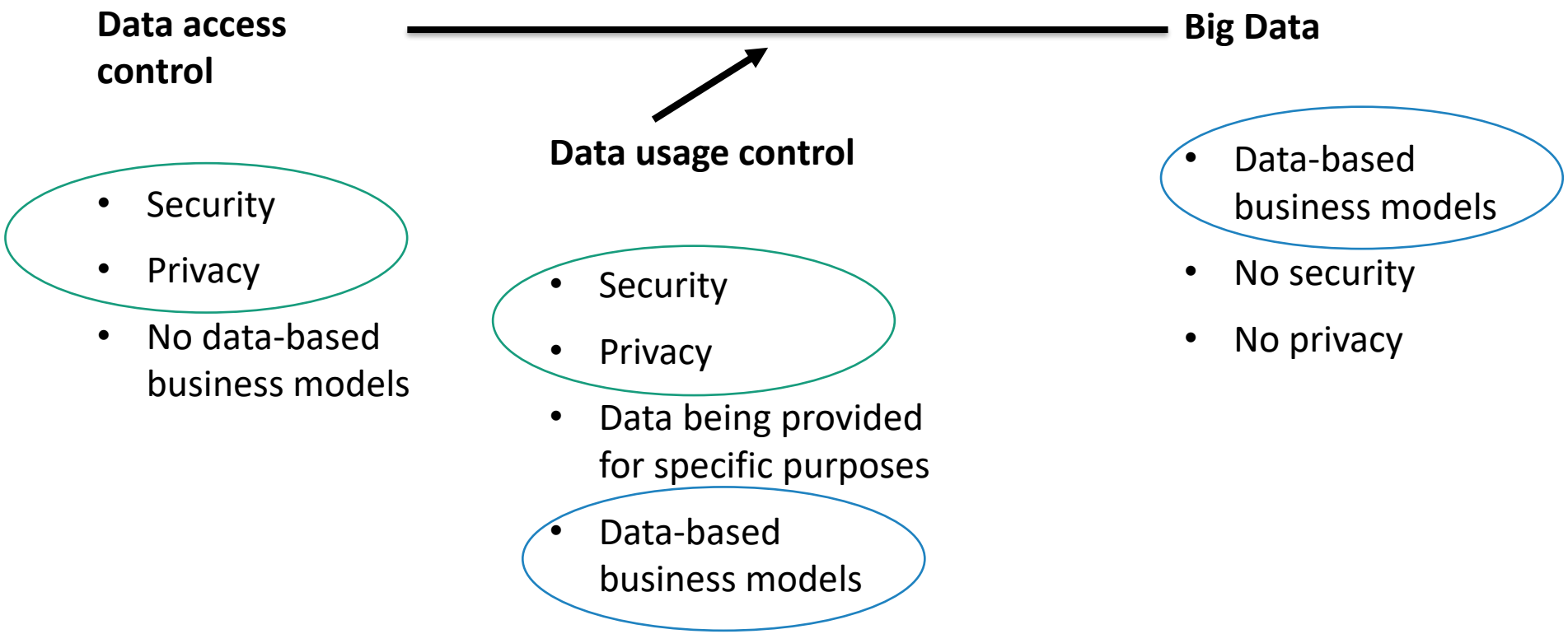
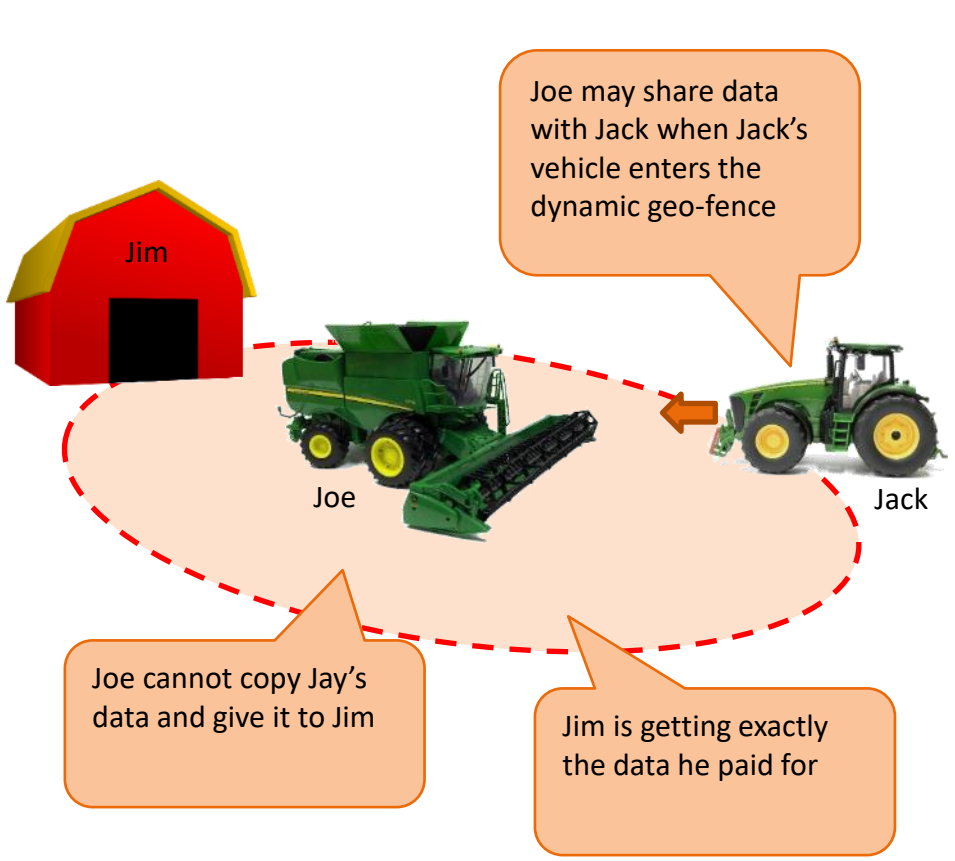
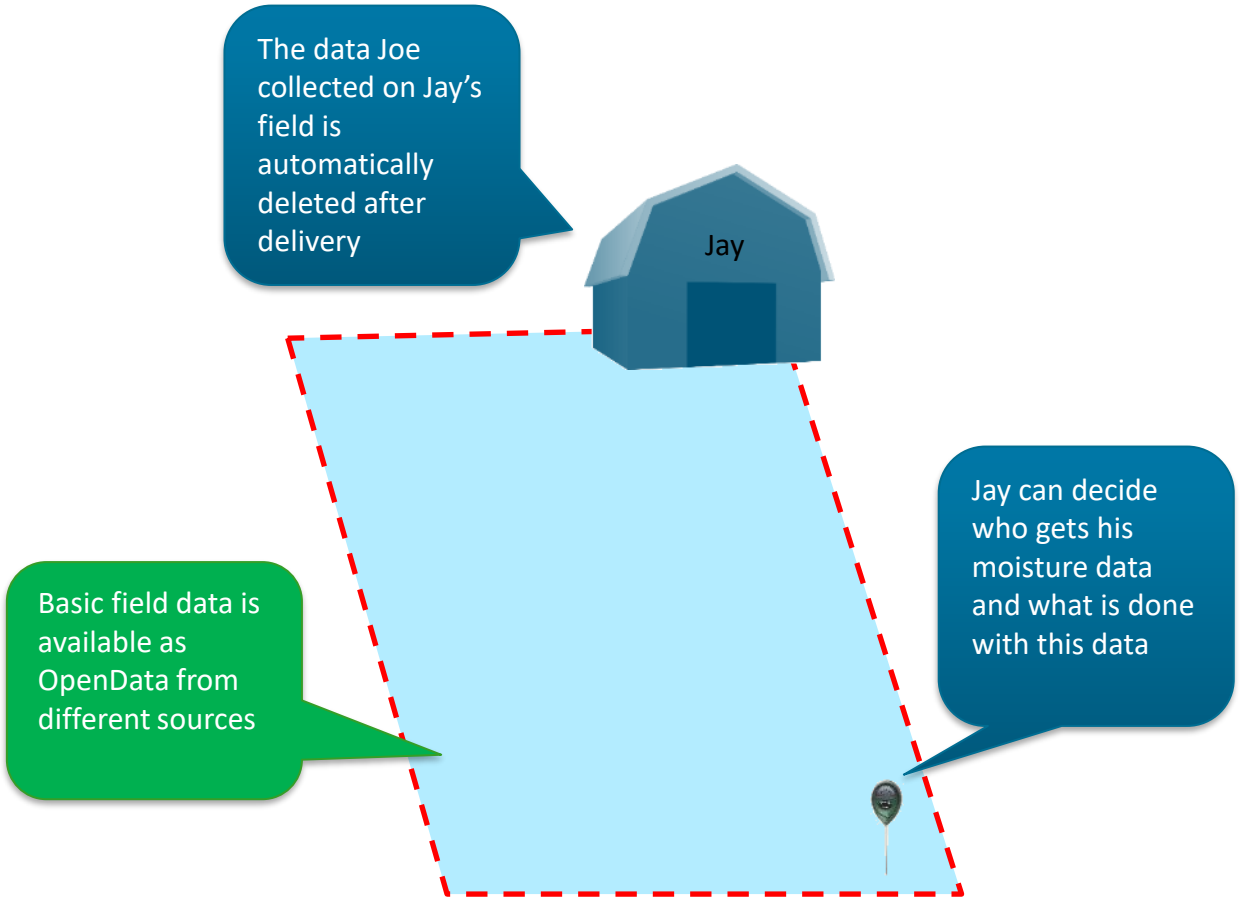
Challenge 3: Big Data, Security
Data Usage Control



Data Usage Control





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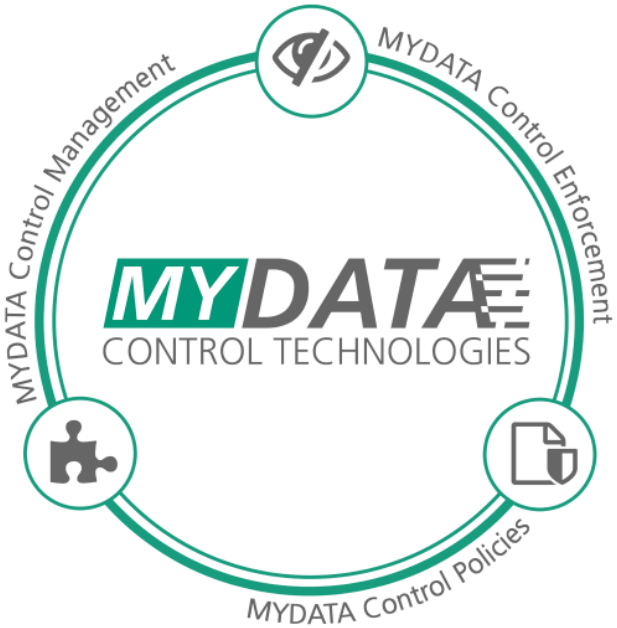
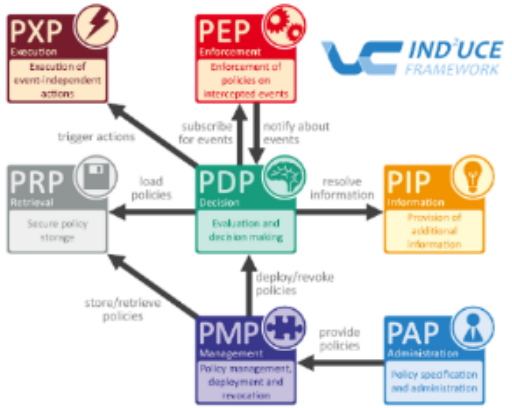
Data Usage Control: Explicit policies for capturing data usage

- Policies can be seen as parameters for ***managing data behavior across domains***
- Devices detect and prevent data misuse according to policies
- Middleware component for deciding and acting upon policies
- Fraunhofer IESE's IND²UCE framework and ***MyData*** control technologies enable Data Usage Control features



EARTO
IMPACT DELIVERED

2014 Innovation Prize Winner



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Technical Trends und Challenges

- ***Agile processes*** vs. certification of safety
- Dynamic reconfiguration of Systems: ***guaranteeing properties***
- Handling of ***AI-technologies*** (Deep Learning): reproducibility, understandability / transparency
- X@Runtime: Enabling of Systems vs. Current ***state of standards***
- ***Autonomy:*** how to handle the unexpected, unanticipated?
- Interdisciplinarity: achieving engineering methods that are ***accepted across different disciplines*** (e.g. Informatics and mechanical engineering)