TRUSTIF AI

by TÜV AUSTRIA Group & scch

Predictive AI for state of health – monitoring and life cycle cost optimization

About us

TRUSTIF AI
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TRUSTIFAI is…

- the European AI test and qualification hub from Austria
- your first point of contact for all questions about the security, ethics and privacy of AI
- the bundled AI expertise of TÜV AUSTRIA and SCCH in a joint venture
- operating a faculty in cooperation with the Institute of Machine Learning at the JKU
- Pioneer in the functional assurance of AI reliability and author of the world's first test catalog for AI certification (**2021**)

TÜV AUSTRIA

scch { }
software competence
center hagenberg

JKU
JOHANNES KEPLER
UNIVERSITY LINZ

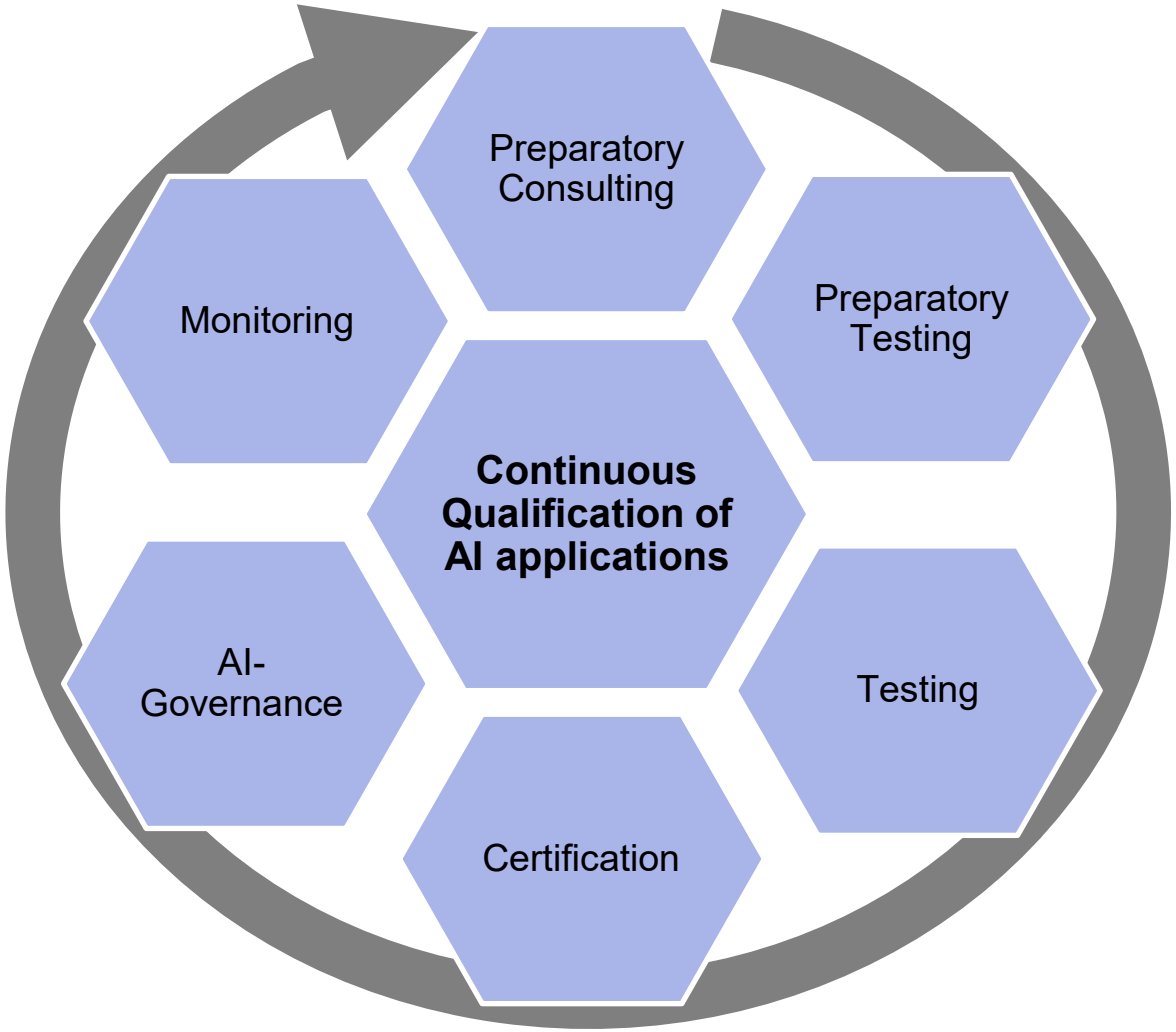
Our services

Product Certification

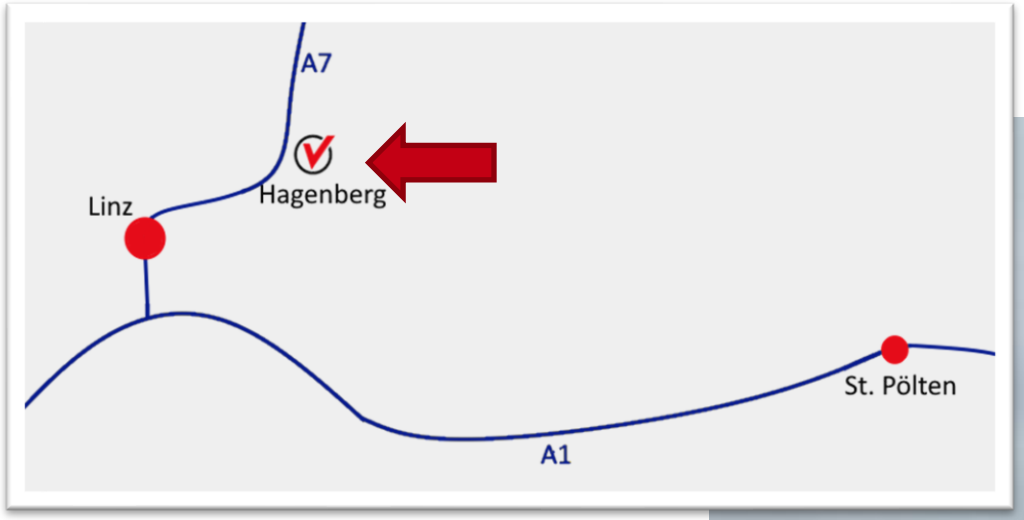
- Legal & Ethical Classification
- Data Protection & Security
- Evaluation of concepts
- Comprehensive test according to the **TRUSTED AI** certification scheme
- Unique concept for the continuous qualification of AI applications

Process Certification

- Legal & Ethical Classification
- Data Protection & Security
- Gap analyses
- Audit, e.g. according to ISO 42001
- Monitoring & Re-Certification



Location



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4th Floor

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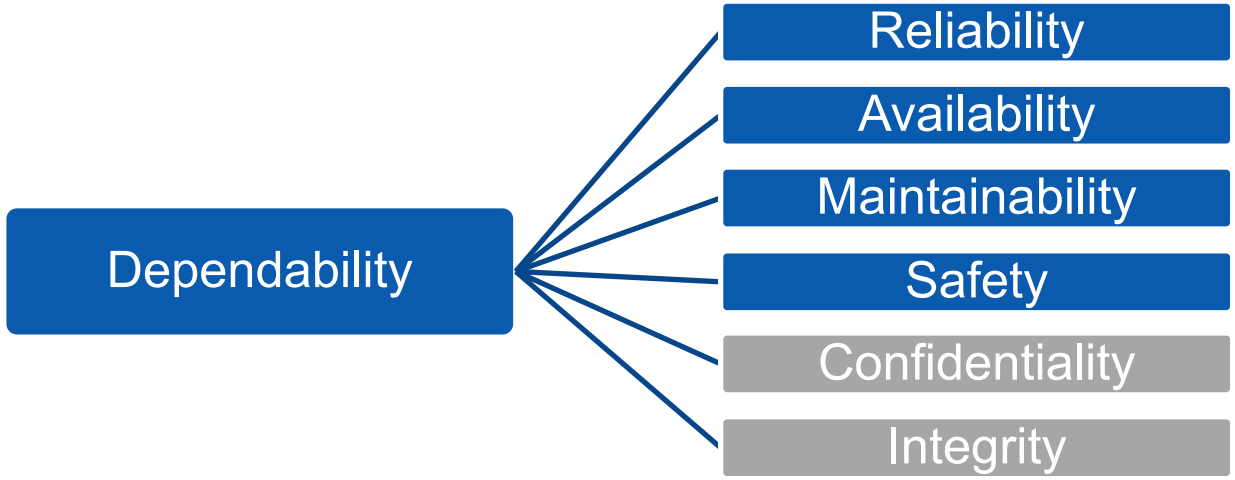
RAMS and LCC in the era of AI

RAMS and LCC in the era of AI

- Based on the interconnection of system dependability attributes, optimization of one factor usually compromises the others, impacting life cycle costs / TCO
- In many cases, however, unclear predictions and limited monitoring abilities force system designers to add safety margins and preemptively maintain components based on worst-case assumptions
- Hence, an improvement in the knowledge about your system health can allow you to utilize hidden reserves and improve performance and reduce lifecycle costs without compromising safety



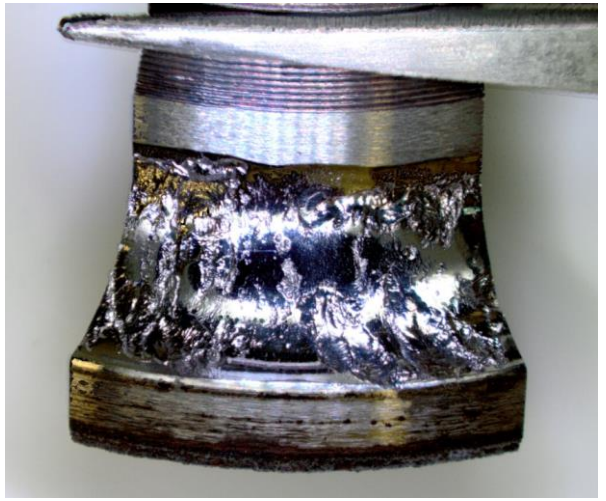
Source: Fundamental Concepts of Dependability, Avizienis et al, 2001

RAMS and LCC in the era of AI

However, component monitoring is not new in machinery engineering and exists for (almost) a century:

- What can be done with existing old-school approaches?
  - Analogous detection of bearing damages since ~ 1930
  - Highly sophisticated detection of damages, bearing overheating, eccentricity etc. also possible with “classical” algorithms or filters since ~1970
  - “Hand-made” detection limits the sharpness of analysis to signals and causal connections that can be identified by engineers
  - Transferring the detection mechanisms to other systems is connected with fine-tuning and only possible for closely related systems or components
  - In some cases expensive hardware

Source: Wikipedia: U-Boot-Klasse XXI

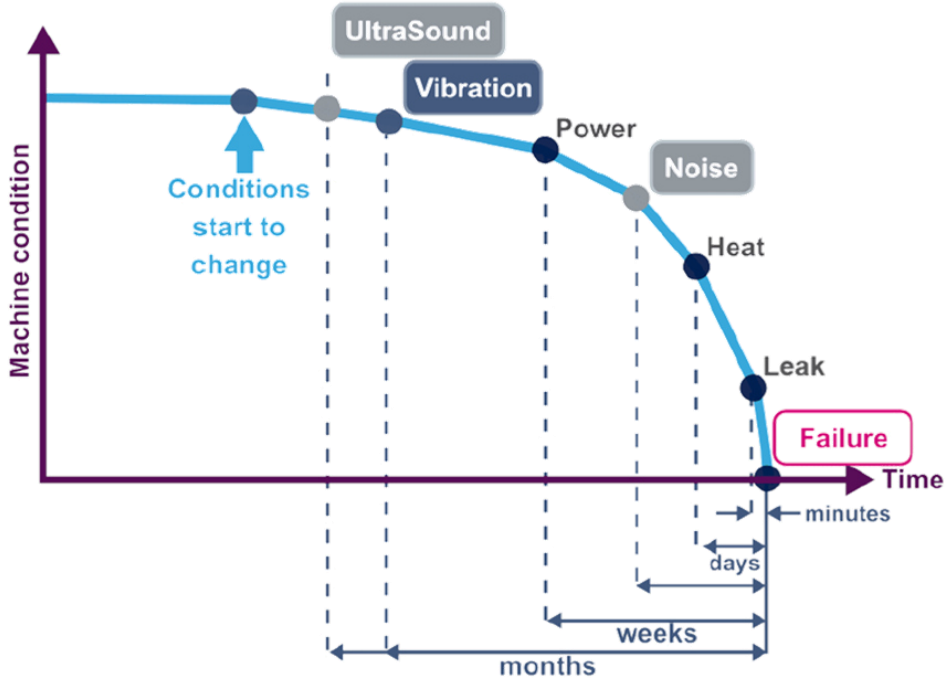


Source: Wikipedia: Pitting

RAMS and LCC in the era of AI

How can machine learning improve the situation?

- „Soft Sensors“ can identify early stages of wear-out or damage
- Use of existing signals / side channels to avoid expensive additional equipment
- Entirely new dimension of equipment control, e.g. vibration suppression by active vibration monitoring and direct control of actuators
- Examples for successful improvements:
  - Sensor Integrity
  - Chemical reactors
  - Filters & Sieves
  - Pump systems
  - Conveyor belts
  - High pressure vessels
  - Construction integrity monitoring



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How to ensure valid AI prognosis

RAMS and LCC in the era of AI

Everyone can download the necessary tools and become an “AI expert” – creating runnable applications is easy. However it has to be considered

- which costs a faulty prediction can cause?
- if safety can be affected by faulty predictions?
- if any legal constraints (#AI Act) limit the use of AI for a specific application?

- The purpose of TRUSTIFAI is to provide independent assessments of AI system reliability and performance to make sure no costly faults happen
- The following slides are intended to present the core elements to ensure that AI prediction systems do what they are intended to do

How to ensure valid AI prognosis?

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Application Domain	☑ The purpose of the system must be clearly defined ☑ The „application domain“ describes the expected distribution
Data	☑ Which data has been used for training & testing, how is overspill avoided ☑ Handling of raw data, labelling, technical constraints, distribution of examples
Model	☑ Reasonable choice of models ☑ Explainability of outliers, quantitative & qualitative analysis
General Quality	☑ Robustness ☑ Scalability and Generalization, Continual Learning Approach
Safety & Security	☑ Protection of the system against manipulation, Monitoring, Maintenance ☑ Use of established safety design practices for AI if required

See our Whitepaper: https://arxiv.org/abs/2310.02727

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Practical example – RISE

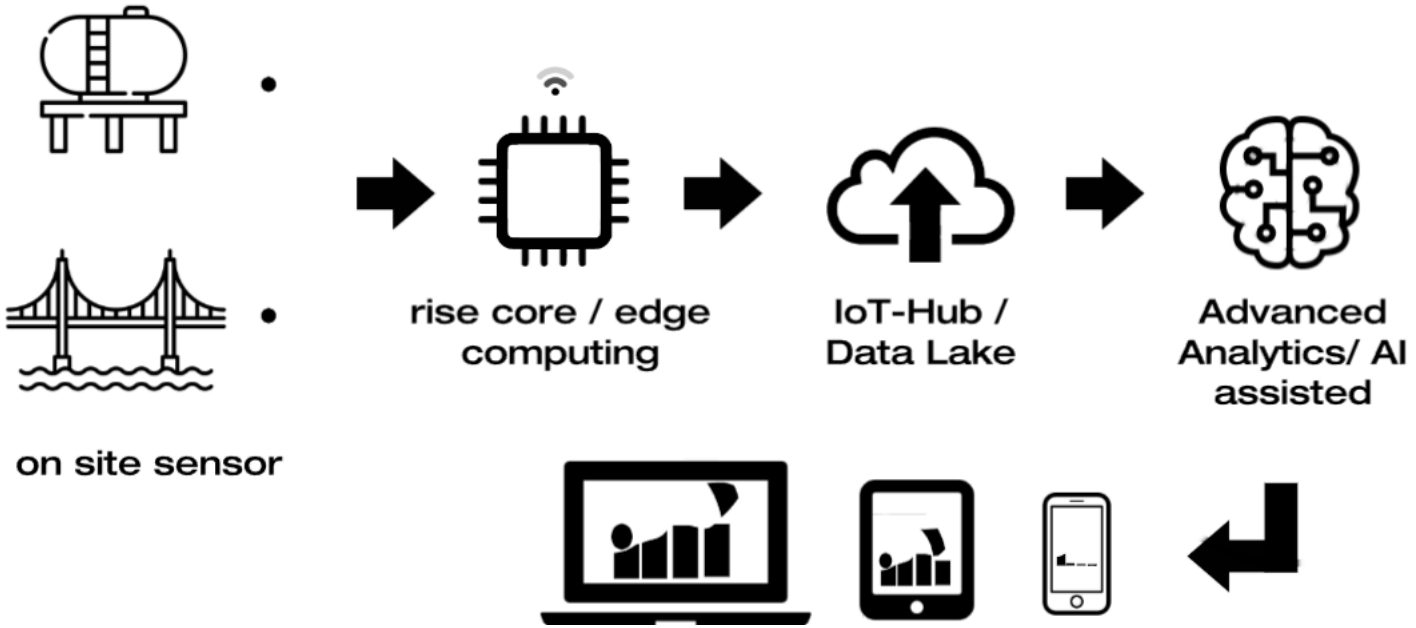
Example

Project RISE (Remote Inspection System Edge)

- Remote analysis of steel and concrete constructions
- The system is trained to identify early markers of cracks or deformations out of a massive amount of acoustic information carried by the “sound” of the structure under operation
- Due to the complexity of the signal, machine learning is an optimal approach to improve detection and support on-site inspection
- An independent certification of the trained model ensures that predictions are delivered state-of-the-art

Example

- The acoustic monitoring is done by several (relatively cheap) sensors on several locations
- A computing node is permanently monitoring the sensor signals for markers of damage on which it has been trained
- A user interface for the site operator issues status information and warnings



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Questions?

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