Keynote 2
The German AI Standardization Roadmap

DIN

DKE
VDE DIN

Gefördert durch:

Bundesministerium
für Wirtschaft
und Energie

aufgrund eines Beschlusses
des Deutschen Bundestages

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German Research Center for AI (DFKI)

Chairman of the Steering Group –

German AI Standardization Roadmap

www.dfki.de/~wahlster

DFKI - Public-Private Partnership for AI-based Innovation

- **Est. 1988**

- **45 Professors**

- **> 1100 Employees**

- **220 M€ Project Budget in 2020**

- **25 % from Industry**

- **394 Ongoing Projects**

- **Turnover: 52.9 M€ in 2020**

- **Operating Income: 73.4 M€ in 2020**

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The World's Largest Public AI Research Center

Lübeck

Oldenburg

Bremen

Osnabrück

Berlin

Saarbrücken

Kaiserslautern

1 January 2021: DFKI Branch at the University of Lübeck

3 Million EUR Start Funding from the State Government Schleswig-Holstein

The Lübeck branch consists of three research departments:

- **Artificial Intelligence in Medical Imaging**
  Head: Prof. Heinz Handels

- **Artificial Intelligence in Biomedical Signal Processing**
 Head: Prof. Alfred Mertins

- **Stochastic Relational AI in Healthcare**
 Head: Prof. Ralf Möller

Selected Research Highlights of Medical AI in Lübeck

-Transparency of diagnostic results by considerating of

    causal relationships (StaRAI)

-Reduction of the necessary training for deep learning data

    to realistic orders of magnitude

-Control of exoskeletons in rehabilitation

-AI methods for motion compensation in magnetic

  resonance imaging (use of generative networks, GANs)

-Acoustic event detection and localization

-Health monitoring (e.g., Dräger: Dreamguard apnoe detection)

-EEG analysis for the control of hearing aids
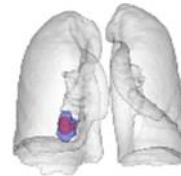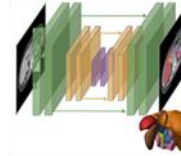
AI as the Core Innovation Engine
for Smart Medical Services
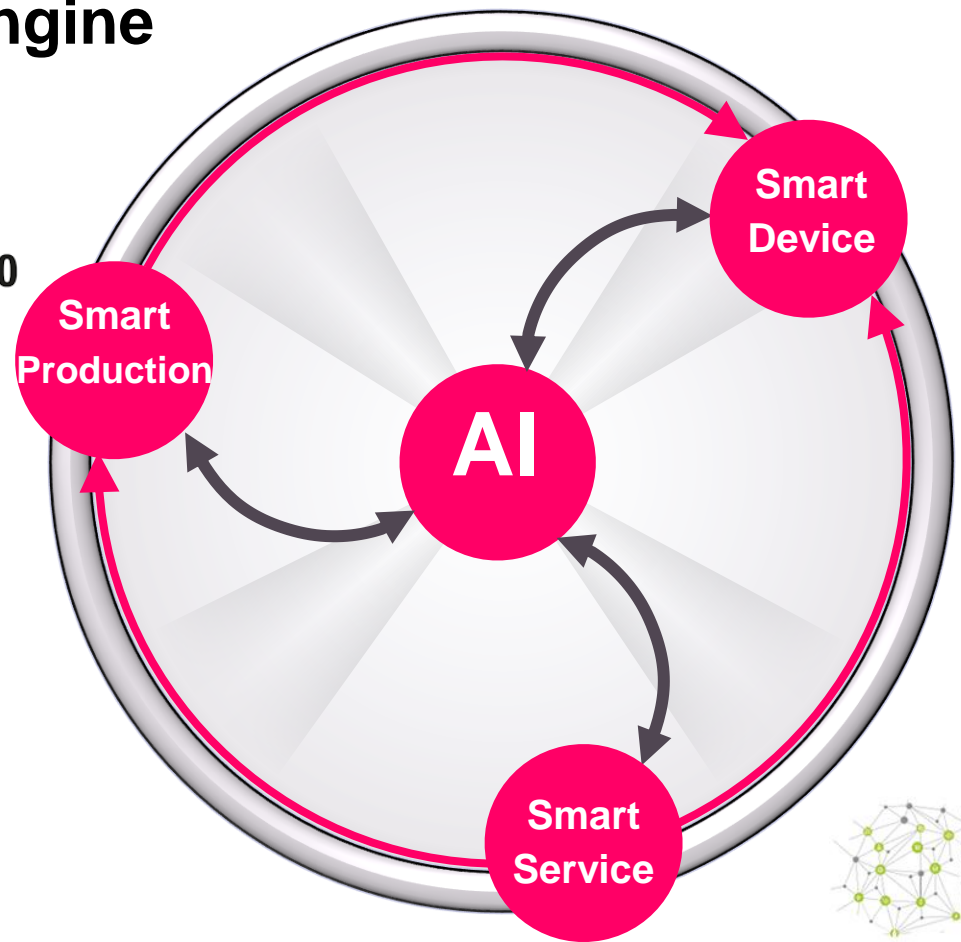
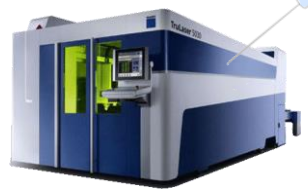**Three Large-Scale German Future Projects for Disruptive Innovation:**
Industrie 4.0 – Smart Service World – Learning Systems

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Boosting Economy by Injecting AI: Transforming Successful Export Products Into Smart Products

Cars

Manufacturing Equipment

Medical Equipment

Aircrafts

Home Appliances

Agricultural Machinery

Artificial Intelligence for the Second Wave of Smart Medical Devices
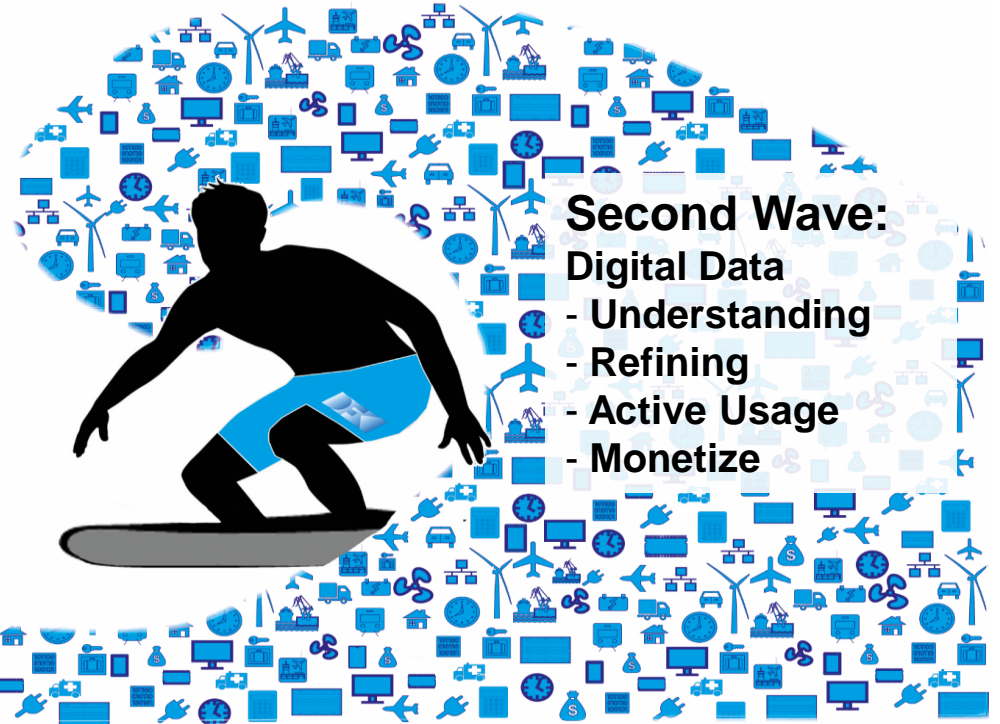
First Wave:
Digital Data
- Record
- Store
- Transmit
- Process

Second Wave:
Digital Data
- Understanding
- Refining
- Active Usage
- Monetize

Machine-*readable* Data:
Internet and Cloud Tchnologies

Machine-*understandable* Data:
Artificial Intelligence and Machine Learning

Multimodal Interaction with AI-based Medical Devices

Speech

Graphics

Gesture

Biometrics

Physical Action

Facial Expression
Body Language

Multimodal
Interaction

→ **is faster**

→ **is more robust**

→ **is less ambiguous**

→ **is more expressive**

→ **is shorter**

→ **is more coherent**

→ **is more fun !**

than **Unimodal Discourse**

Combining all Senses - Getting Rid of Keyboard and Mouse

High Demand for Testing, Certification and Clear Labelling of AI Systems

Interviews with 1000 Managers in German Industry – AI Certification Study by VdTÜV, October 2020

Do you agree with the following statements?

Statement	Agreement
AI Solutions must be clearly labeled for the users	85%
AI Solutions should only be allowed to be placed on the market once their safety has been verified by independent agencies	85%
The Trustworthiness of AI products should be certified by independent testing organizations like TÜV	83%
Government must pass new laws to regulate AI	78%
For AI products it is sufficient for the manufacturer to declare that they are safe	17%

Source: VdTÜV Berlin

Steering Commitee at the German Institute for Standardization (DIN): a Standardization Roadmap for AI (DIN – CEN – ISO, W3C)

18 Members from Industry, Academia, and Government

Chair: Prof. Wolfgang Wahlster

Deliverable: Standardization Roadmap at the German Government's Digital Summit in October 2020

Some Relevant Standards and Proposals:

OWL, RDF, OMM, USDL, FIPA ACL, SSML, VoiceXML, PDDL, EMMA,

Ethics and Standards for AI are an Important Topic for various Commissions and Platforms in Germany

The Data Ethics Commission

Enquete Commission on AI of the German Parliament

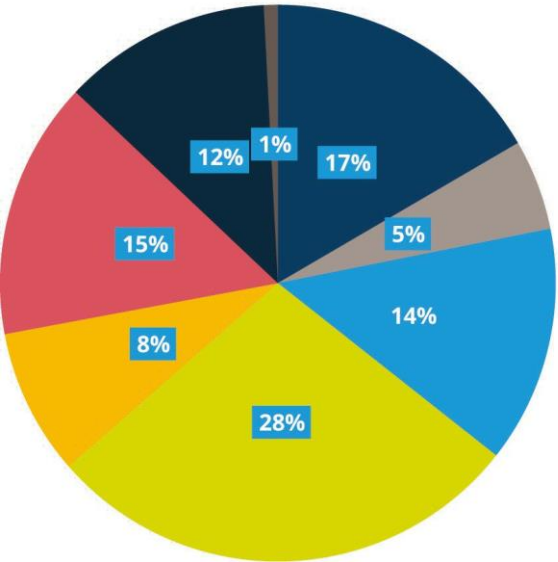**Learning Systems: National Platform for AI**

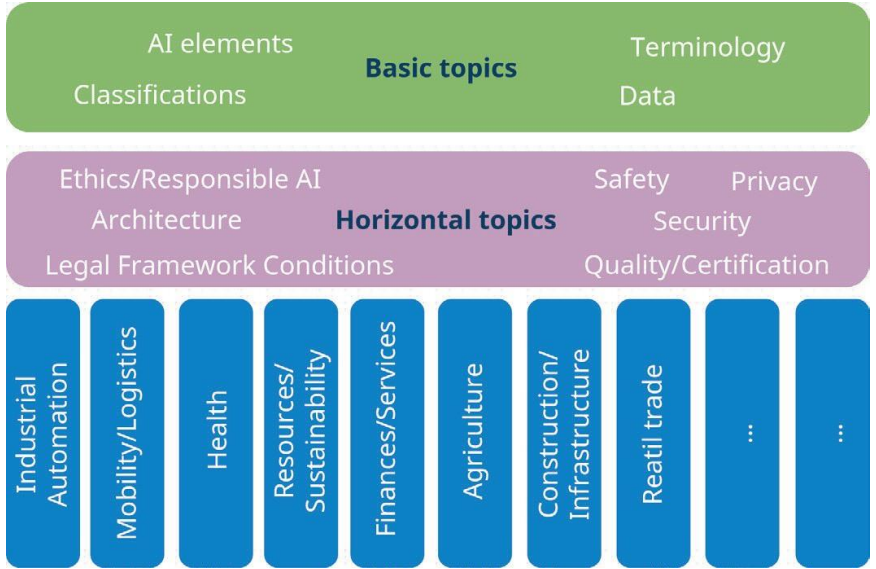**The Steering Group for the AI Standardization Roadmap**

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Diversity and Inclusion in an Open Standardization Ecosystem
7 Working Groups and 183 Authors

Standardization Roadmap AI

- Research
- Trade unions/Employer's liability insurance associations
- SMEs
- Corporations
- Public sector/Federal agencies
- Universities/colleges
- Associations
- Foundations/Societies/non-profits

	Basic topics	
AI elements		Terminology
Classifications		Data

	Horizontal topics	
Ethics/Responsible AI		Safety · Privacy
Architecture		Security
Legal Framework Conditions		Quality/Certification

Industrial Automation | Mobility/Logistics | Health | Resources/Sustainability | Finances/Services | Agriculture | Construction/Infrastructure | Reatil trade | ⋯ | ⋯

1

Germany publishes the first comprehensive Survey on AI Certification

DIN DKE

Wolfgang Wahlster, Christoph Winterhalter (eds.)

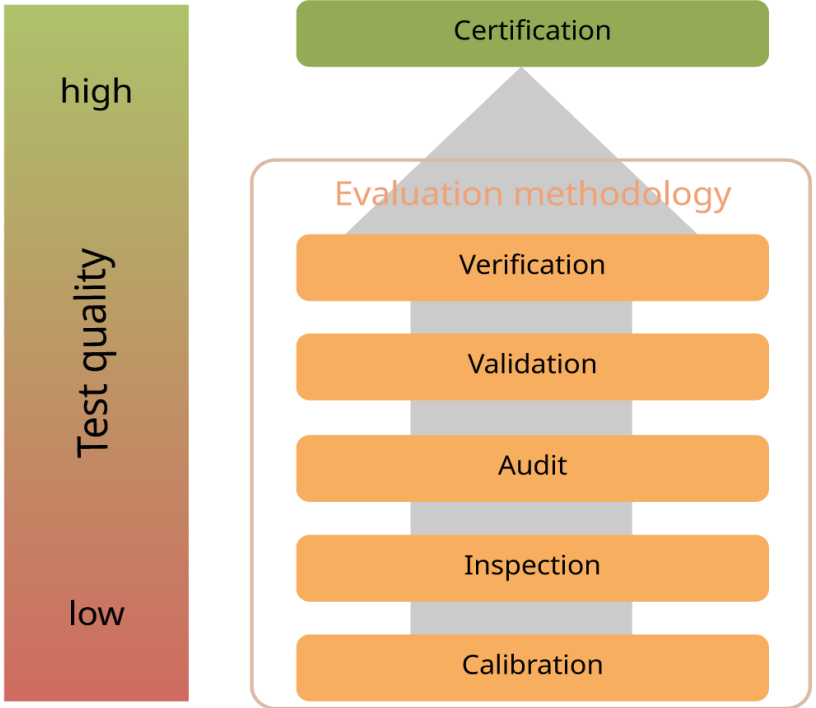**GERMAN STANDARDIZATION ROADMAP ON ARTIFICIAL INTELLIGENCE**

November 2020, 256 pages

Bundesministerium für Wirtschaft und Energie

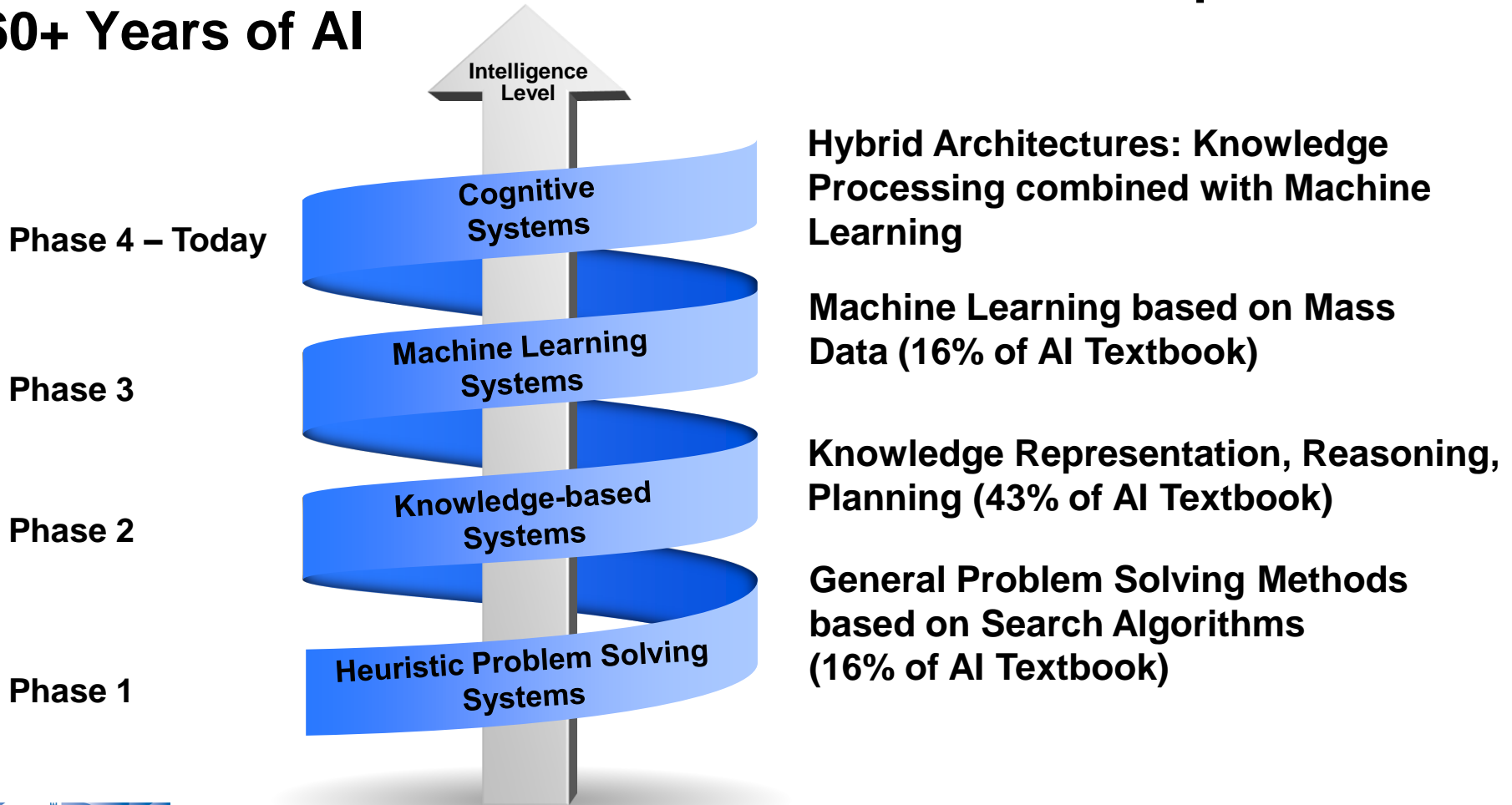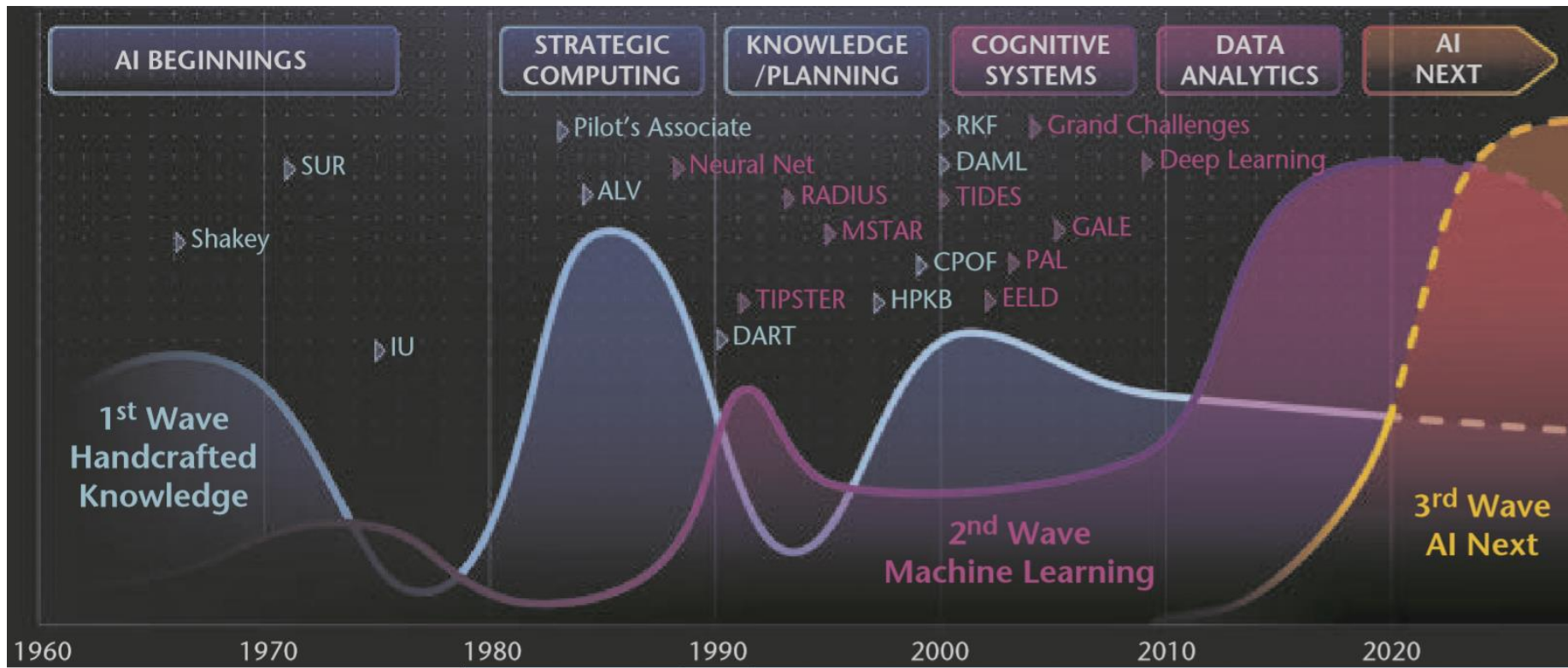aufgrund eines Beschlusses des Deutschen Bundestages

Conformity assessment

Certification

Test quality

high

low

Evaluation methodology

Verification

Validation

Audit

Inspection

Calibration

Internationally harmonized testing principles

Four Phases of AI Research: The AI Evolution Spiral
60+ Years of AI

Intelligence Level

Phase 4 – Today

Cognitive Systems

Hybrid Architectures: Knowledge Processing combined with Machine Learning

Phase 3

Machine Learning Systems

Machine Learning based on Mass Data (16% of AI Textbook)

Phase 2

Knowledge-based Systems

Knowledge Representation, Reasoning, Planning (43% of AI Textbook)

Phase 1

Heuristic Problem Solving Systems

General Problem Solving Methods based on Search Algorithms (16% of AI Textbook)

AI NEXT: 2 Billion USD Program by DARPA in the US

New Focus of the AI Next Programs

Injecting AI: AI + Smart Data = Smart Services
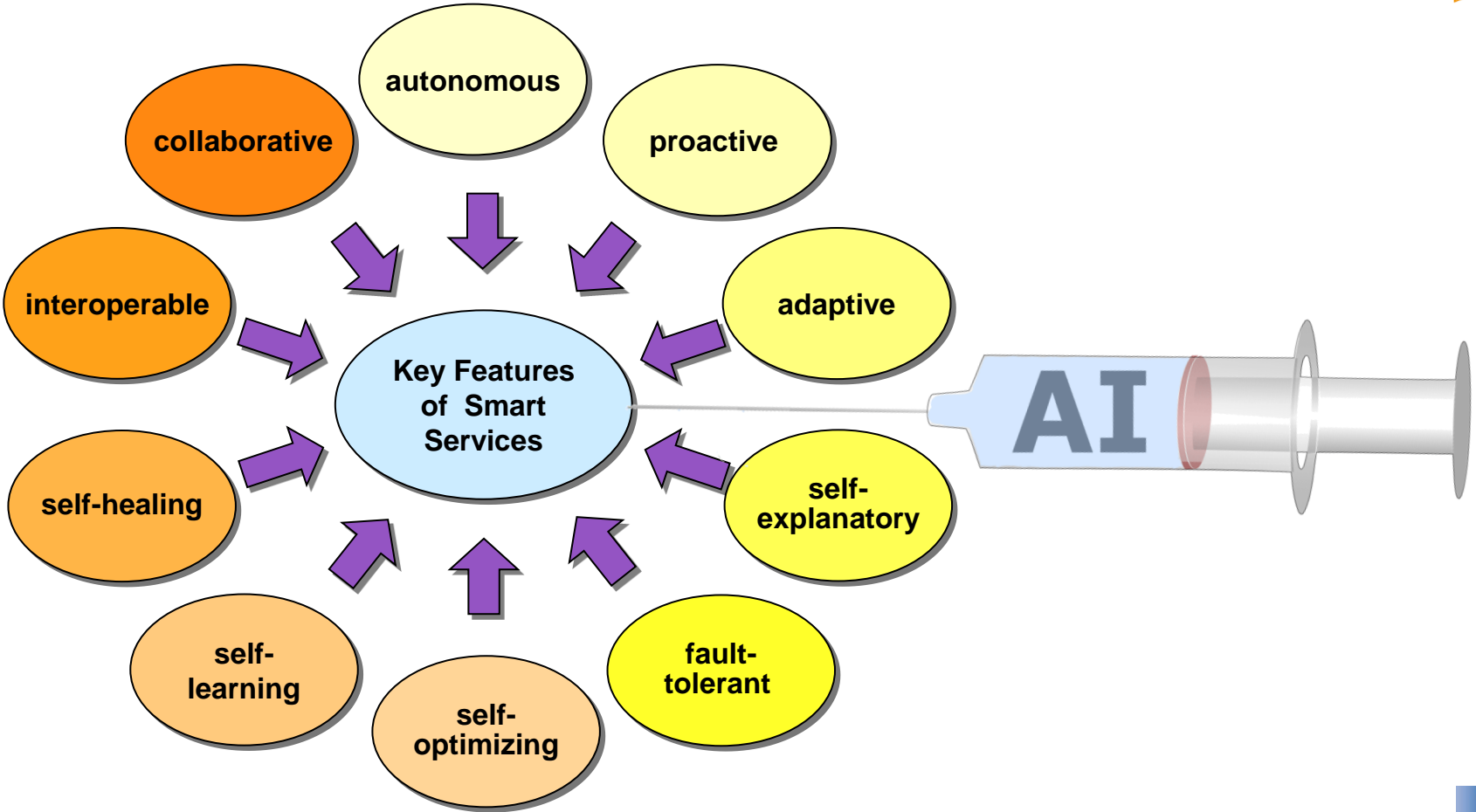
Building Blocks for Complex AI Systems: AI on Demand

Sense

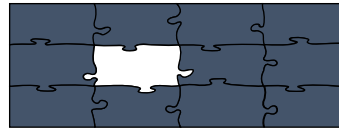|			
Signal-Symbol Transformation	Multisensor Fusion	Pattern Recognition	Biosignal Analysis
Attention Tracking	Emotion Recognition	User and Context Recognition	

Understand

Text Understanding	Image and Video Understanding	Maschine Learning	Spoken Dialog Understanding
Knowledge Processing & Reasoning	Action Planing & Plan Recognition	Information Extraction & Intelligent Search	

Act

Sensor Motoric Feedback	Complex Motion and Object Manipulation	Sensor Control	Transfer of Control
Explanation Component	Multiagent & Collaboration Techniques	Personalized Presentation	

Autonomous Systems must cope with the following Challenges

Problem:

Methods:

- **Uncertainty**

  Probabilistic Frameworks

- **Vagueness**

  Possibilistic Frameworks

- **Incompleteness**

  Non-monotonic Logics and POMDPs

- **Resource Boundedness**

  Anytime Algorithms and Metareasoning

Combination of Machine Learning and Knowledge-Based Inference

<table>
<tr>
<td>

Knowledge-Free AI Methods

Statistical & Neural Learning Methods

e.g. Deep Neural Nets

</td>
<td>

Knowledge-Based AI Methods

Search, Inference and Planning Procedures

e.g. Terminological Logics

</td>
</tr>
</table>
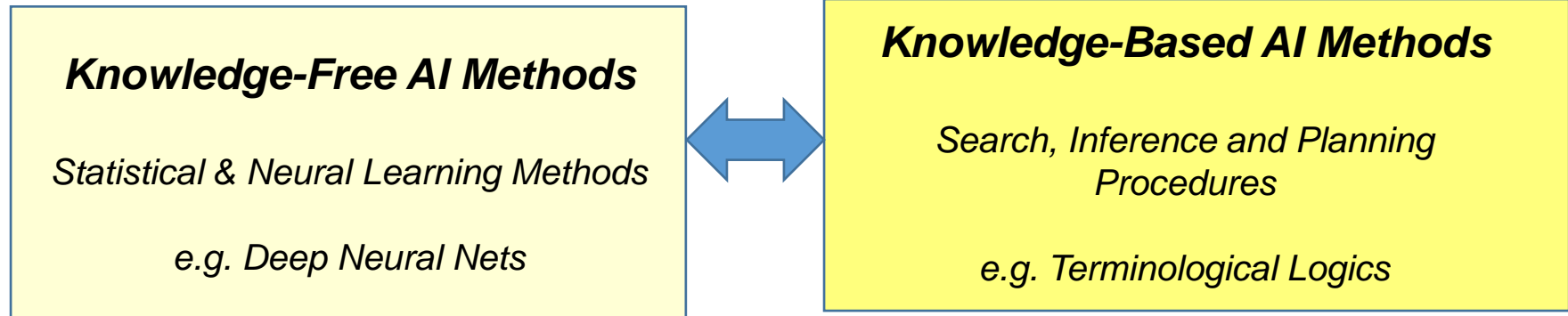
Mutual Support

Statistical learning methods can be used,

- to control search processes in knowledge-based systems and thus make them more efficient.

- to learn basic operators for knowledge-based inference and planning procedures.

Knowledge-based AI methods can be used,

- to combine, complete or correct the results of machine learning.

- to make the results of machine learning processes plausible or explain them.
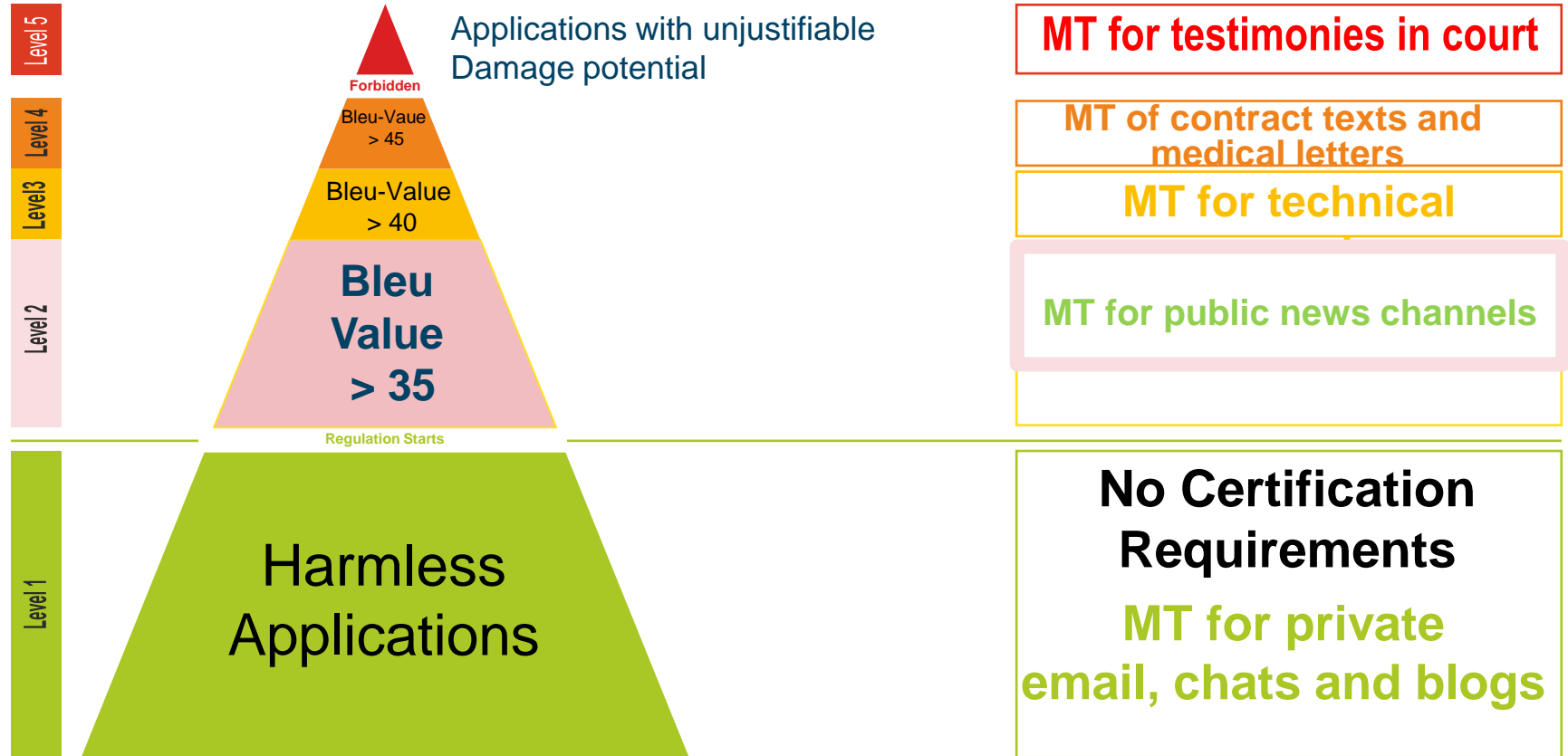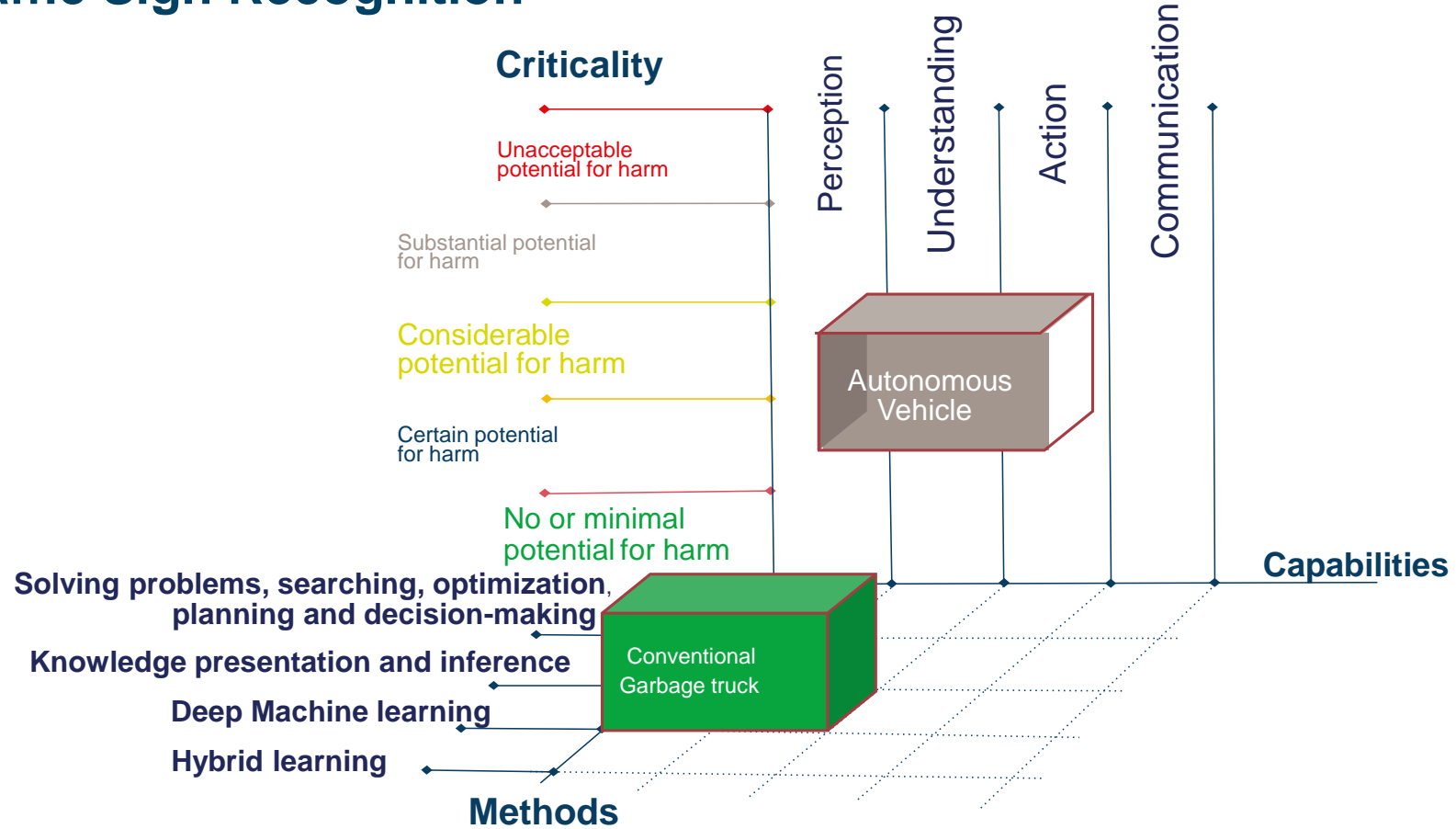
Open Problems for Deep Learning

- **Overfitting (After Too Much Training)**

- **Missing Data (Rare Anomalous Situations)**

- **No Extinction Learning**

- **Weak Explanation Capabilities**

- **Architecture Alchemy**

- **False Alarms by False Positives**

Risk-adaptive Regulation for AI Applications based on simple Quality Metrics
Example: Machine Translation Systems and their BLEU Value

Level 5

Level 4

Level 3

Level 2

Level 1

Applications with unjustifiable Damage potential

Forbidden

Bleu-Vaue > 45

Bleu-Value > 40

Bleu Value > 35

Regulation Starts

Harmless Applications

MT for testimonies in court

MT of contract texts and medical letters

MT for technical

MT for public news channels

No Certification Requirements

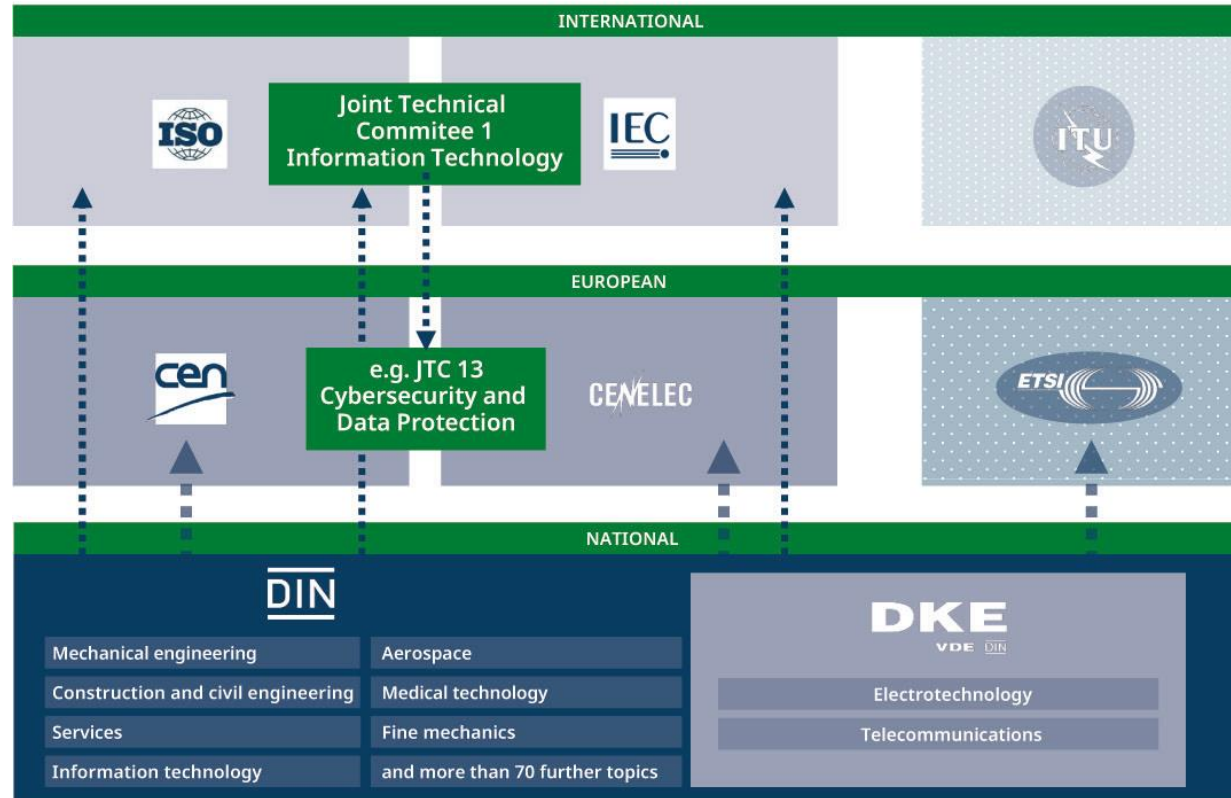**MT for private email, chats and blogs**

3D Classification Scheme for the Certification of AI-based Traffic Sign Recognition

The German AI Standardization Approach is embedded in an International Ecosystem

INTERNATIONAL

ISO

Joint Technical Commitee 1
Information Technology

IEC

ITU

EUROPEAN

cen

e.g. JTC 13
Cybersecurity and
Data Protection

CENELEC

ETSI

NATIONAL

DIN

Mechanical engineering	Aerospace
Construction and civil engineering	Medical technology
Services	Fine mechanics
Information technology	and more than 70 further topics

DKE
VDE DIN

Electrotechnology

Telecommunications

ISO: International Organization for Standardization

IEC: International Electrotechnical Commission

ITU: International Telecommunication Union

CEN: European Committee for Standardization

CENELEC: European Committee for Electrotechnical Standardization

ETSI: European Institute for Telecommunications Standards

DIN: German Institute for Standardization

DKE: German Commission for Electrical, Electronic & Information Technology in DIN and VDE

DIN and DKE represent German national interests in European and international standardization

The Top 5 Recommendations for Action

Designing Reference Models for AI Data and Architectures for Interoperability

Establishing a horizontal AI security guideline

Engineering practical criticality criteria and tests

Implementing an National Programme on „Trusted AI"

Investigating the Need for Standards and Test Profiles for Specific Use Cases

Interoperability of Training Data

For supervised machine learning, standardized tools and ontologies are used to guarantee consistency of training data created simultaneously by many clickworkers around the world.
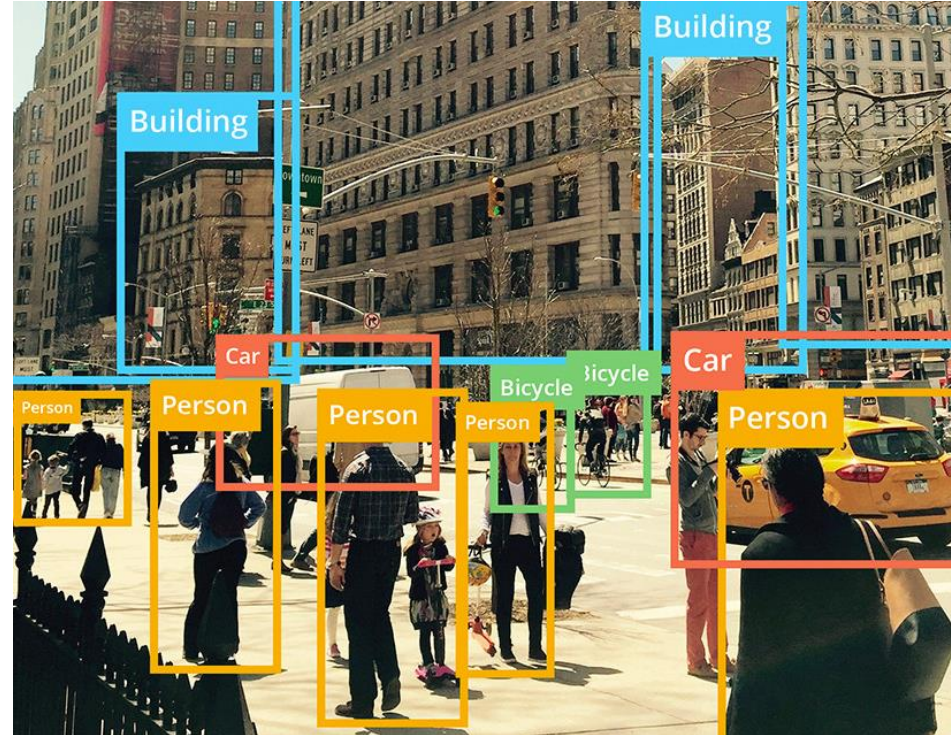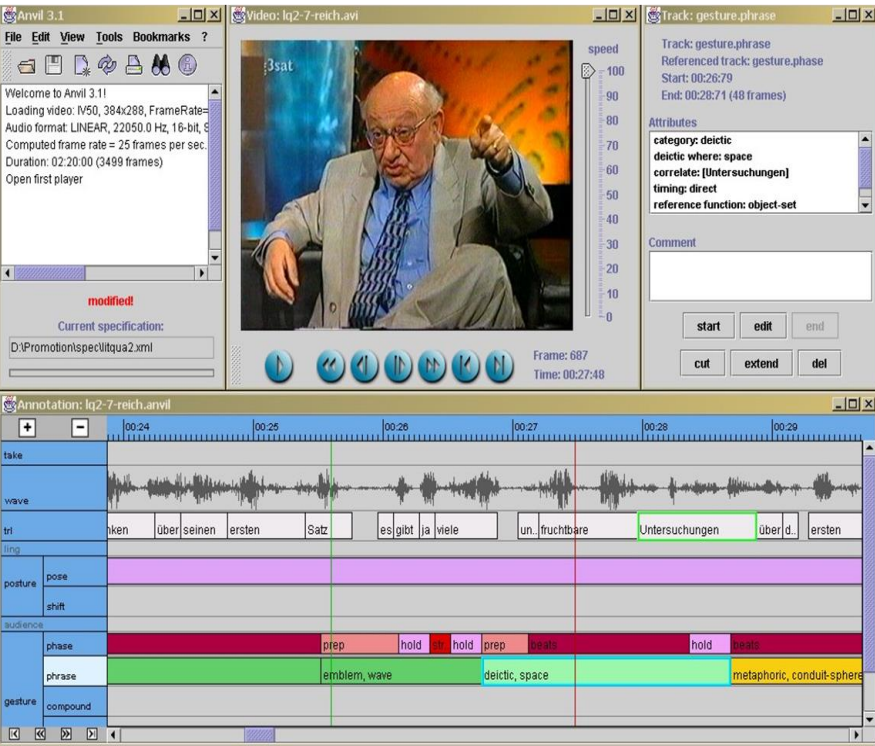
Anvil Workbench for Dialog Annotation   **Annotation based on standardized RDF Ontology**

Example for Domain Dependance due to Training Data: Best Translator for Legal Documents misses Ambiguity

EU Council Presidency Translator | KI für den Menschen - Intelligente Lösun...

Von: Französisch Englisch Bulgarisch

Nach: Deutsch Englisch Bulgarisch DFKI **Anbieter:** **Übersetzen**

Je mange une avocat

Ich esse einen Anwalt

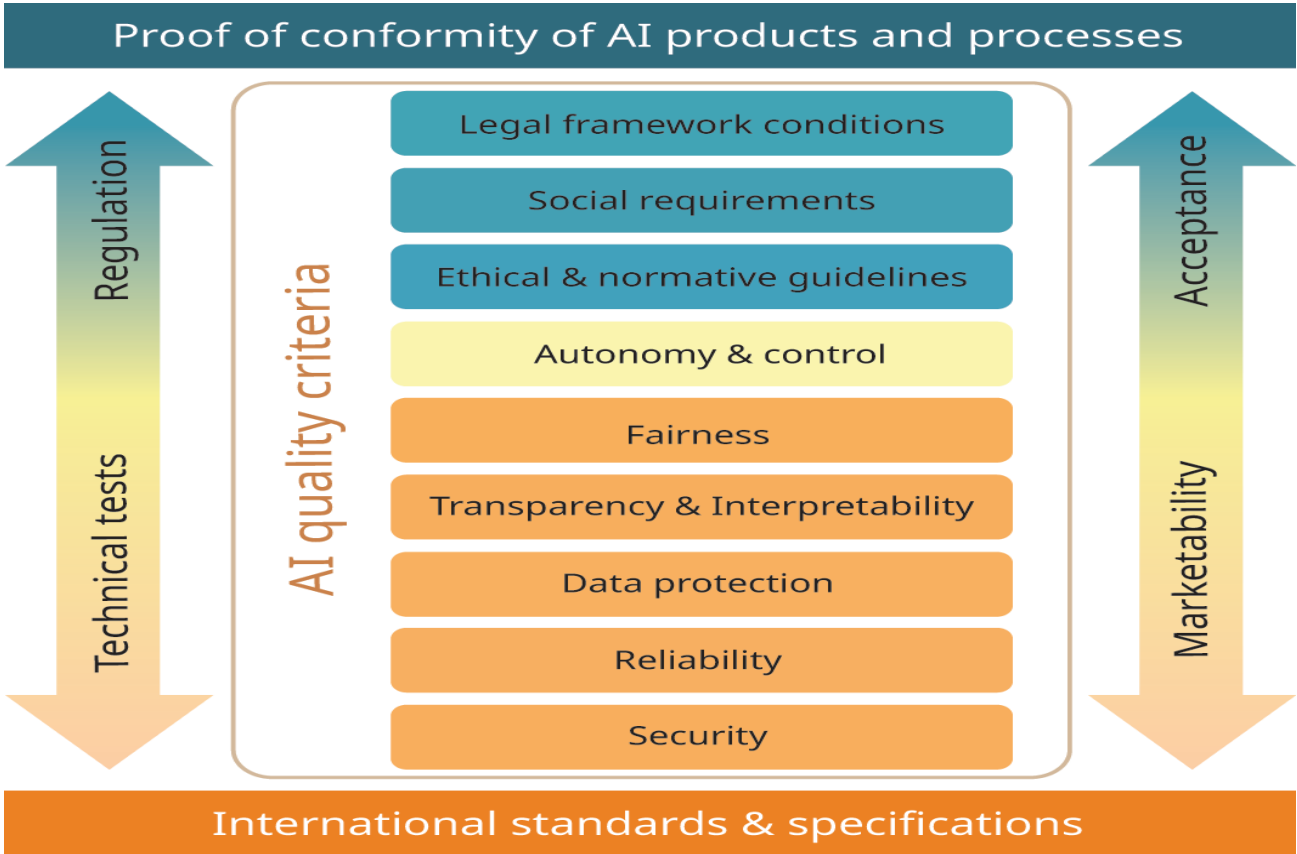**Missing World Knowledge: Cannibalism is extremely rare.**

Von: Französisch Englisch Bulgarisch

Nach: Deutsch Englisch Bulgarisch DeepL **Anbieter:** **Übersetzen**

Je mange une avocat

Ich esse eine Avocado.
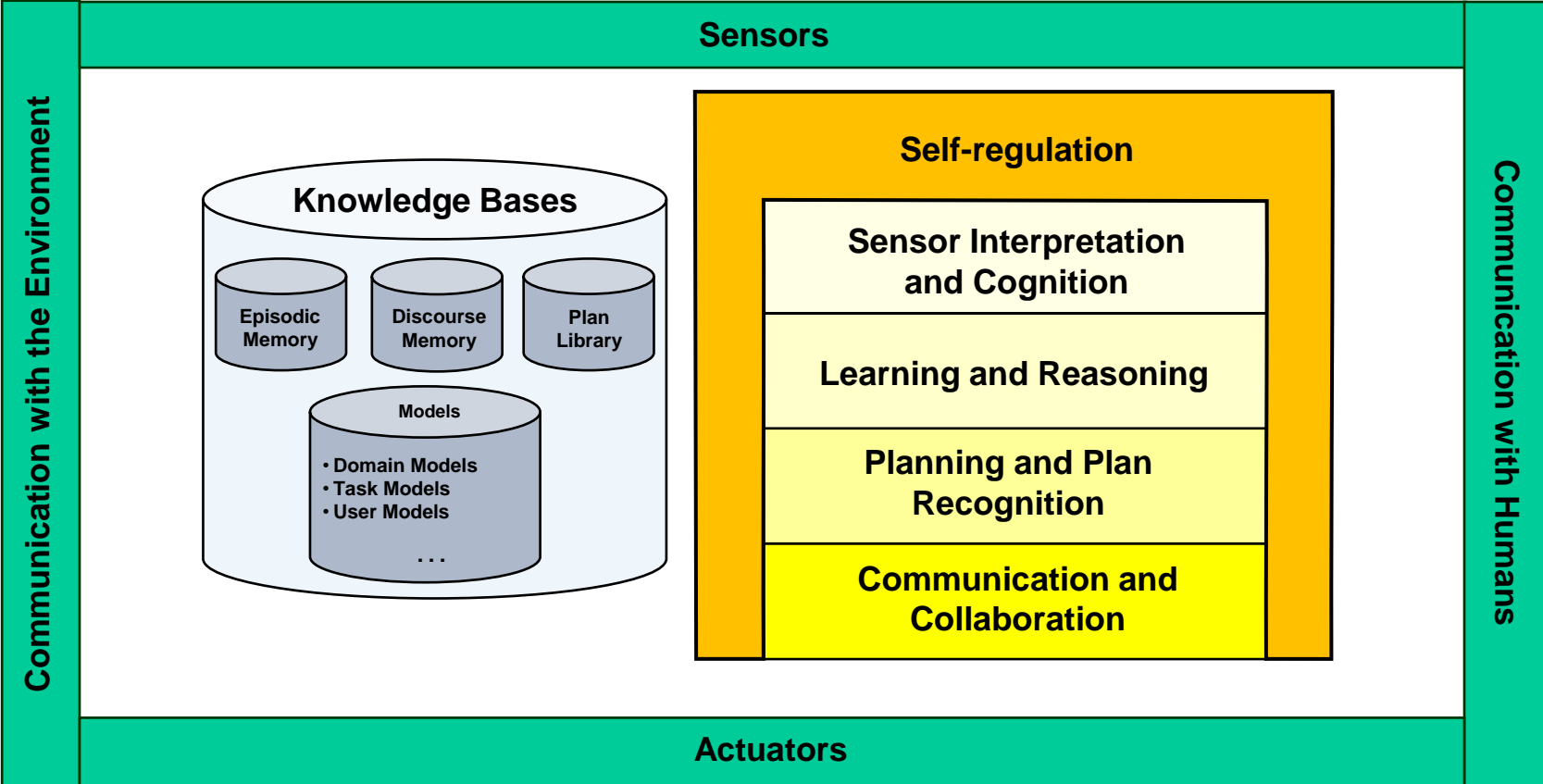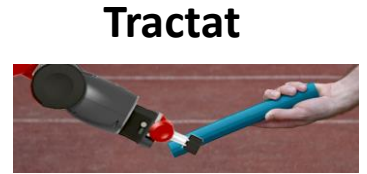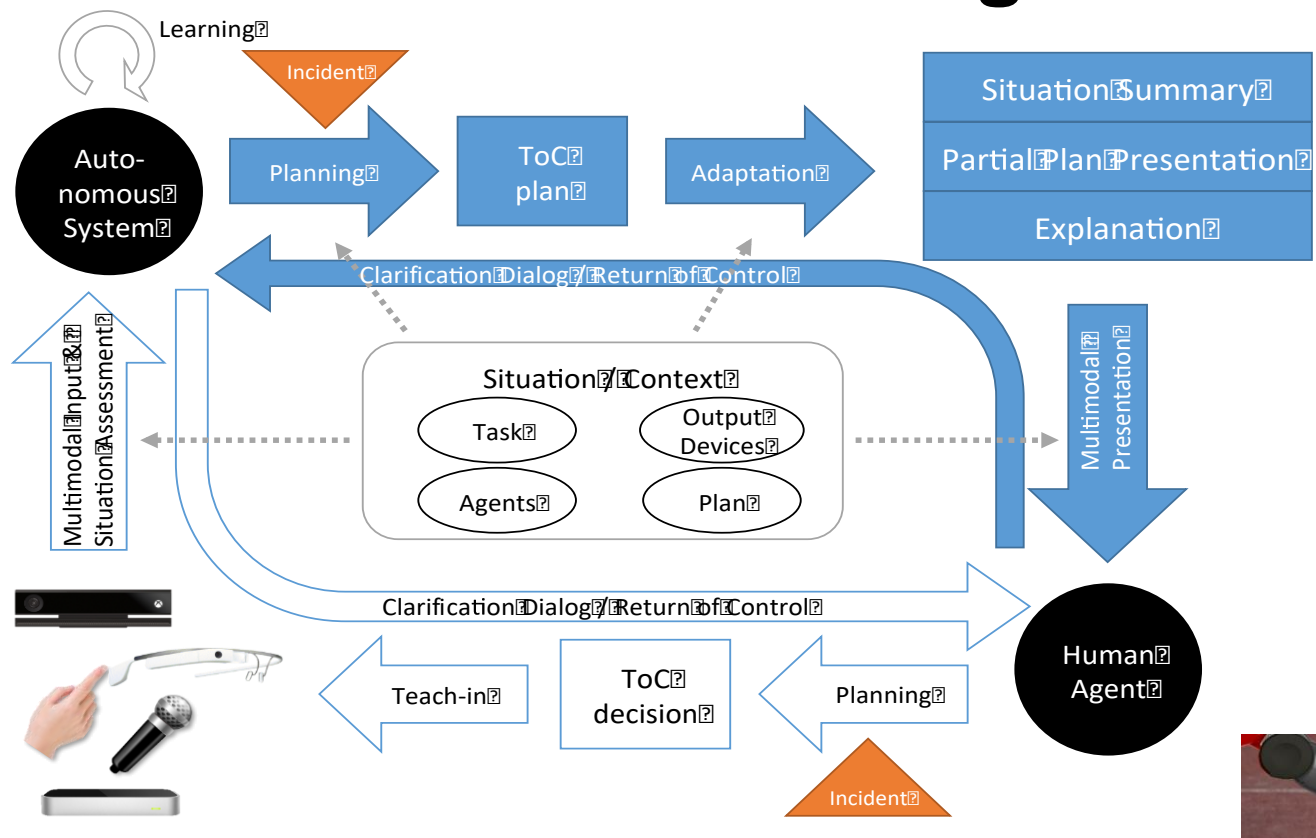
https://presidencymt.eu/#/

Future AI Certification Hubs e.g. at TÜV, BSI, FhG, DFKI

Reference Architecture for Autonomous Systems

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Safe Transfer of Control between Autonomous Medical Devices and Human Agents

Autonomous AI System to manage Type 1 Diabetes in a Closed Loop

HANDSET

Insulin Pump

CONTINUOUS GLUCOSE MONITORING

© Diabeloop 2019

Certification of Medical Devices and Apps

Medical Correctness, Conformity with Standards and Norms
Quality of Training and Test Data, IT Security, Privacy Protection, No Lock-In

Additional Certification Criteria for „AI-inside"

- **Transparency, Self Explainability**

- **Trustworthiness, Reliability, Resilience**

- **No Discrimination in Training Data**

- **No Pseudo-correlations and non-causal reasoning chains**

- **No fear of losing control and smooth transfer of control between AI and user**

Regulation must not Hamper Innovation of European AI Companies

Access to Data

Data Protection

Ethics Regulation

Standards and Norms
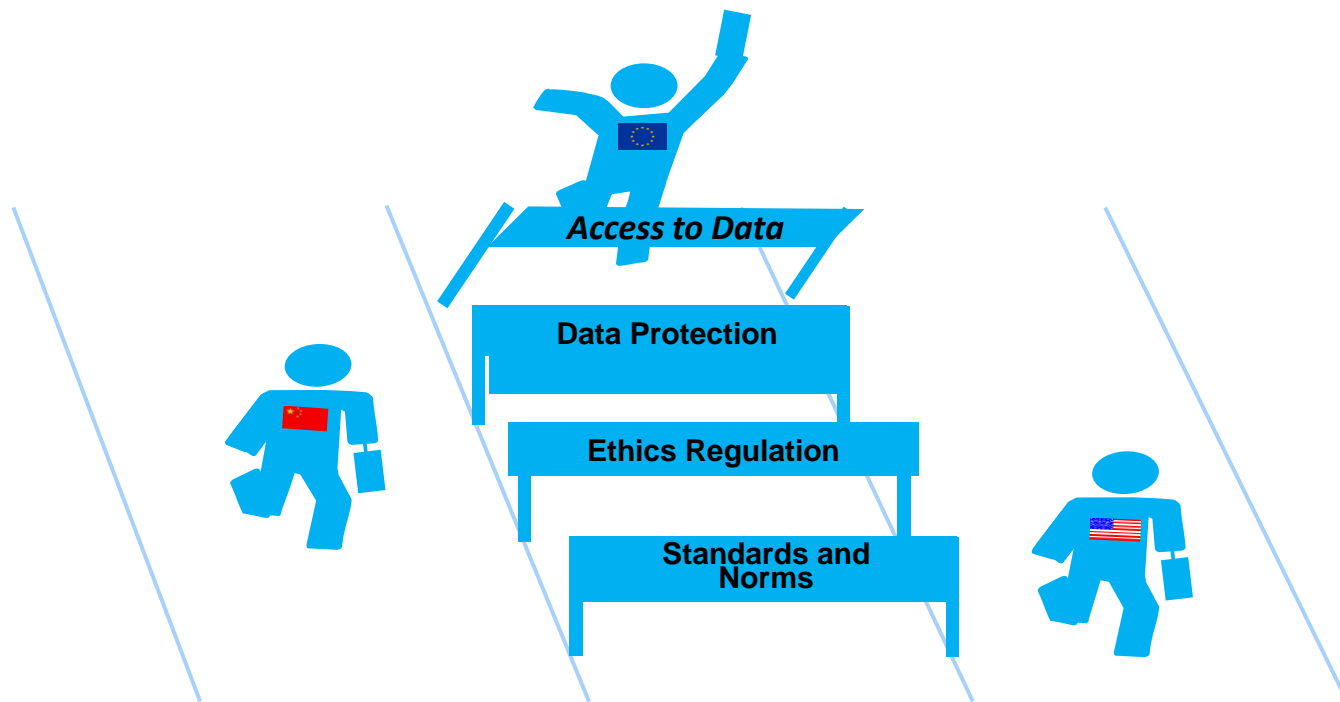
An unfair hurdle race against hyperscalers from the USA and China

Thank you very much for your attention

http://www.dfki.de/~wahlster/wp-content/uploads/normungsroadmap-ki-data.pdf

http://www.dfki.de/~wahlster/wp-content/uploads/normungsroadmap-en-data.pdf