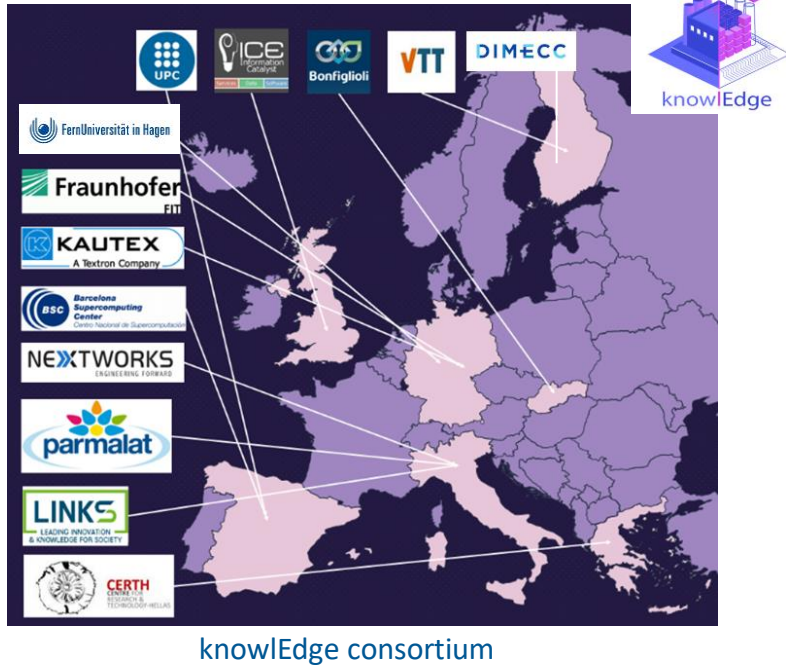


# knowlEdge project: AI for manufacturing edge-to-cloud platform - Emphasising the human perspective

EU-IOT Event "Evolving manufacturing in Europe –  
The role of edge computing", 16.02.2022

Dr. Stefan Walter, [stefan.walter@vtt.fi](mailto:stefan.walter@vtt.fi)

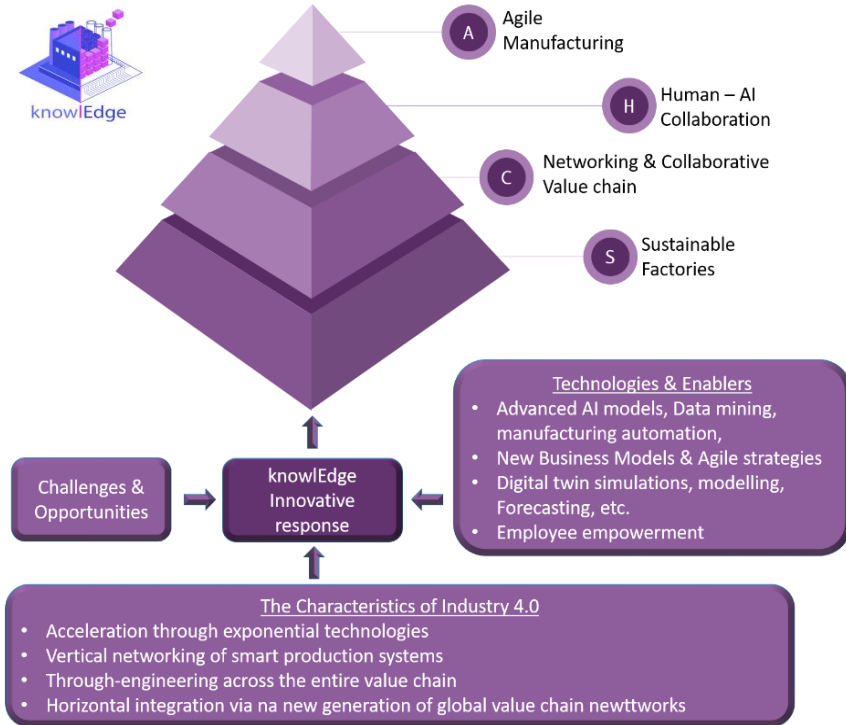
# knowlEdge: Towards AI powered manufacturing services, processes, and products in an edge-to-cloud-knowlEdge continuum for humans [in-the-loop]



## Horizon 2020, ICT-38 AI for manufacturing, 2021 – 2023

- AI centric **software architecture** to support agile manufacturing scenarios.
- Deployment model capable of **distributing data mining and analytic services** across the compute continuum.
- Interactive and multi-sided **knowledge marketplace** to enable the provisioning and utilisation of AI applications.
- Efficient and secure communication, **data management and governance infrastructure**.
- Advanced **user-facing applications** and services.

# knowEdge: Towards AI powered manufacturing services, processes, and products in an edge-to-cloud-knowEdge continuum for humans [in-the-loop]



- Accordingly, companies must address the transition with digital technologies to **reinvent their products, processes and services from a variety of perspectives**, including design, engineering and support services. The convergence of technologies such as sensors, artificial intelligence, high-volume data analysis and the Internet-of-Things enables companies to move forward and gain competitive advantage.
- The solution to realise the potential of digitalisation and the progress in the manufacturing industry lies in a **meaningful combination of smart and connected technologies**.
- The outcome of this effort is the **technical enabler** of Industry X.0.

# knowEdge platform: functional layers

## Smart decision-making

- Provides user interfaces and offers the human-in-the-loop aspects

## knowEdge management

- Represents and stores knowledge used throughout the architecture

## AI and data analytics

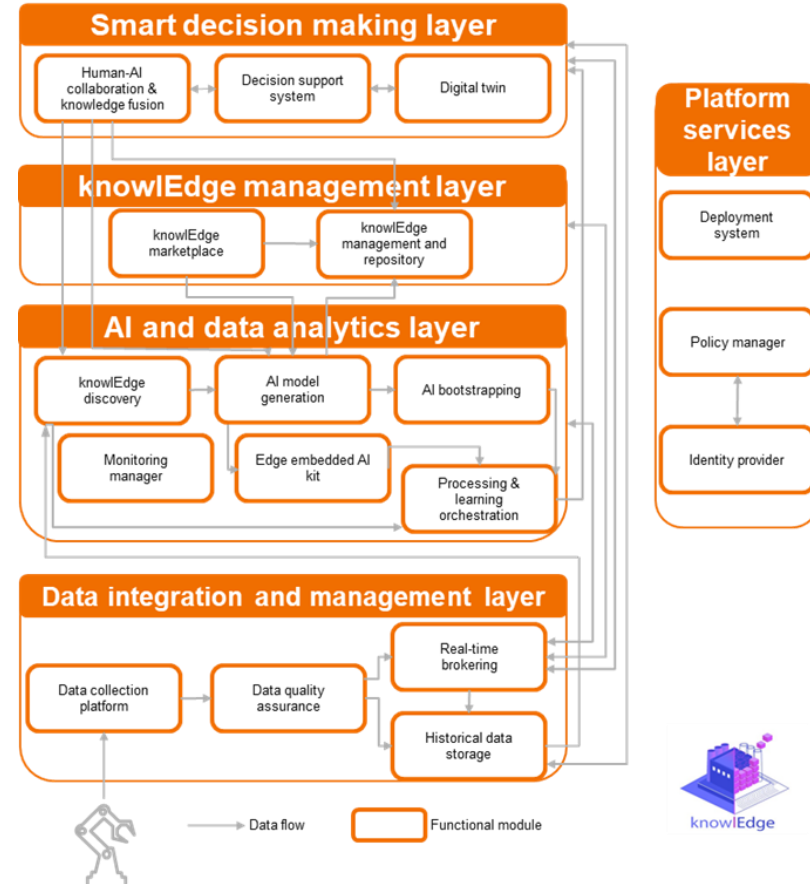
- Covers the AI lifecycle, from model training to deployment and maintenance

## Data integration and management

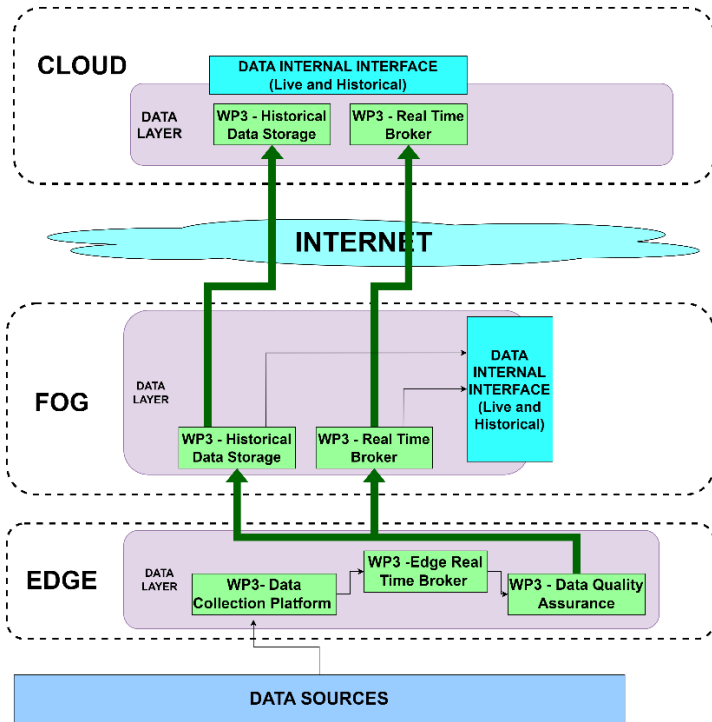
- Enables interoperability and incorporates data from various sources, such as supply chain nodes

## Platform services

- Covers the deployment of models in the cloud, fog and edge computing continuum



# Deployment environments



Edge-to-cloud chain of services: data pipeline perspective

## CLOUD

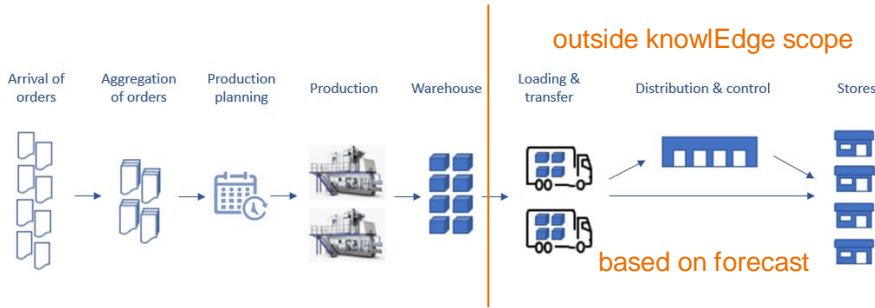
- Hosts the software modules that will be shared among all the users of the platform (e.g. knowlEdge Management and Repository component, the knowlEdge Marketplace, etc.);
- Instantiates components that require a large amount of computing power (e.g. Historical Data Storage or AI Model Generation component).
- Enables on-demand availability of computing and/or storage resources, advantages in terms of deployment complexity, scalability and infrastructure costs.

## EDGE/FOG

- Keep the manufacturing data secure: Data Integration and Management layer deployed to keep the data in the shopfloor's private network and prevent cyber attacks. Data Quality and Anonymization executes pre-processing of the manufacturing data to create an anonymous and refined dataset ready to be exported for AI processing tasks.
- Move the AI and Data Analytics Layer closer to the data: Components can run close to the data sources in order to significantly improve performance (reducing data process latency, execution time of the algorithms during the runtime).



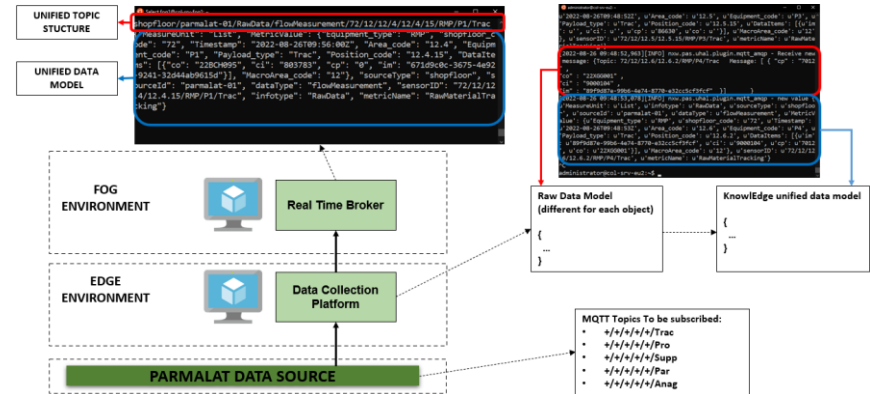
# Application: dairy producer



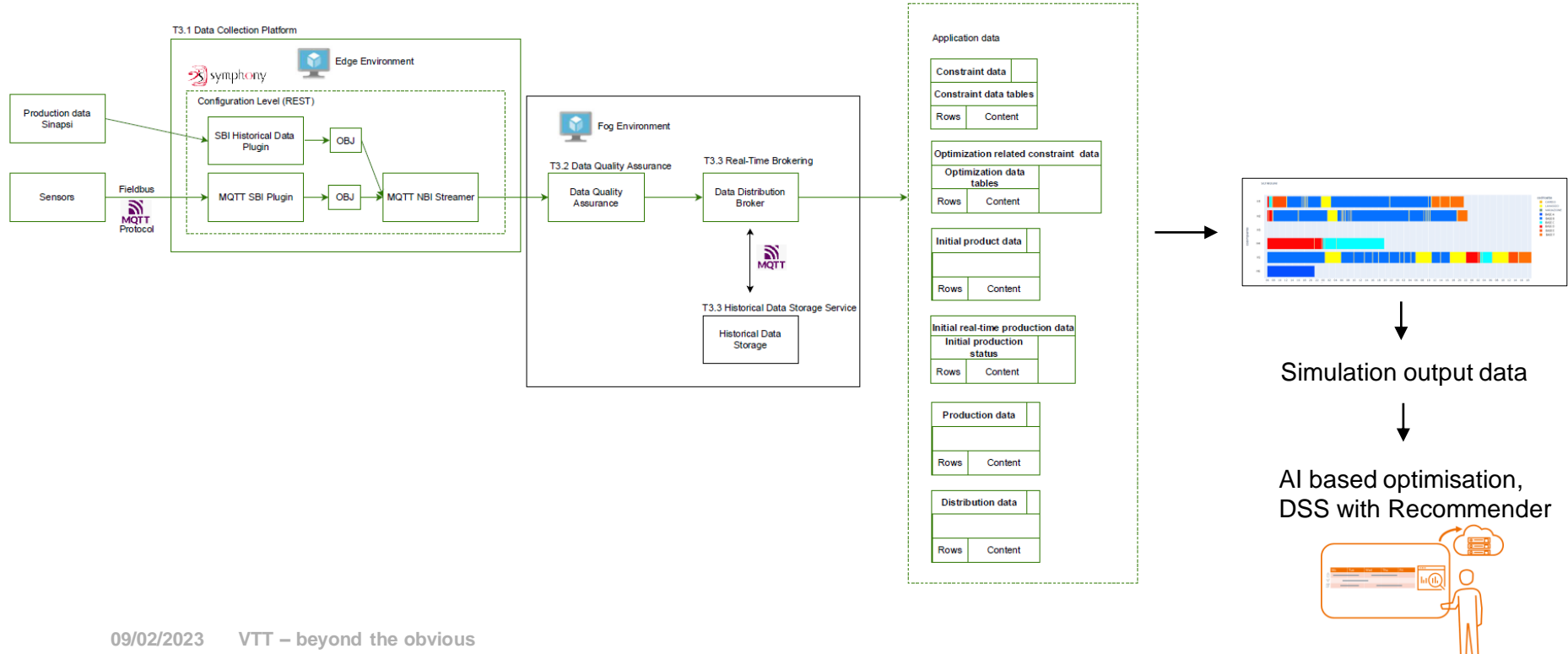
From production planning...



...to data collection platform and AI scheduling

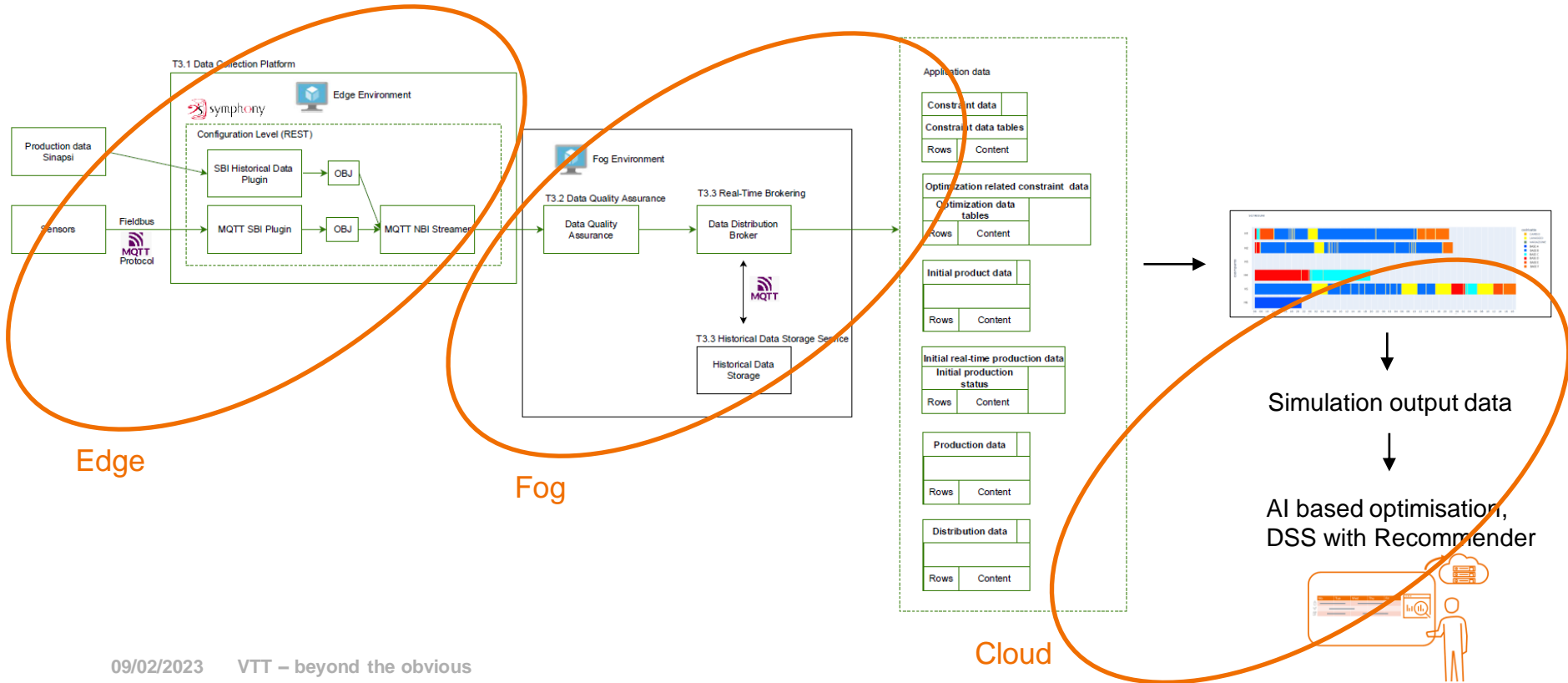


# Dairy producer: edge/fog/cloud processes

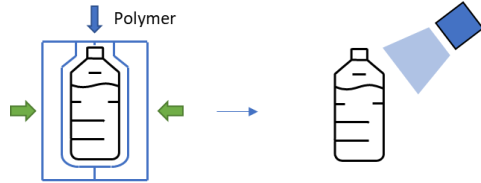




# Dairy producer: edge/fog/cloud processes



# Application: automotive/fuel tank production



## Use case

3. Production optimization for small batches (Blow molding of fuel tanks): Based on a set of adjustable manufacturing information, ensure the final product quality, reduce faulty output and waste, reduce raw materials.

## AI scenarios

### Anomaly detection for zero defect production

- System unifies and continuously updates all relevant information (product specifications, material properties, machine data, KPI's), thereby aligning the process, checks and informs about potential deviations from production scenario and product specifications
- System notifies on any deviation from the expected specifications
- Domain experts can take active role and request attention based on their own perspective on the process: accept a notification as an actual deviation or reject system proposal
- AI model learns from acceptance/rejection by the domain expert
- Documents success and effects of the solution in the system; available for future reference and solving issues

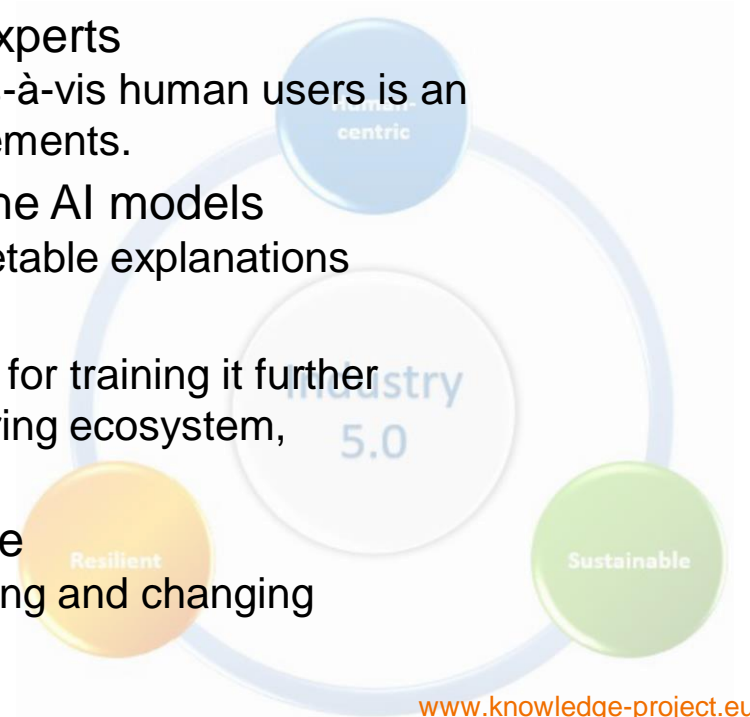
# Challenges

- Integration with legacy systems, data governance framework
- Data quality, integrity
- Real-time data processing and decision making (required infrastructure)
- Scaling the setup and the AI solutions (e.g. ensuring the adoption of AI across various levels and sectors)
- Explainability, **trust**, reluctance to be open

**Edge-cloud addresses some of these challenges!**

# Edge-cloud advancing human-centrism

- Interaction possibilities for human domain experts
  - The way the knowlEdge architecture will run vis-à-vis human users is an important part of the operational system requirements.
- Ingesting domain experience and improve the AI models
  - Reason with the models, create human-interpretable explanations
- New data-based business models
  - Provide model to other companies in exchange for training it further (collaborative model creating digital manufacturing ecosystem, "prosumer")
- Human learning – develop human work force
  - Giving agency to humans for actively participating and changing



# Outlook

- Decentralisation of intelligence
  - Distributed control of processes etc.
- Multiagent-systems, involving both AI and humans
  - Humans as agents, which are truly autonomous, interacting with AI
- Sensors and actuators are located at the edge
  - Not only to be seen in a mechatronical way
- Self-X (e.g. organisation, optimisation, diagnostics, repair,...)
  - Autonomous management of issues
  - Allowing rapid responses due to greater autonomy, flexibility
  - Will redefine operational management, adaptation and resilience

# bey<sup>0</sup>nd

## the obvious

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