AI @ Audi

Transforming Automotive Production Through Data and Artificial Intelligence

Dr. Andreas Kühne | ETH Zürich | 17.03.2026

AI at Audi Production

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Insights to Audi

Audi within the Volkswagen Group

twelve distinct brands united by a shared commitment to sustainable mobility

Brandgroup Progressive

> **Each of our brands stands for outstanding performance, pioneering technologies, captivating design, and powerful emotions.**

Key Financial Figures of the Audi Group for 2024

Deliveries

1,6 Mio

Emplyoees

88.000*

Plants

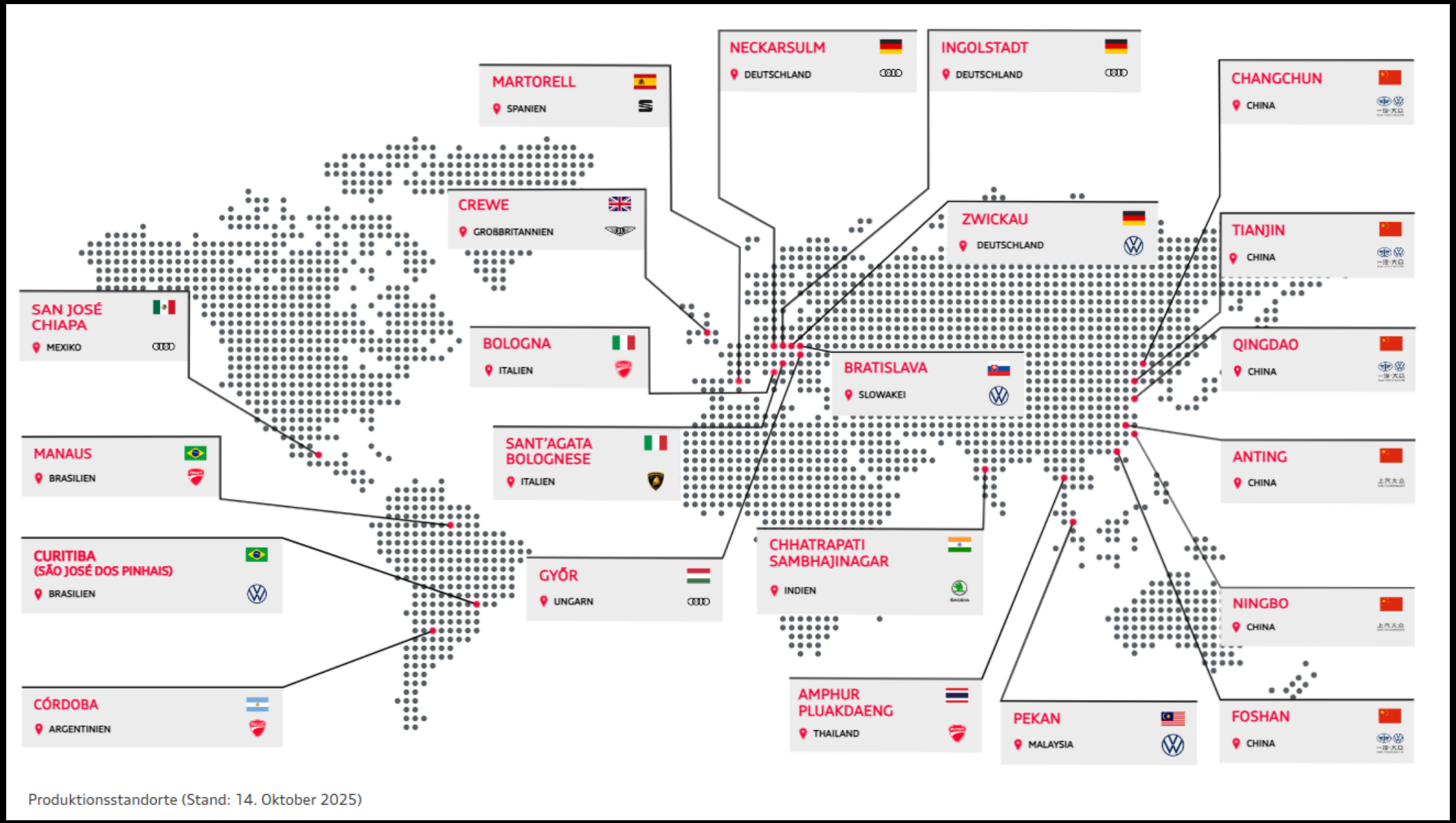
4 (+ more in VW Group)

Models

14 (4 of which are fully electric)

*March 2024

Audi Group – Production Sites

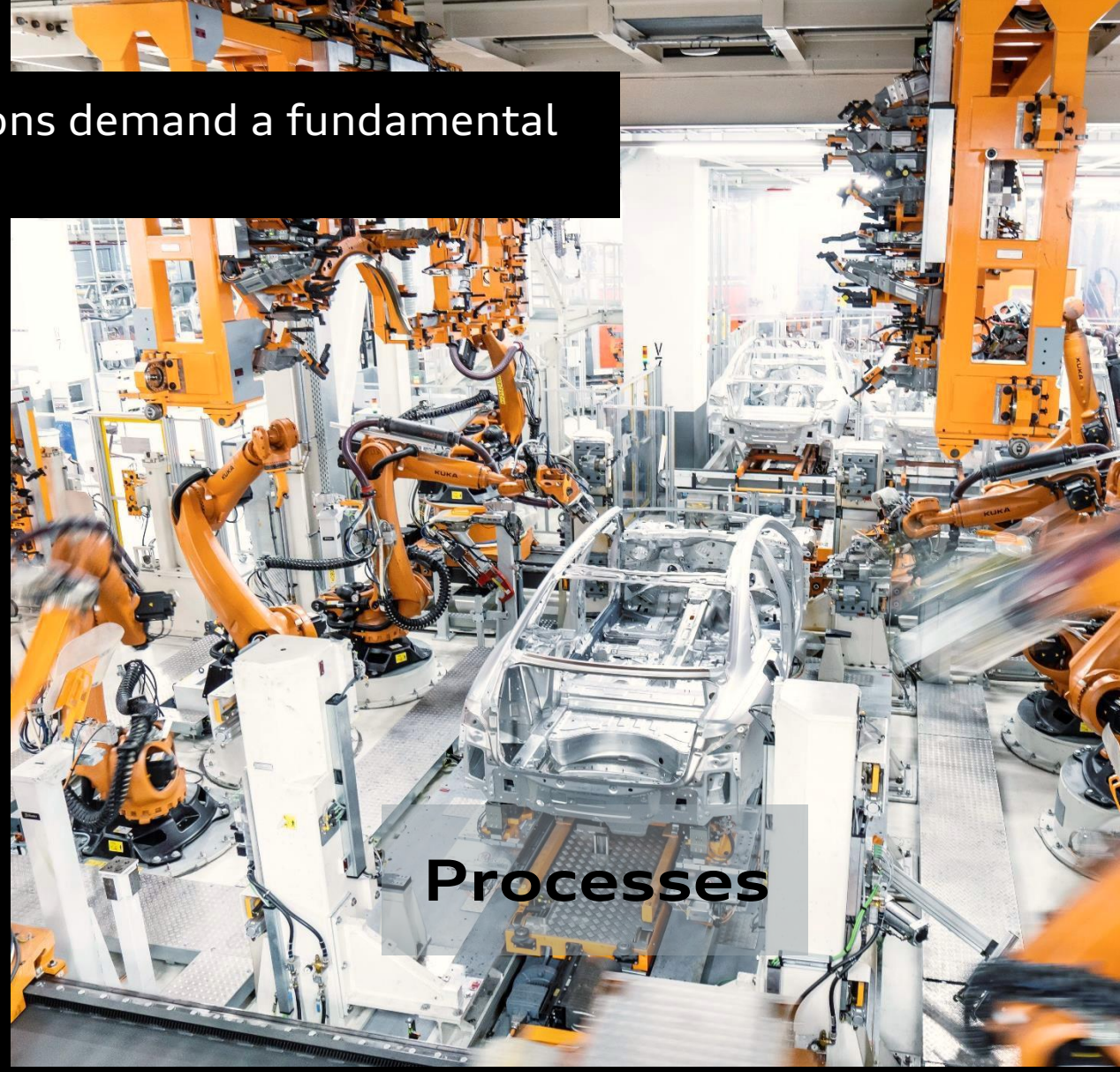


Produktionsstandorte (Stand: 14. Oktober 2025)

AI@Audi production

Global competition and changing customer expectations demand a fundamental shift in the automotive industry...

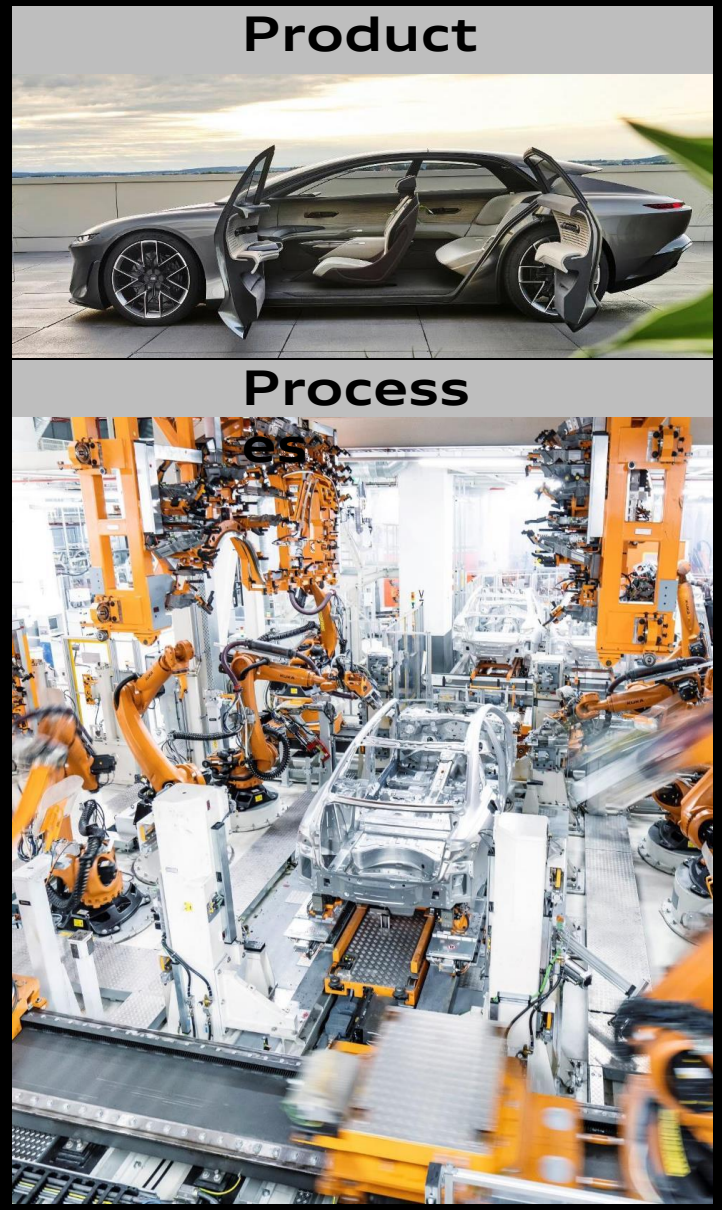
Product



Processes

...extending beyond the product to the way vehicles are manufactured."

What does transformation entail in the digitalization of processes?



Challenges & Potentials

> Long-established structures and processes

> Very high complexity across products, processes, and systems

> Establishment of standardized, digitalized processes

> Efficiency improvements driven by digital transformation

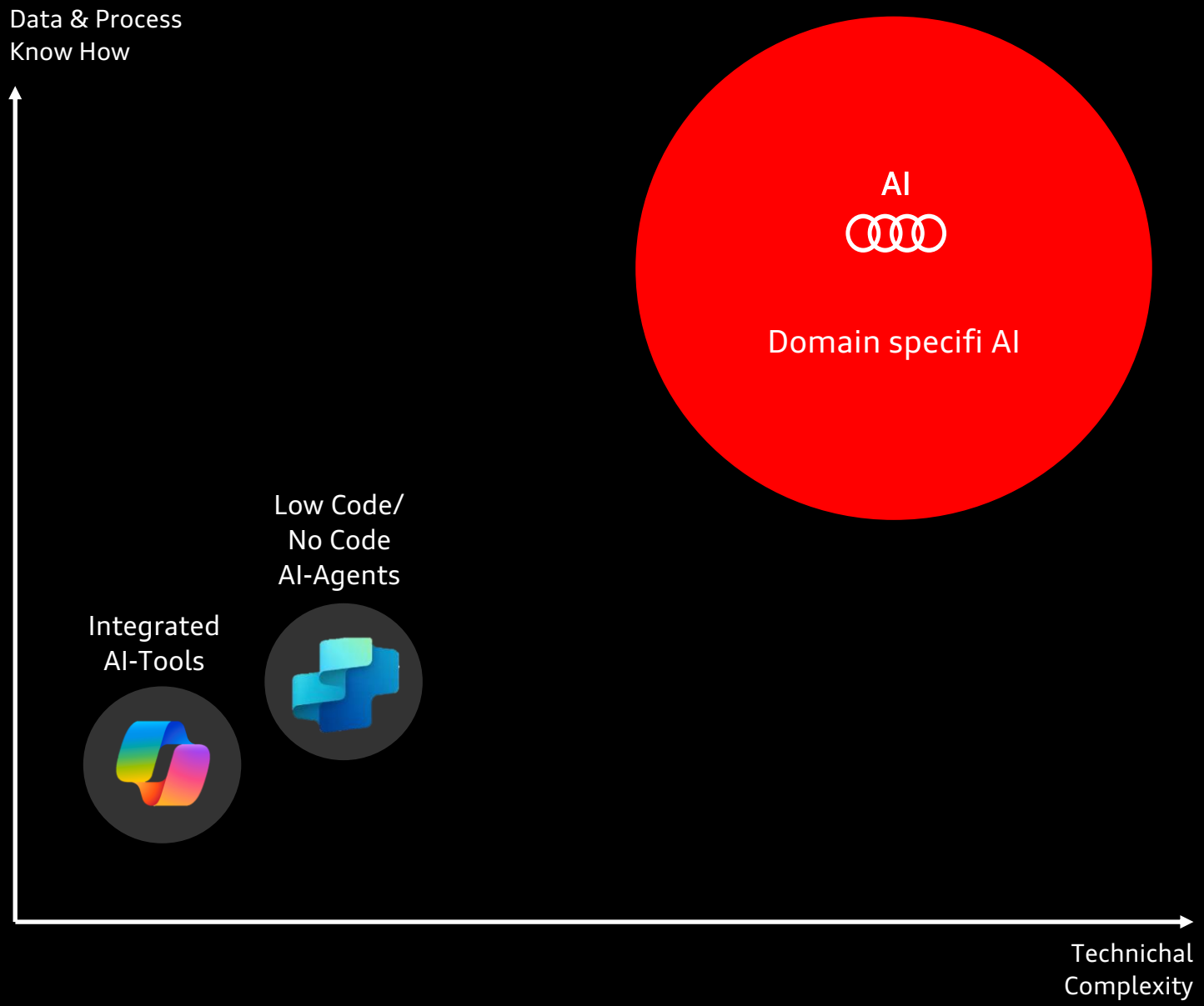
> Systematic use of regional strengths and synergies to enable transformation

AI in the 360 factory

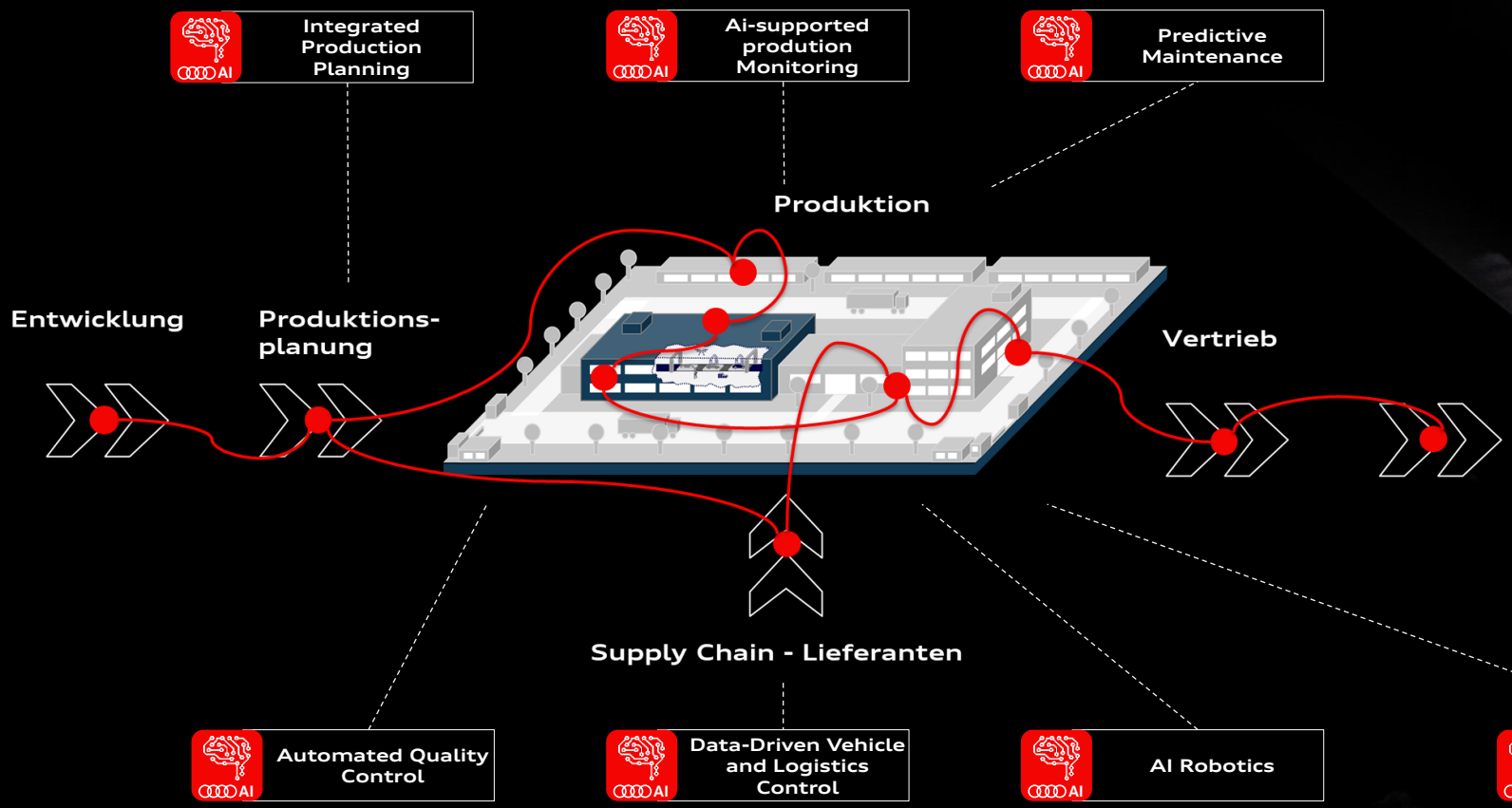
The 360 Factory is a comprehensive initiative aimed at optimizing Audi’s production processes and making them future-ready.

The widespread use of artificial intelligence plays a key enabling role in ensuring the competitiveness of future production

More executive: Combining AI capabilities with Audi's domain expertise



AI Potentials Along the Audi Production Value Chain



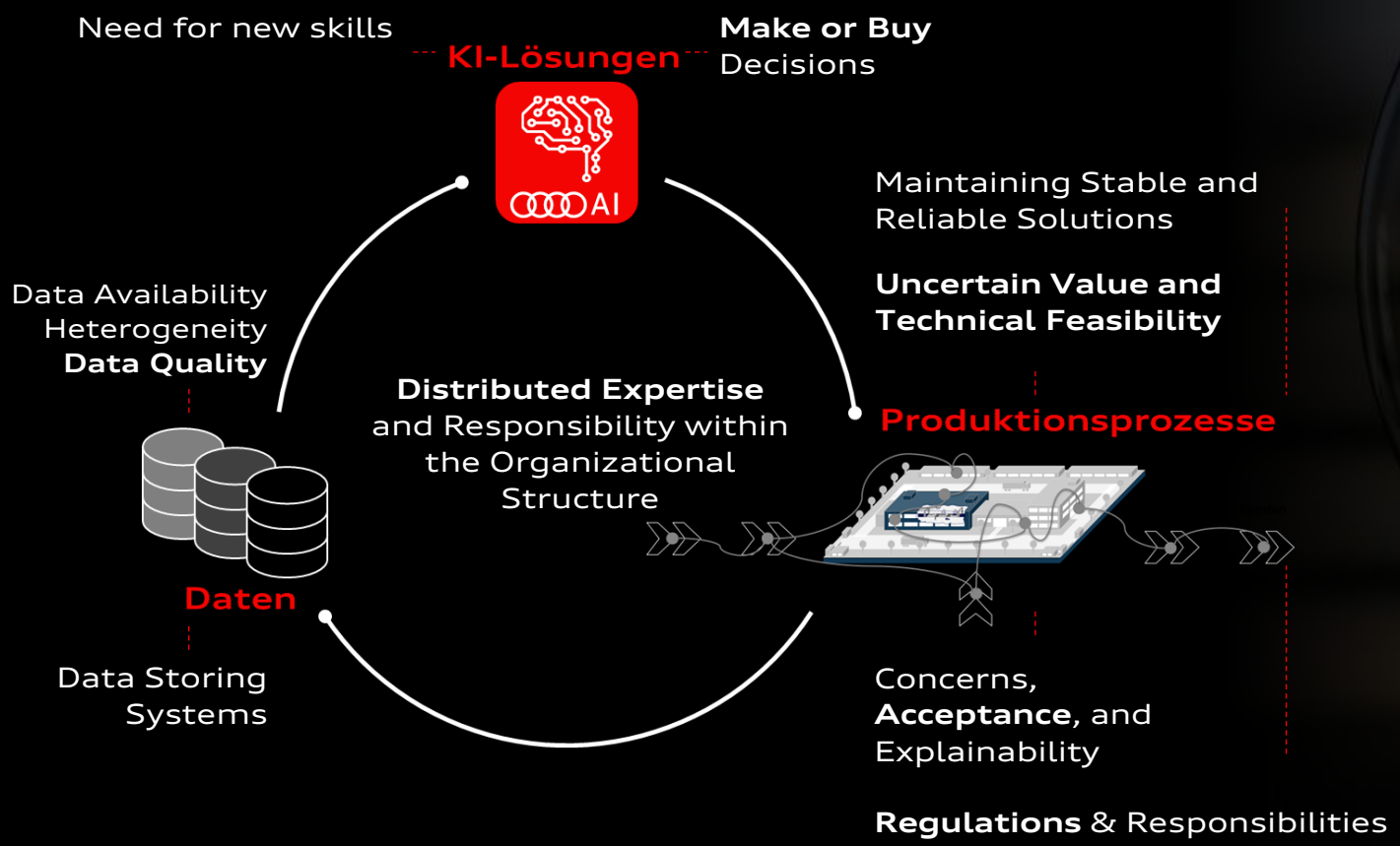
Reduced Production Costs

Higher Flexibility

Sustainable Resource Utilization

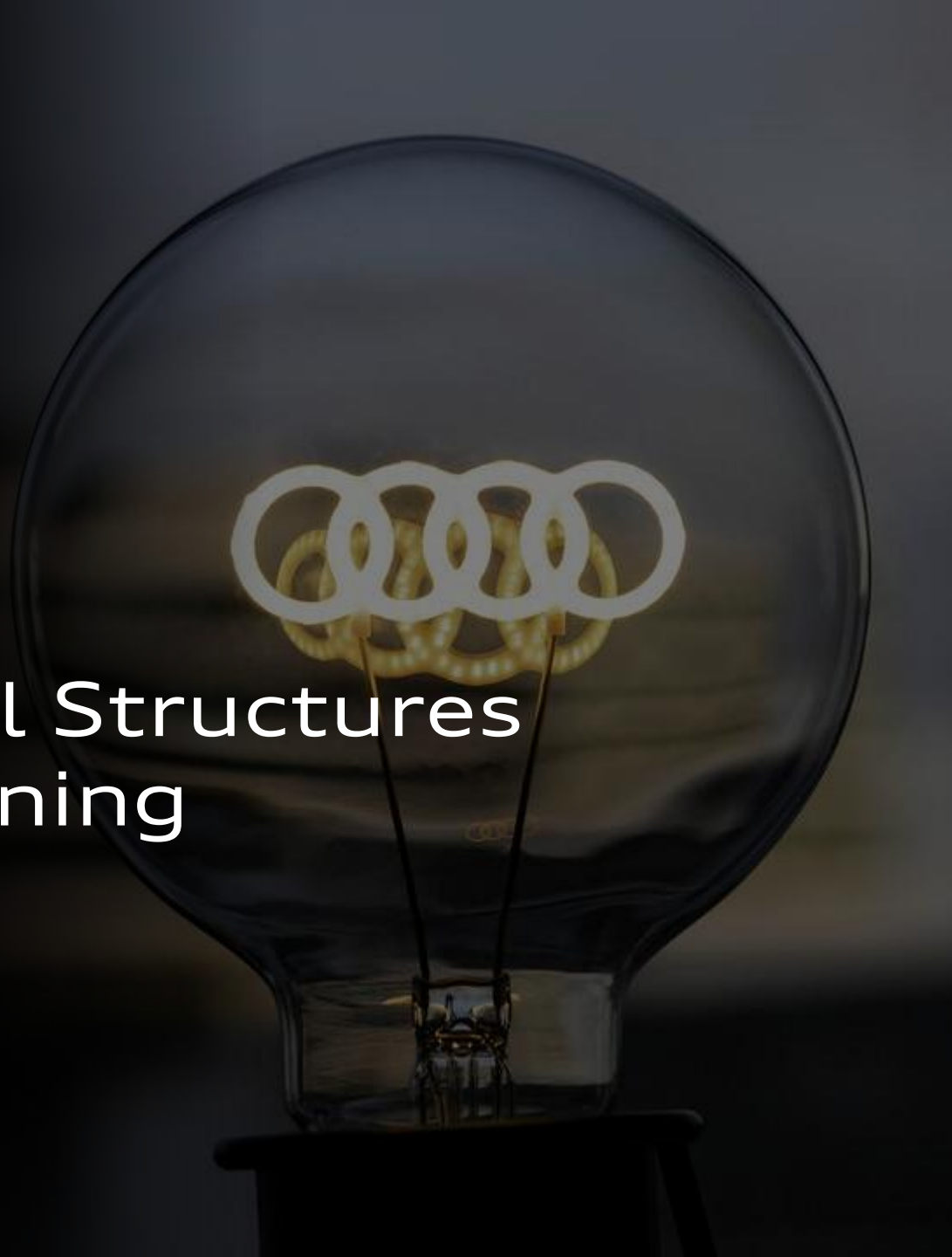
Employee Attractiveness

Challenges in Implementing AI Solutions

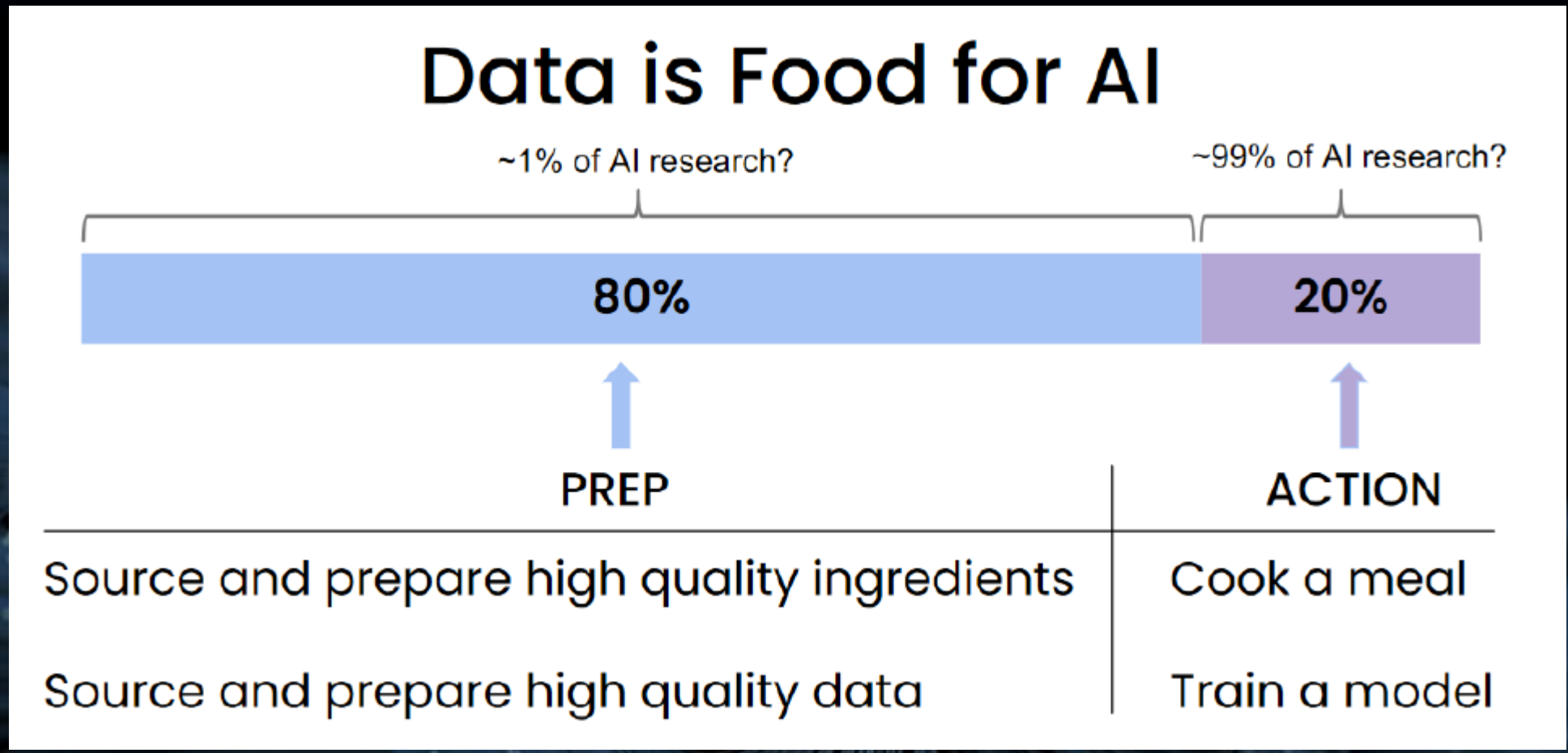


1. Establishing sustainable structures for scalable data provisioning
2. Engaging employees to strengthen trust and acceptance
3. Creating an agile organization for strategic planning and implementation of AI
4. Expanding the AI network to gain external impulses and expertise

Establishing Fundamental Structures for Scalable Data Provisioning



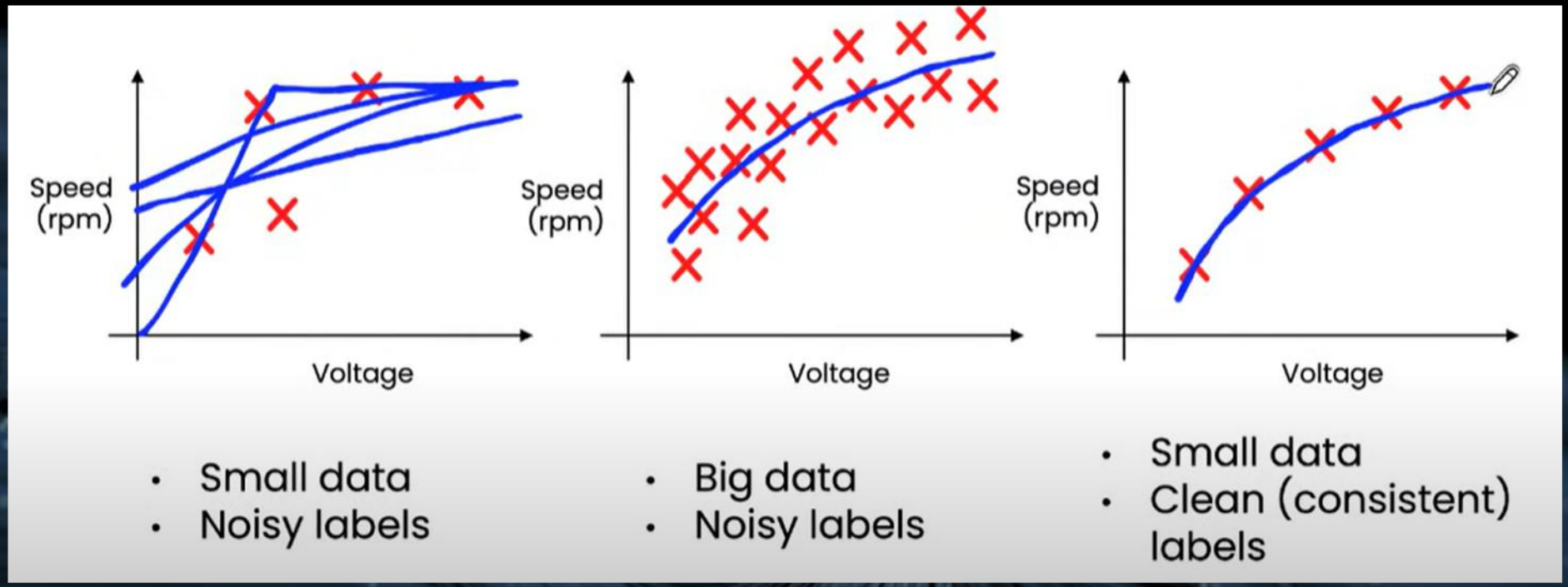
Data is Food for AI
Bullshit In – Bullshit Out



Source: Andrew Ng, Data-Centric AI

Data Quality
Impact of Data Quality on AI model performance

Especially when working with small datasets, data quality is critical to the predictive performance of AI models.



Source: Andrew Ng, Data-Centric AI

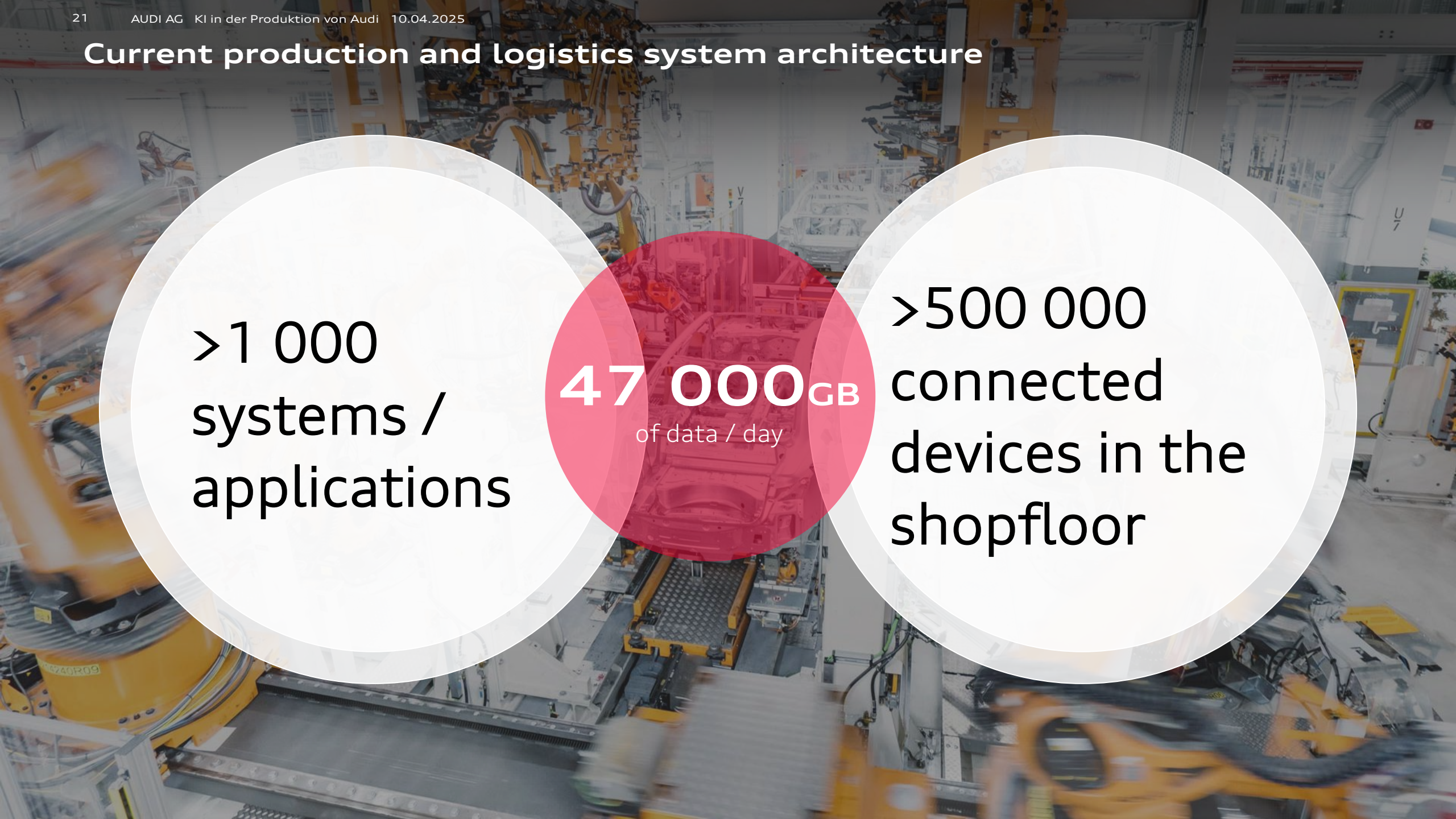
Data Quality

Impact of Data Quality on AI model performance

What constitutes good data for AI solutions?

- Clearly and consistently defined
- Coverage of all relevant and critical cases
- Timely feedback from productive systems(data distribution captures data drift and concept drift)
- Appropriate size, i.e. a sufficient number of samples for the task

Current production and logistics system architecture



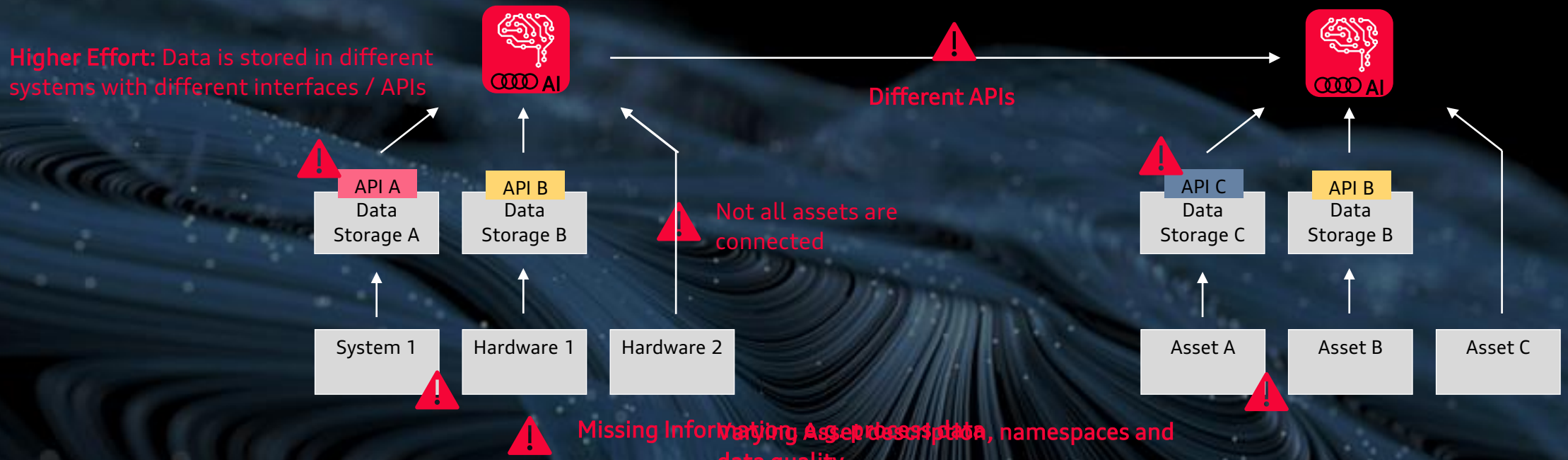
>1 000 systems / applications

47 000 GB of data / day

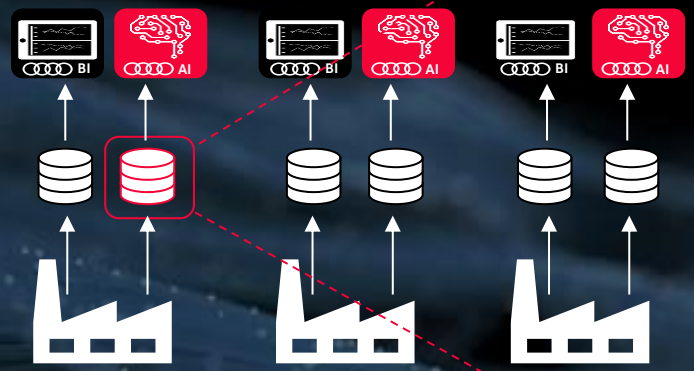
>500 000 connected devices in the shopfloor

Impact of data availability and harmonization on scalability of AI

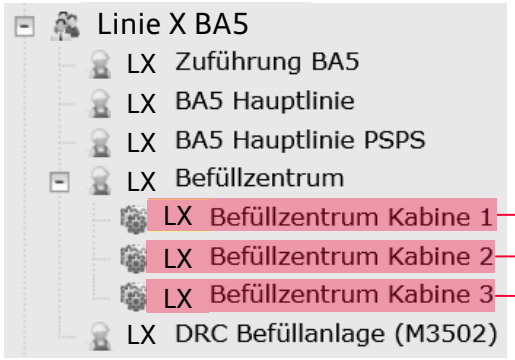
The integration of machines and equipment remains a major challenge in many cases. Available data is extremely heterogeneous and distributed across different systems. As a result, the development of data products is time-consuming and cost-intensive.



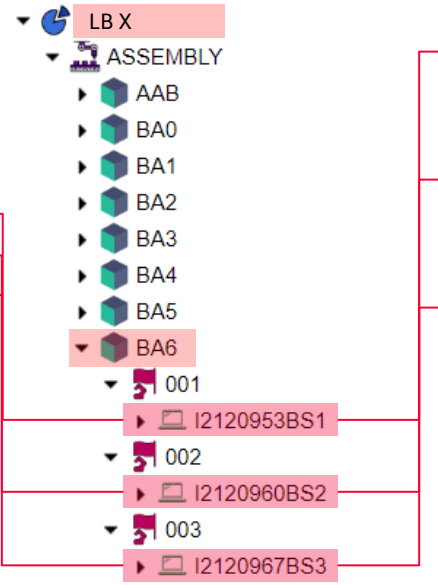
Lack of end-to-end data integration, illustrated by the example of production equipment



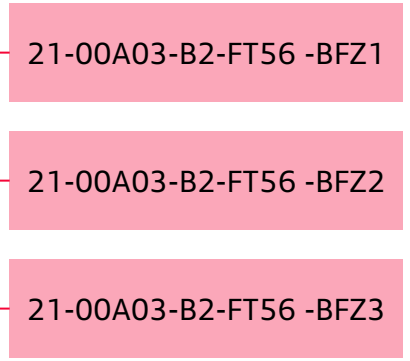
Application 1



Application 2



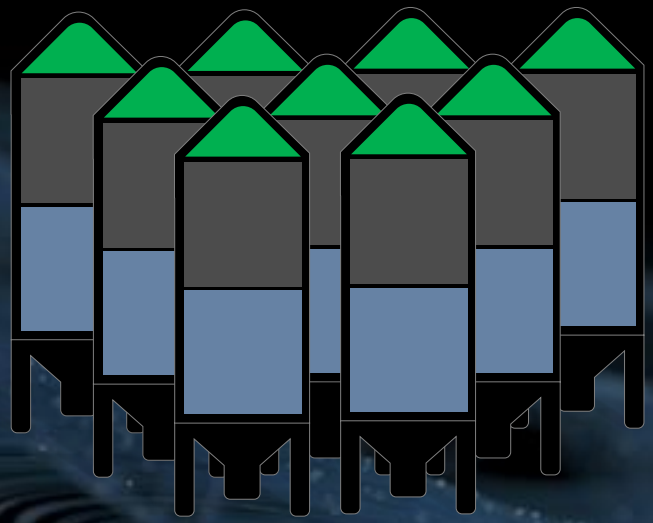
Application 3



No central management of asset information

3 x Effort for development

From silos to platforms



Benefit

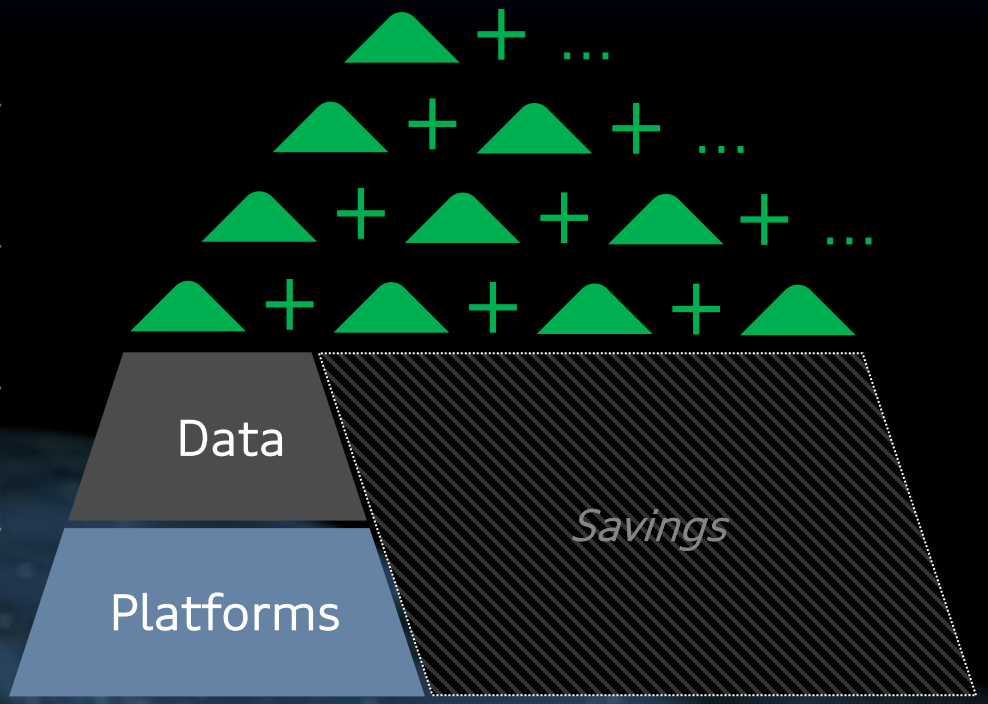
Effort

Planning / PV

Logistics / SC

Enabling SUP

Production / DPM

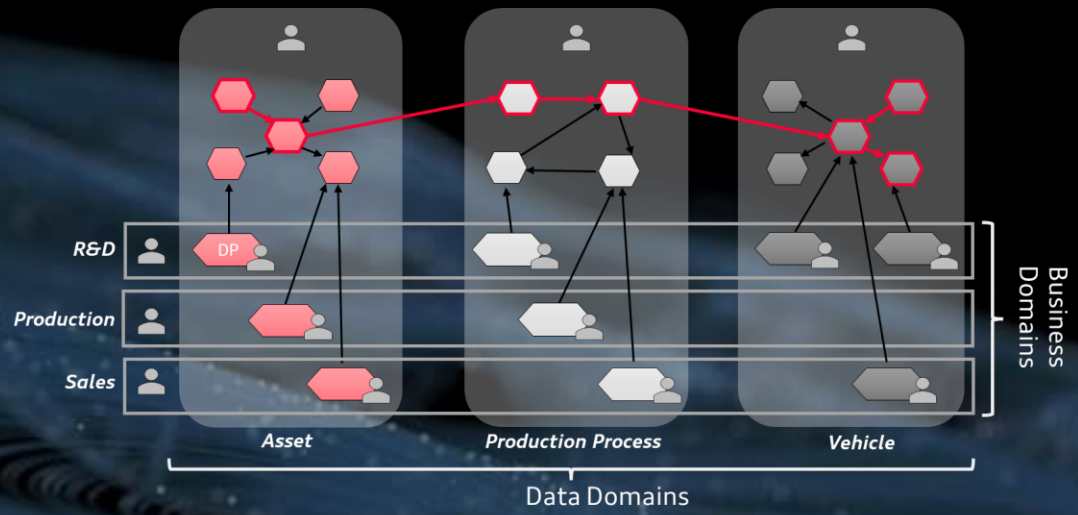


Effort

Benefit

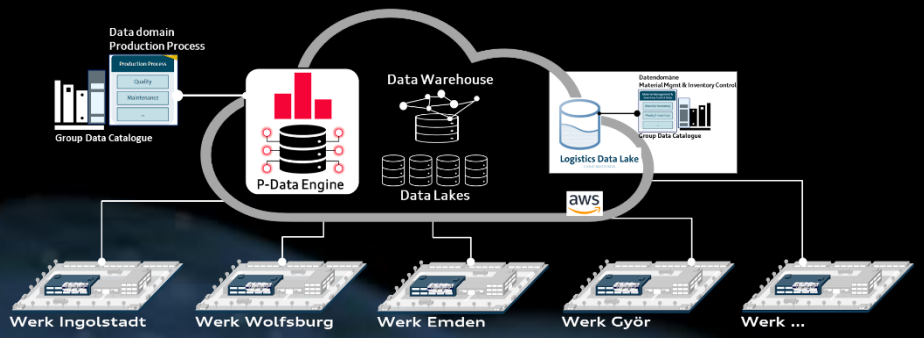
By leveraging data domains and integrated data platforms, we are establishing key enablers for scalable data availability

Necessary Enabler



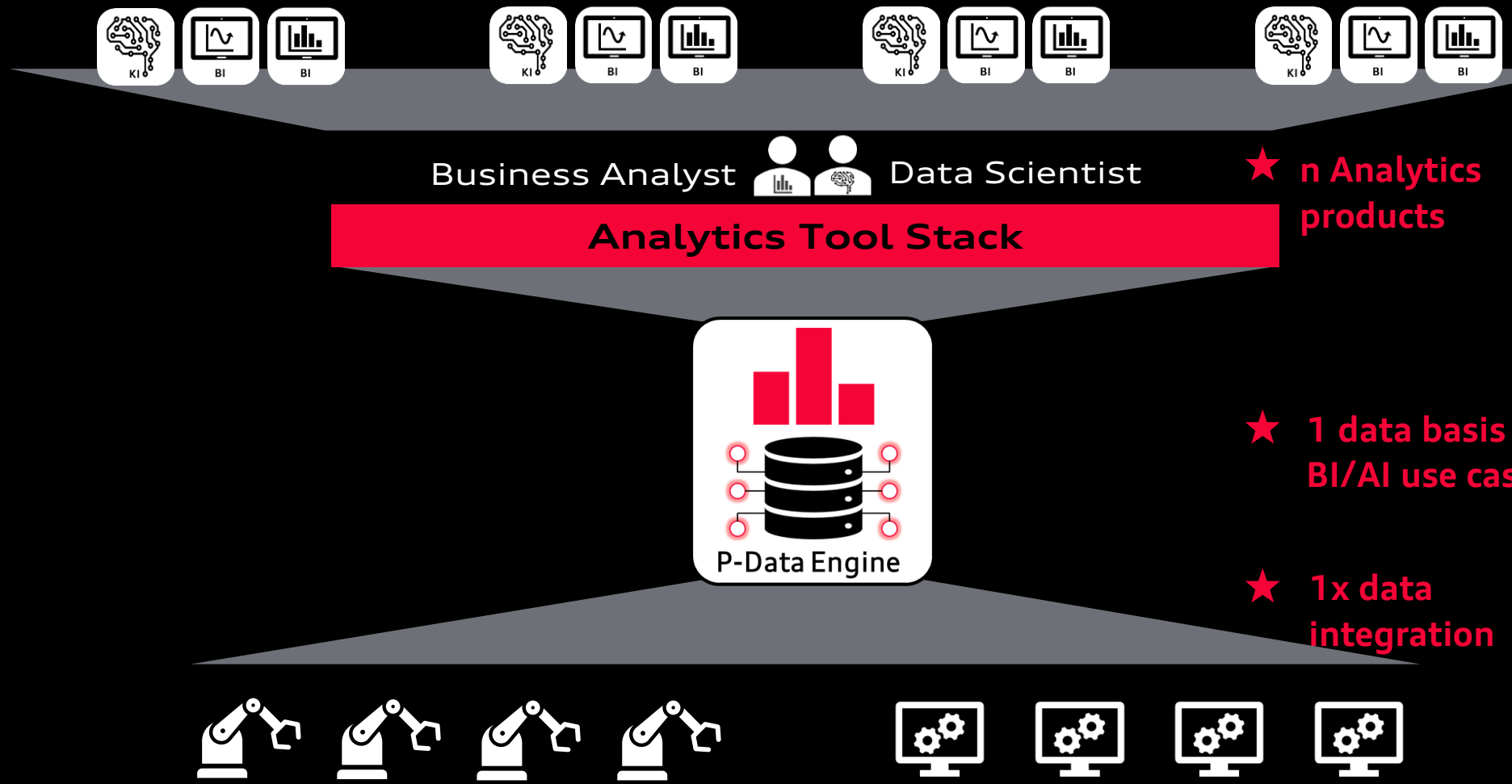
- Establishing **data domains** reinforces a data-driven mindset across the organization
- A unified **information model** maps key data relationships and enhances availability, quality, and consistency in data utilization

Synergetic Data Provisioning



- Integrated **data platforms** form the backbone for cross-plant and cross-brand data synergies
- Robust **data products** in the data mesh architecture enhance reusability and guarantee high-quality outcomes for end users

P-Data Engine – a cross-plant reporting and analytics platform”



★ n Analytics products

★ 1 data basis for BI/AI use cases

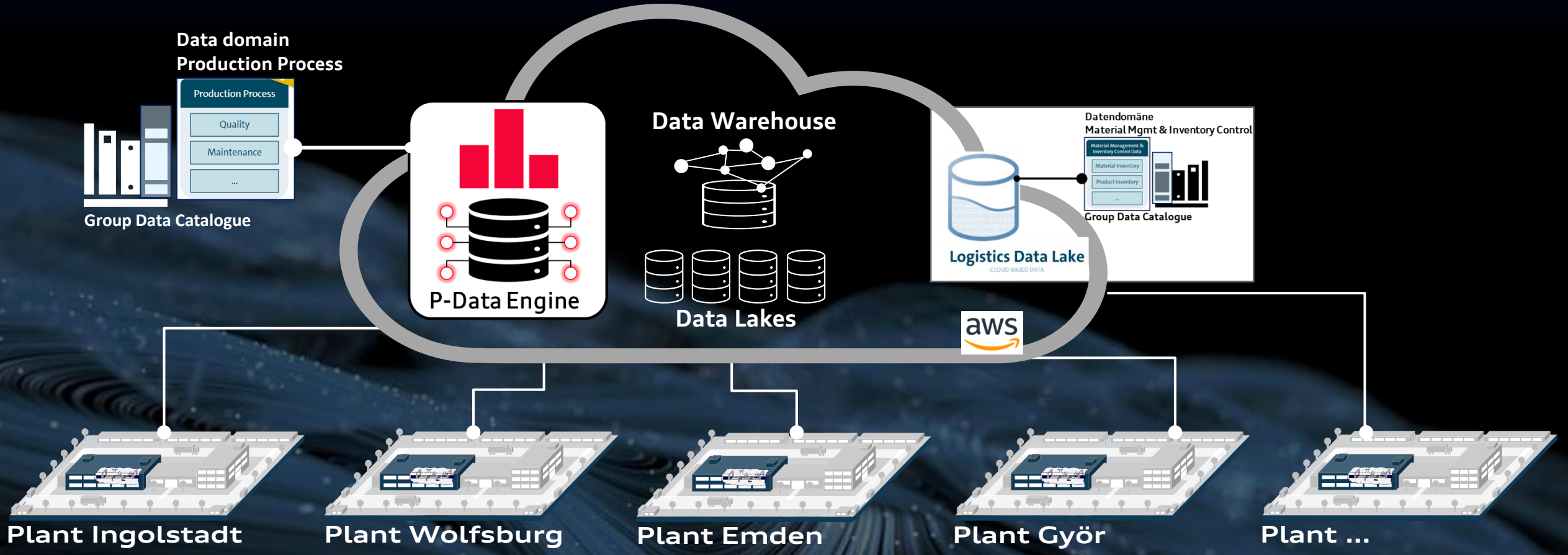
★ 1x data integration

Faster development of analytics products

Lower resource and cost requirements

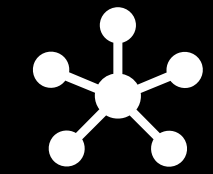
Lack of standards drives high development effort

The P-Data Engine – A unified platform enabling reporting and analytics across plants and brands in manufacturing

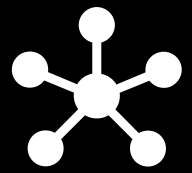


Centralized delivery of high-quality, integrated data to accelerate the deployment of analytics solutions.

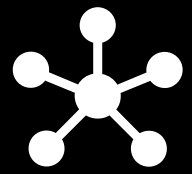
The P-DE core data model as an enabler for individual data products



Quality Model

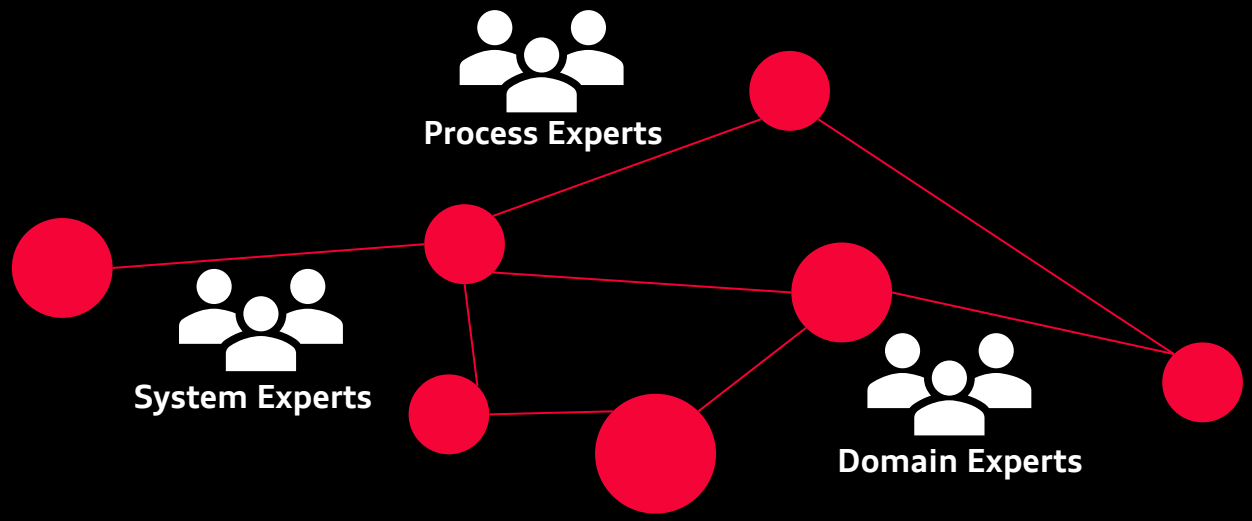


Tracking Model



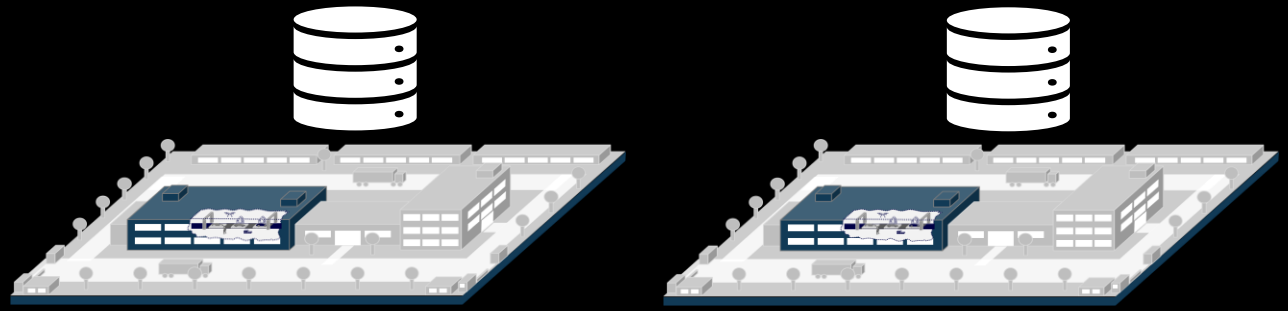
Process Model

Sub-models tailored to the requirements of analytics products.



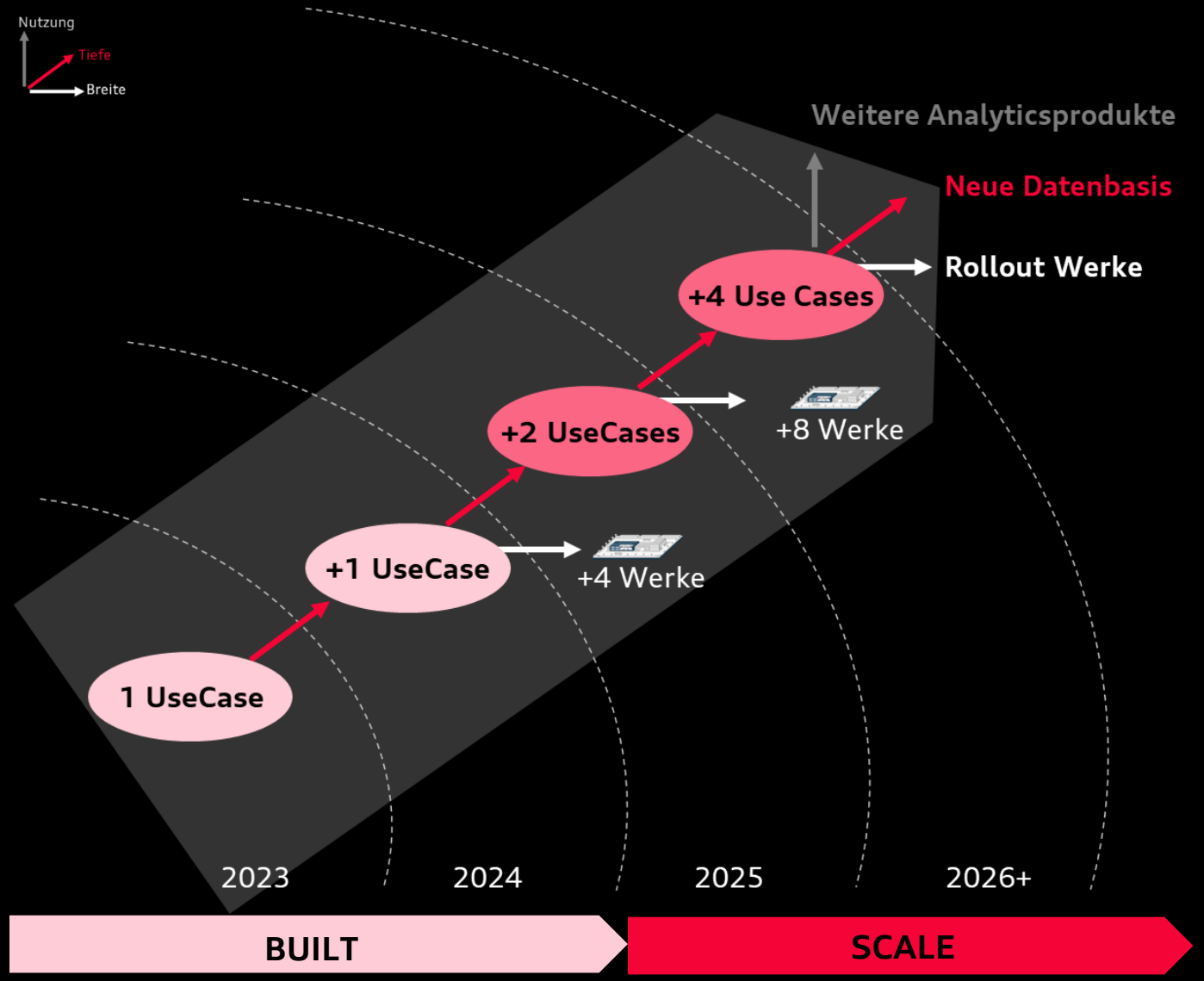
Translation of hard-to-interpret raw data into a semantic core data model, supported by input from various expert groups.

Scalable and reusable for decentralized data warehouses as a foundation for data products.



Standardized provision of raw data from consolidated and quality-assured data lakes.

How to scale?



VORGEHEN

- **Kundenfokus**: Erweiterung der Datenbasis nur mit klarem fachlichem Nutzen
- **Standard First**: Priorisierung von Use Cases mit verbreiteten Standards in der Datenbereitstellung
- **Enabling Anwender**: Auf derselben Datenbasis Entwicklung unterschiedlicher Analytics-Produkte

Engaging employees to strengthen trust and acceptance

Audi’s AI Principles – Fundamental Declaration

AUDI AG affirms its commitment to the responsible use of artificial intelligence (AI) as a key technology of our time through a fundamental declaration based on three guiding principles.

The company supports its employees in dealing with AI and aligns its actions with the 'Ethics Guidelines for Trustworthy AI' issued by the European Union.

Three Guiding Principles

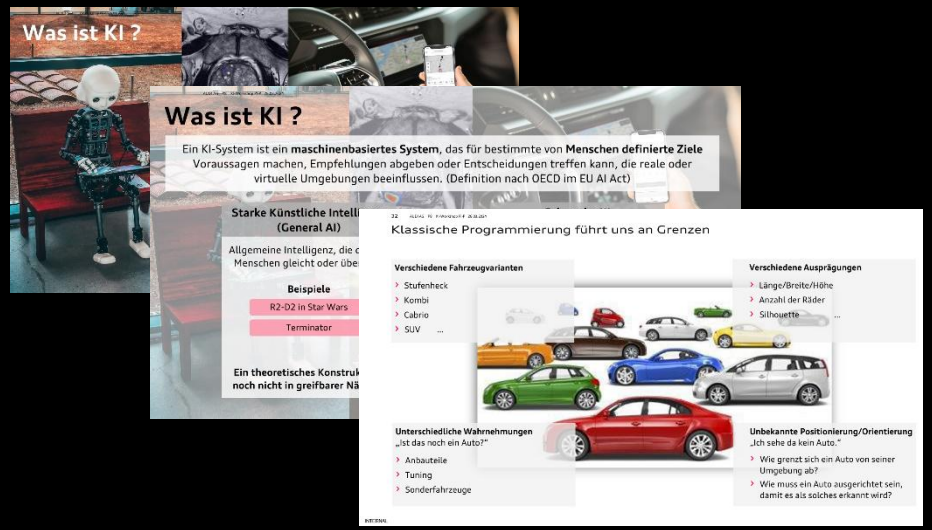
- **Respect**
- **Safety**
- **Transperency**

Foto von krakenimages auf Unsplash

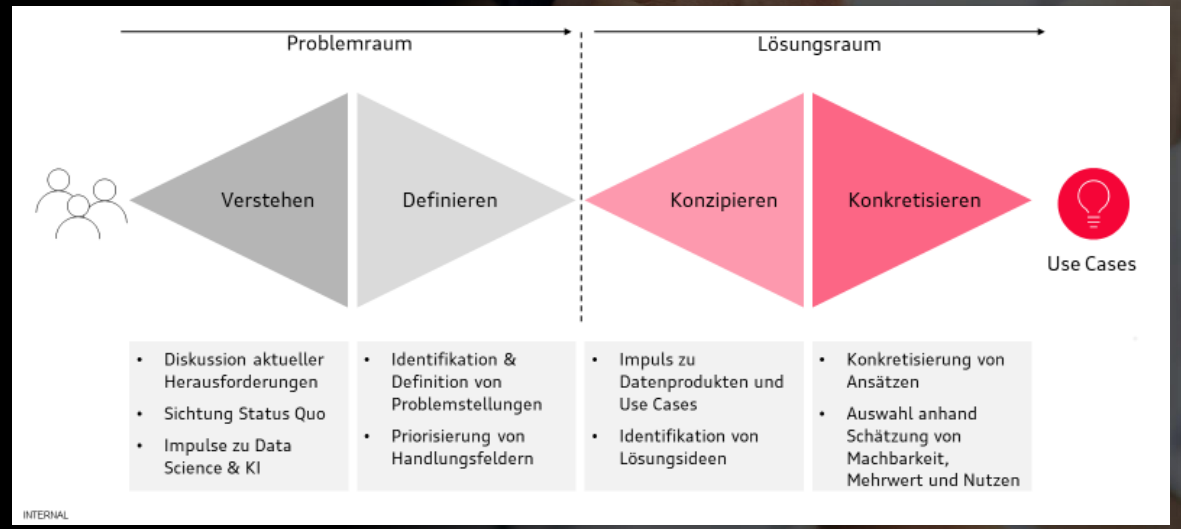
AI workshops with the specialist departments for the joint identification of use cases

One-day workshop together with the specialist departments in heterogeneous teams to build a shared understanding of data and AI solutions ('demystifying AI'), as well as to identify areas for action and use cases.

Enlightenment



Ideation



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Agile organization for the strategic planning and implementation of AI

The AI and Data Program bridges strategic planning for the widespread adoption of AI with its sustainable implementation

AI-& Data-Program

Strategy

Deriving strategic target visions for the use of AI, along with identifying the necessary enablers.

Portfolio

Establishing, consolidating, and managing the cross-domain AI portfolio for GB P

Delivery

Development, industrialization, and rollout of AI use cases across all domains of GB P

Data

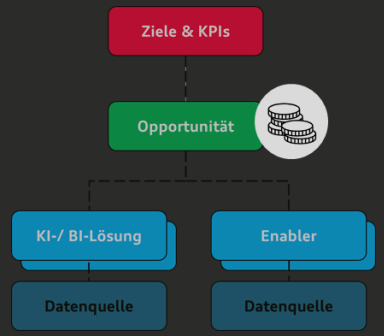
With its pillars of Strategy, Portfolio, and Delivery, the AI Program connects the strategic planning of AI's widespread adoption with the sustainable implementation of AI solutions and essential enablers — all to strengthen the competitiveness of Audi Production through AI

Development of a strategy for the large-scale deployment of AI in production and logistics

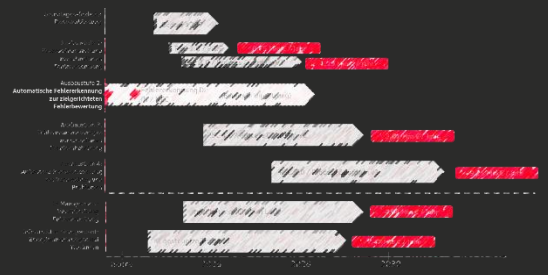
Using the Value Tree methodology, we collaborate with customers and business stakeholders to develop AI target visions, including a value-driven strategic roadmap for the sustainable implementation of AI foundations and solutions in production — all aimed at achieving the vision of the 360° factory

Methodical Approach

Continuous Value-Tree



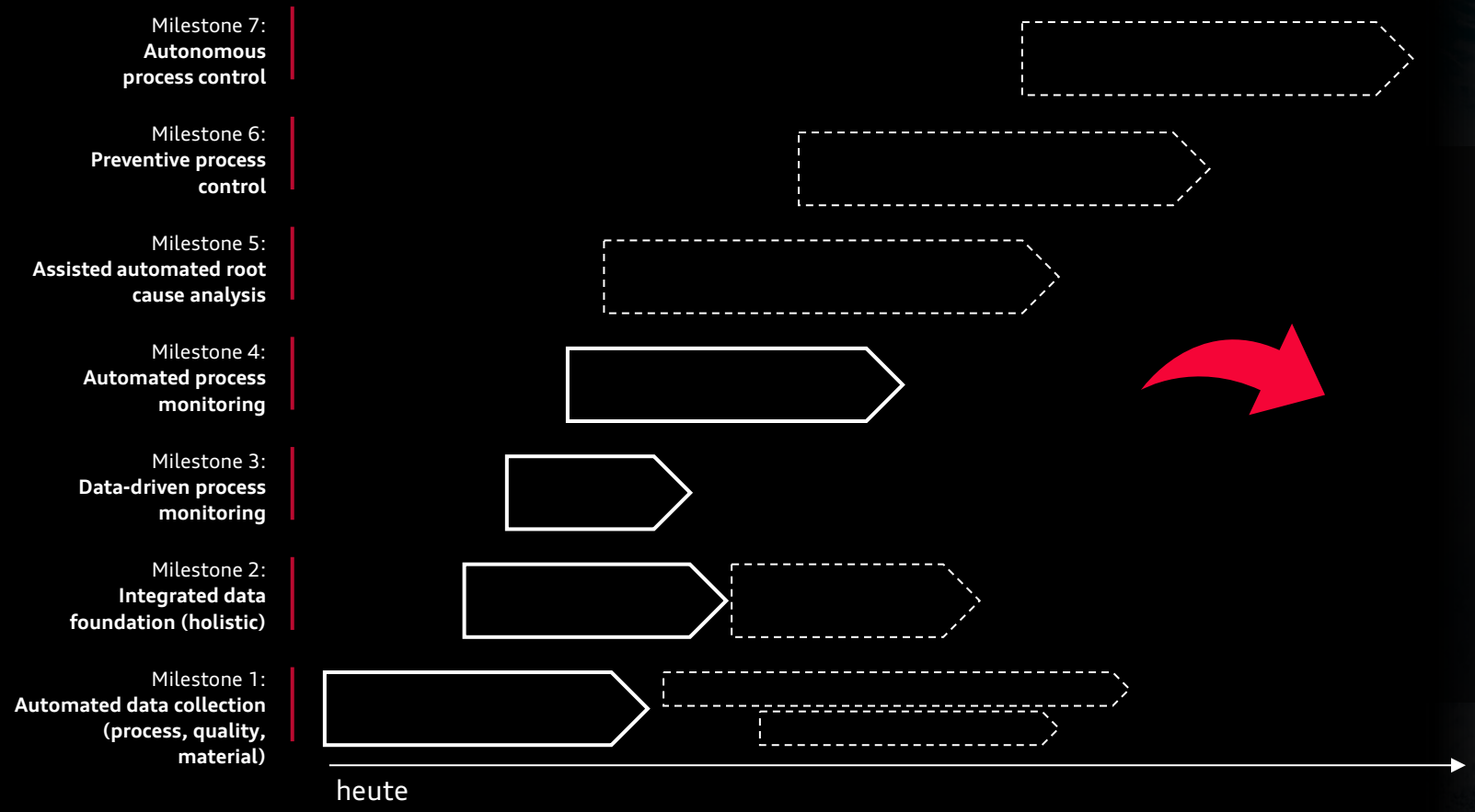
Strategic implementation planning for sustainable delivery



Functional target visions for the 360° factory

Development of a strategy for the large-scale deployment of AI in the paint shop within production

Strategic Roadmap for data-driven self regulating paintshop



1. Data-driven process monitoring with AI
2. Computer vision-based AI in quality control
3. Application of generative AI in indirect business areas

The strategic roadmap outlines a clear plan for the sustainable use of data and AI in the paint shop, based on business potential

Wachsendes KI-Netzwerk für Impulse und Expertise von außen

External impulses and new collaboration models are key success factors for Audi's digital transformation

Quelle: ©IPAI/MVRDV

Ecosystem in Heilbronn

The Heilbronn ecosystem offers Audi unique opportunities to address the challenges of digital factory transformation.

As an active member, we aim to actively shape the development of the ecosystem—and in particular the Innovation Park Artificial Intelligence (IPAI)—from the very beginning within the clusters that are most relevant to us.

Fraunhofer IAO
IPAI
Technische Universität München
CAMPUS FOUNDERS
42

Das Ökosystem Heilbronn ist auf rasantem Wachstumskurs

Startseite > Die ETH Zürich > ... Globale Präsenz > Globale Initiativen > ETH Zürich Campus Heilbronn

ETH Zürich Campus Heilbronn

Die ETH Zürich baut auf dem Bildungscampus der Dieter Schwarz Stiftung in Heilbronn ein Lehr- und Forschungszentrum für verantwortungsvolle digitale Transformation auf. Mit Zuwendungen der Stiftung sollen dort schrittweise 15 ETH-Professuren etabliert werden.

Kontakt | Bildungscampus Heilbronn

IPAI

ETH zürich

TECH

MAX-PLANCK-GESELLSCHAFT

KI FESTIVAL

42 HEILBRONN

mec

BILDUNGS CAMPUS DIETER SCHWARZ STIFTUNG

DHBW

CAMPUS HEILBRONN | TUM

XL2 by Audi & Capgemini

ALEPH ALPHA

Fraunhofer HNFIZ

Fraunhofer IAO

Ferdinand-Steinbeis-Institut

HEILBRONN SLUSH'D

CAMPUS FOUNDERS

HHN HOCHSCHULE HEILBRONN

DHBW CAS

2011-2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026+

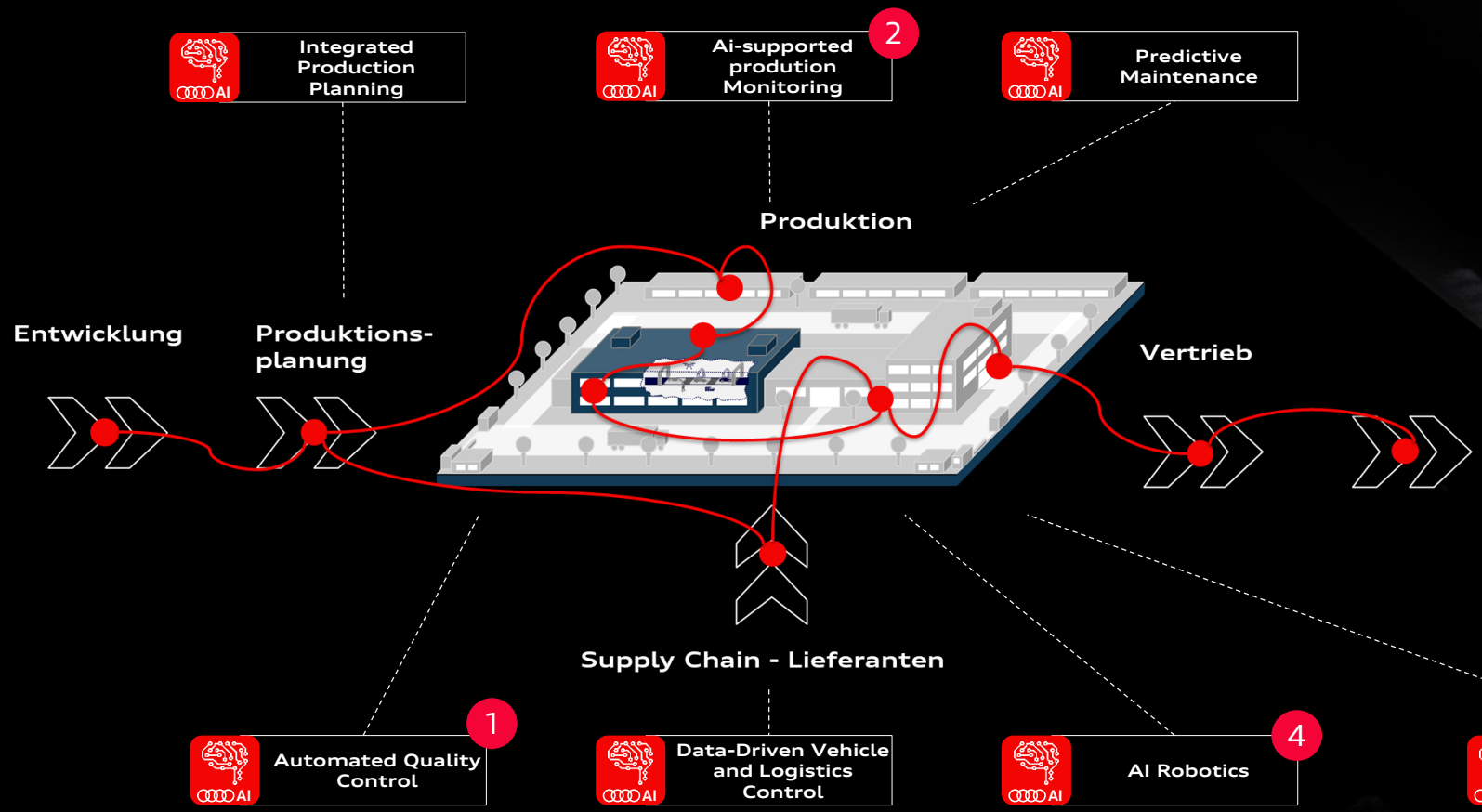
Audi @ Digital Ecosystem HN

- **Scientific partners from elite universities**
  Scientific support for key questions related to digital transformation
- **Ecole 42 – leading software coding school**
  Access to top IT graduates
- **Campus Founders – startups**
  Access to a rapidly growing startup ecosystem and co-creation of innovative AI solutions
- **IPAI – the AI powerhouse**
  Platform for joint AI solutionsCross-company collaboration
- **XL2 – joint venture of Audi and Capgemini**
  Digital transformation of production planning, maintenance, quality assurance, and more
- **Real-world lab Böllinger Höfe**
  Provides real industrial use cases

AI+ serves as Audi's umbrella brand, connecting strategic partners, innovation ecosystems, and real-world laboratories to accelerate digital transformation.

Examples for AI Use Case in production

AI Potentials Along the Audi Production Value Chain

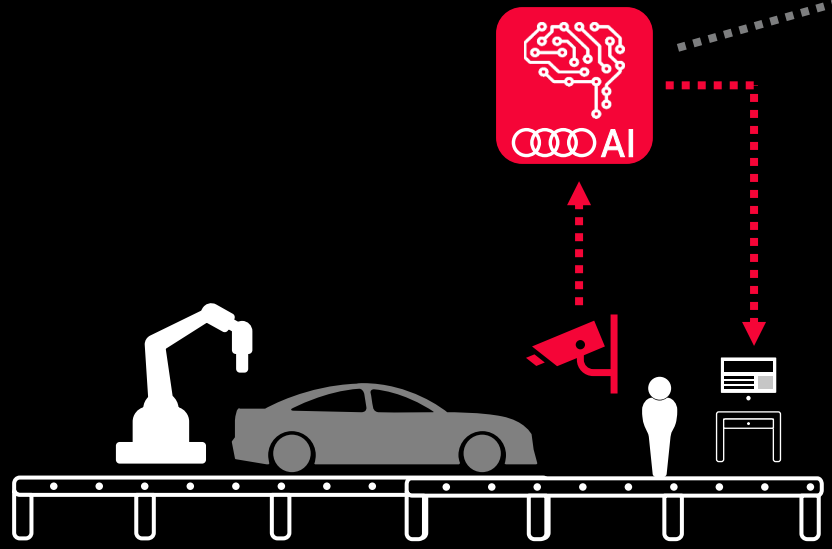


Automated Quality Control

Automated inspection of production quality using AI, based on process data or computer vision technologies, reduces inspection effort and leads to quality improvements

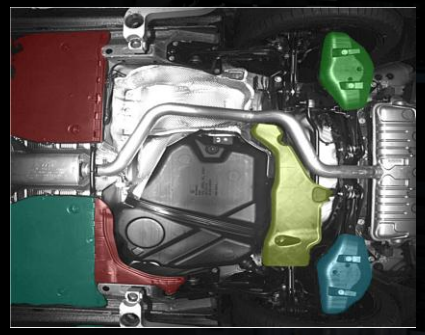
IRIS

AI algorithms automatically inspect components and surfaces for presence and damage



Label inspection

- position
- content
- errors



Assembly verification

- Correctness
- Position
- Quantity

Surface inspection

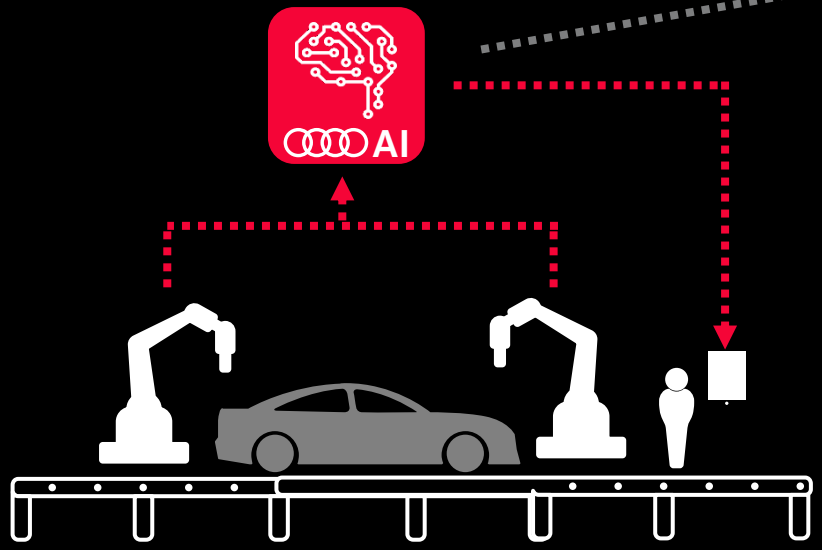
- Scratches
- Dents
- Paint defects

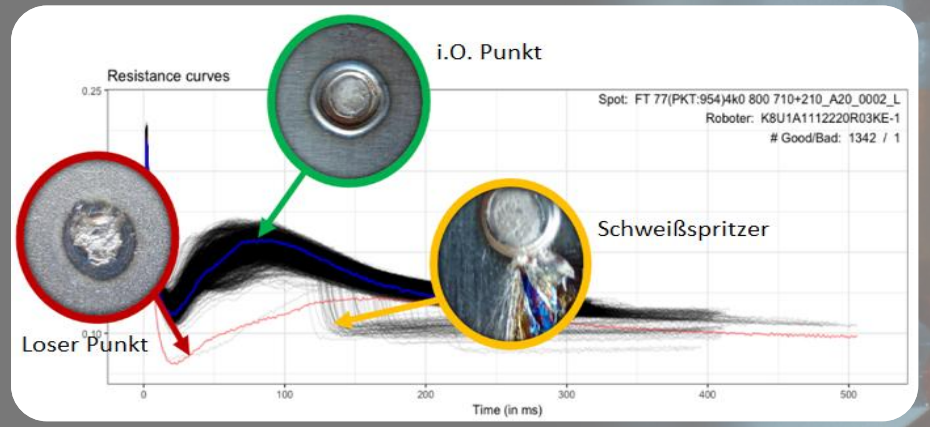
Data Driven Process Monitoring

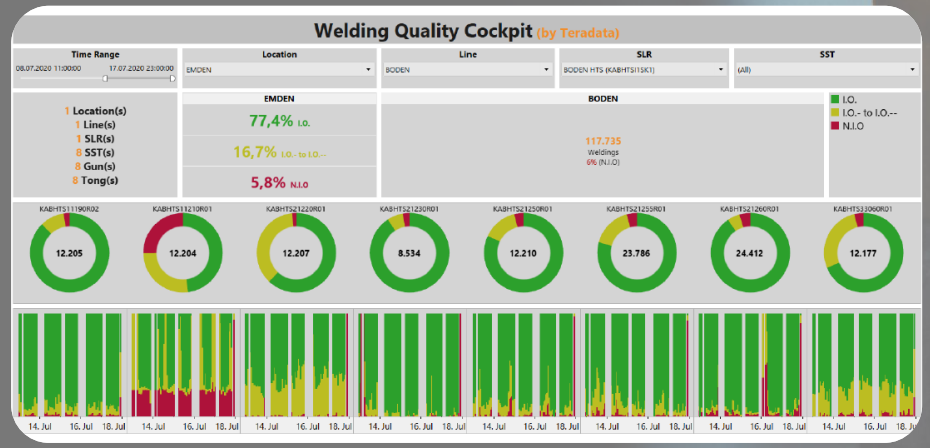
Unstable manufacturing processes can cause serious problems and high costs in production.

WPS Predictive Quality

Using AI, all welding points are inspected based on process and equipment data







Data Driven Process Monitoring

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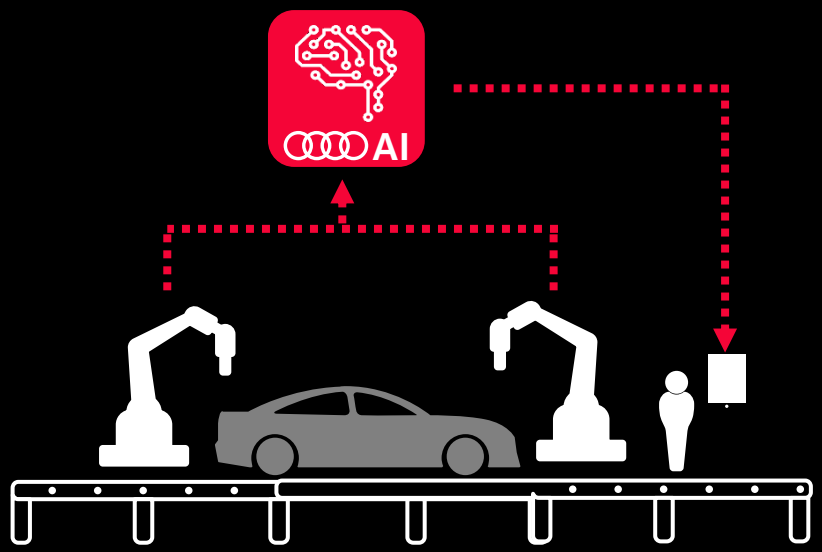


How can we scale AI-based manufacturing process monitoring to additional processes?

- Bodyshop
- Paintshop
- Assembly
- ...

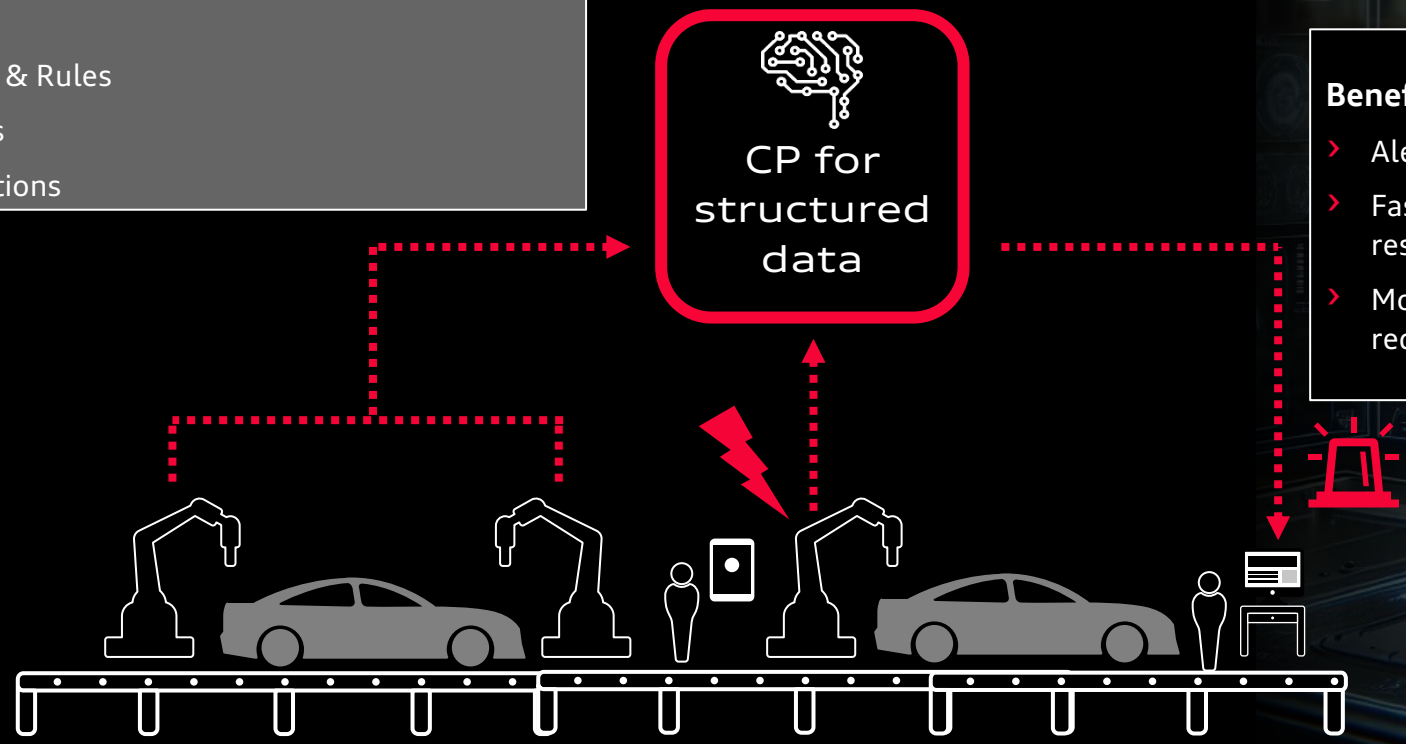
Project Lead: Andreas Rieker (P8-42)

Potential of Data-Driven Process Monitoring

Unstable manufacturing processes can cause serious problems and high costs in production. Real-time monitoring of the production process using AI solutions based on machine and sensor data enables the detection of unexpected issues and allows for early intervention.

Scalable Product for Data-Driven Process Monitoring

- Statistics & Rules
- AI Models
- Visualizations



Benefits

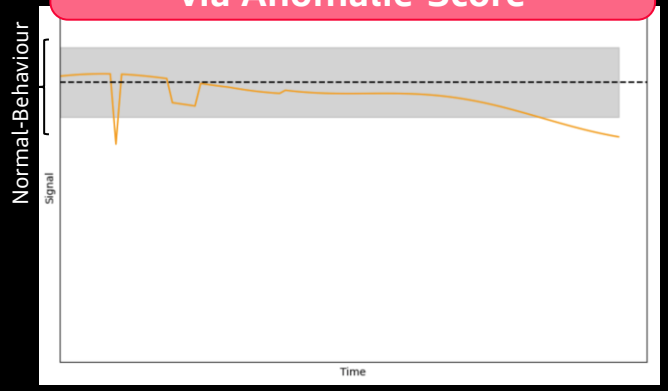
- Alerting & early detection of emerging issues.
- Faster root cause analysis and problem resolution.
- More stable processes, meaning less scrap, reduced wear, and fewer downtimes.

Data-driven manufacturing monitoring enables the systematic digital mapping and expansion of existing production knowledge, allowing for early prevention of errors

Use Cases for AI-based process monitoring

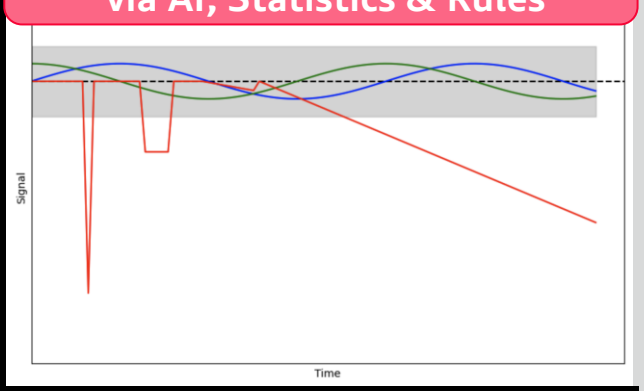
CP for structured data

Monitoring via Anomalie-Score



Machines are continuously compared to their normal behavior using an anomaly score

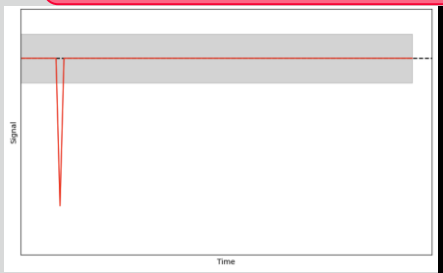
Anomalydetection via AI, Statistics & Rules



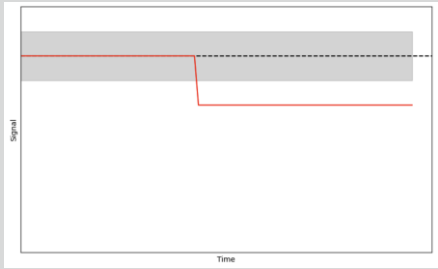
The anomaly score is composed of all monitored signals

Anomalies are automatically detected, root causes can be identified and resolved, thereby increasing production efficiency

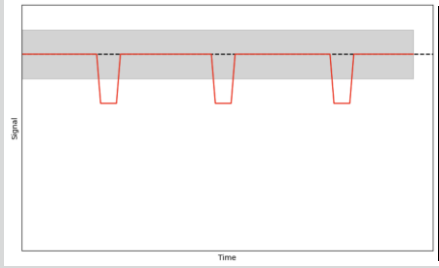
Types & possible reasons



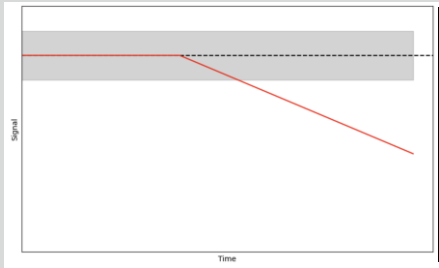
Spontaneous Events
Examples: Tool breakage, equipment failure



One-time Systematic Events
Examples: Parameter changes, program adjustments

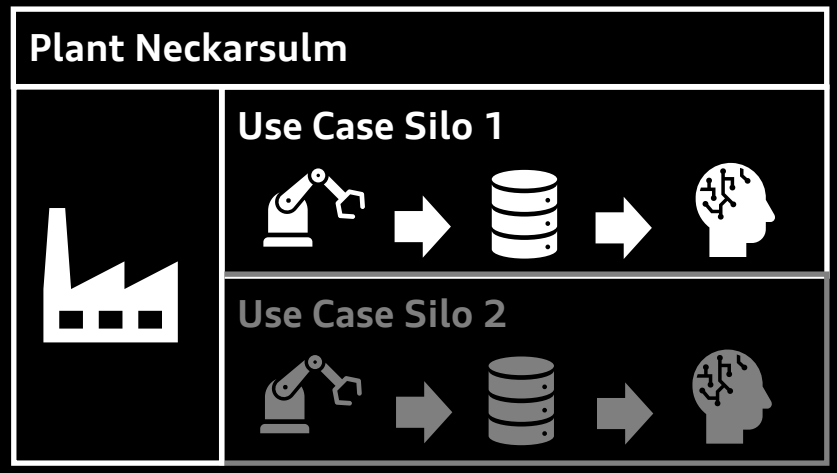


Recurring Systematic Events
Examples: Cyclical maintenance,



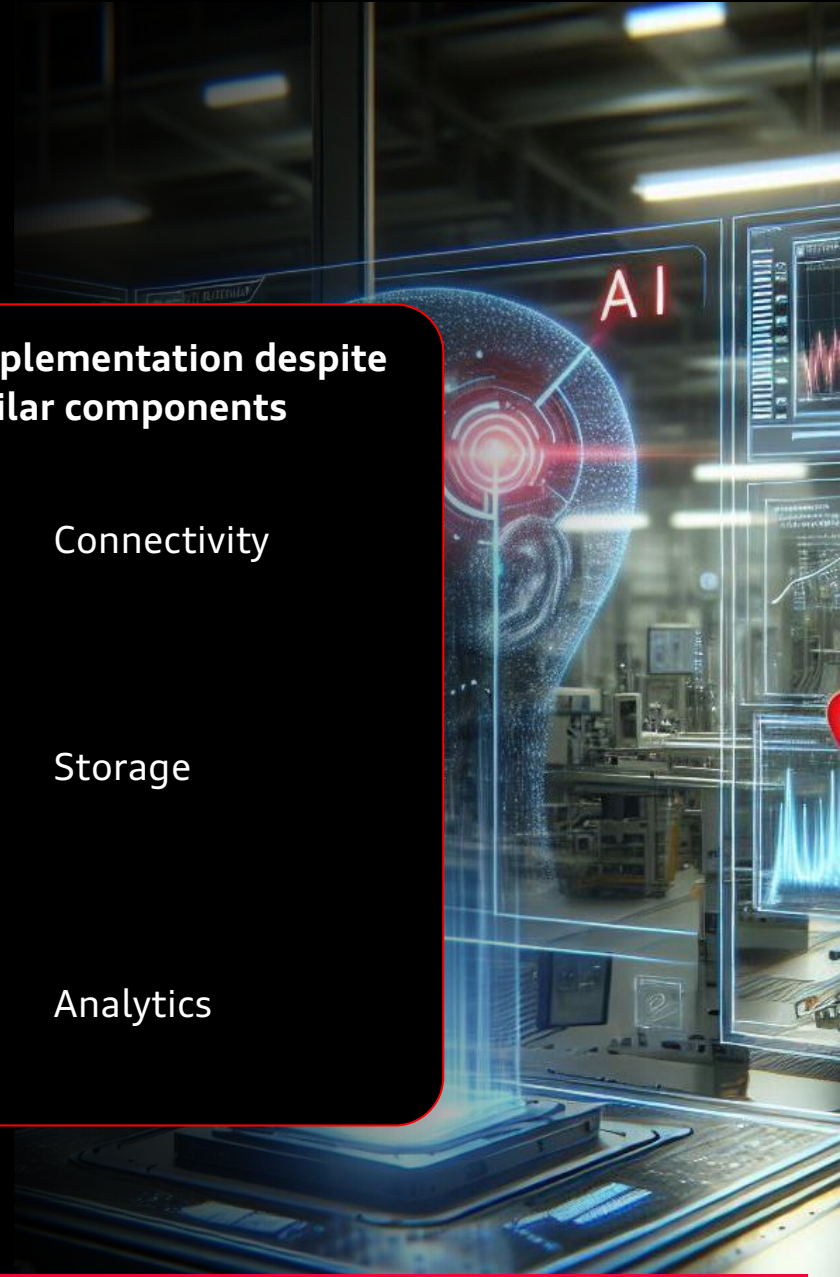
Systematic Trends
Examples: Growing issues in automation

Process monitoring is implemented in silos



Siloed implementation despite similar components

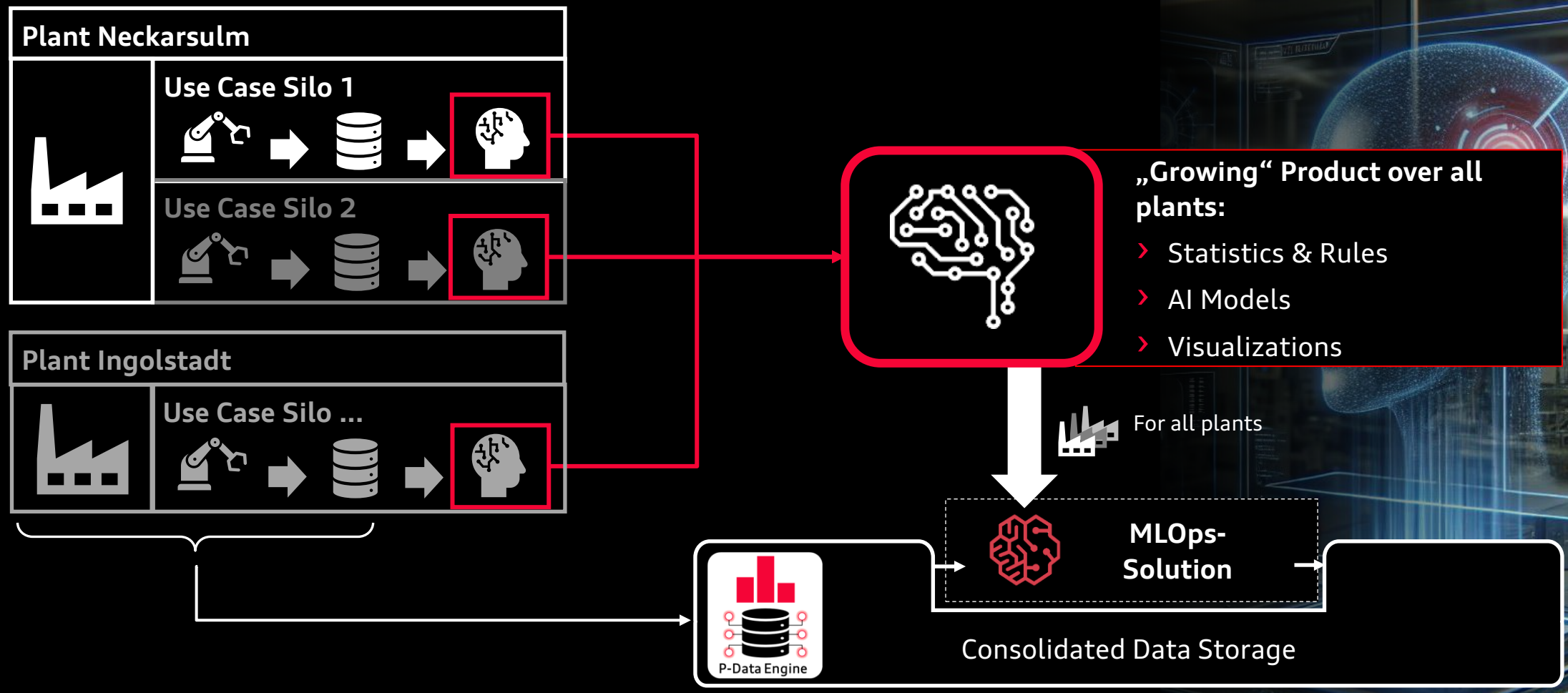
- Connectivity
- Storage
- Analytics



High Cost per Usecase

Time-consuming implementation because each component must be addressed individually

Process monitoring as a central product instead of isolated silos



Faster Implementation because of product & platform approach

Reduced Costs, because of reusable components

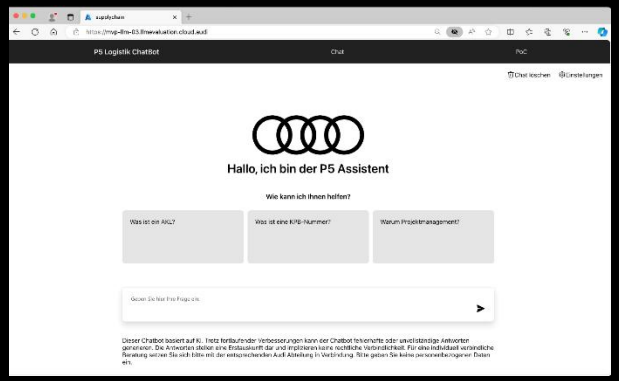
Generative AI in production

In Audi production, a significant share of work involves knowledge-based activities.Generative AI offers the opportunity to democratize this knowledge and support our employees with intelligent assistants.

Knowledge Assistants

Assistants for searching and summarizing relevant information based on internal sources

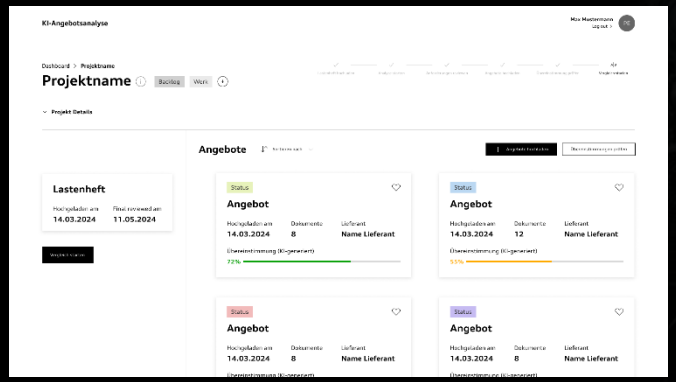
Example: Supply Chain Chatbot



Co-Pilot for Planners

Creation, comparison, and benchmarking of planning-relevant documents, e.g. specifications, documentation, or operating manuals.

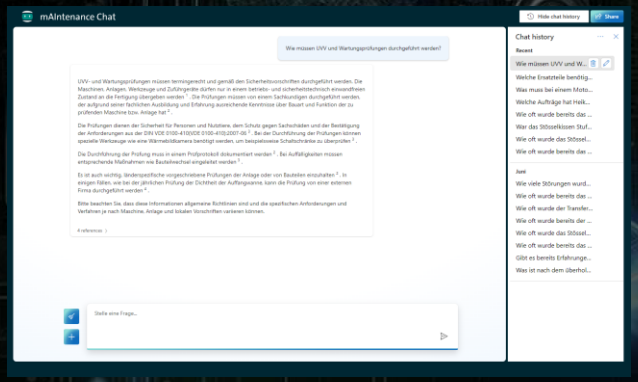
Example: TenderToucan



Assistants for Maintenance

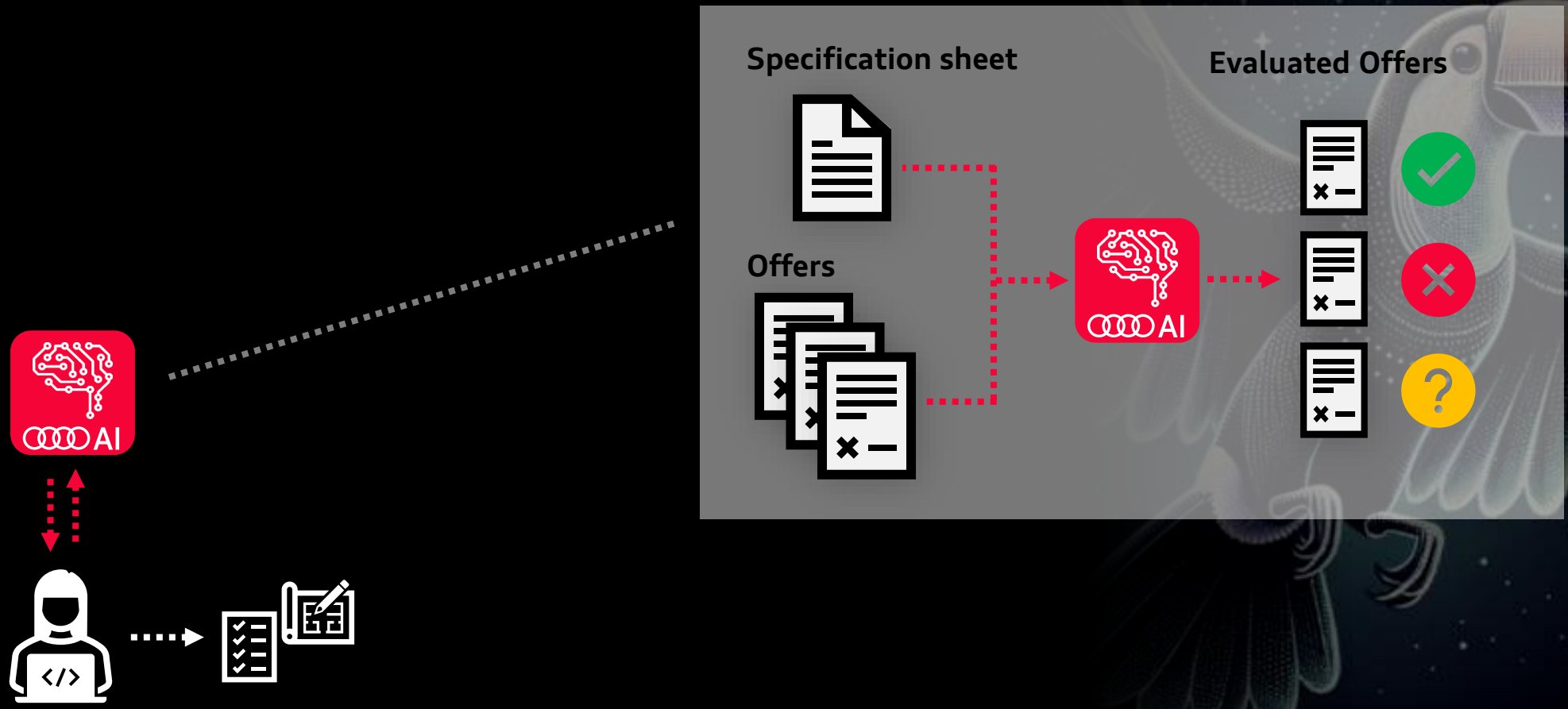
AI is trained on existing maintenance knowledge and supports maintenance staff in fault analysis, diagnostics, and solution finding.

Example: mAIntenance Copilot



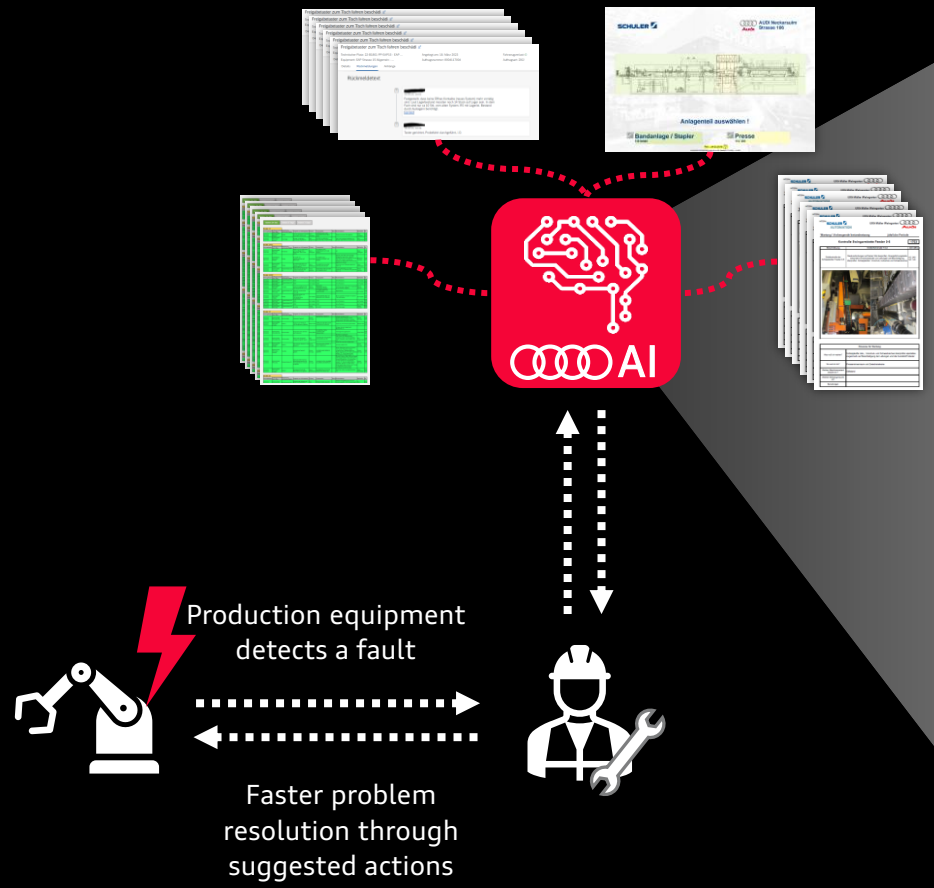
TenderToucan - AI-driven support in the tender / procurement process

TenderToucan transforms complex, manual bid evaluations into a fast, scalable, AI-supported decision process by automatically analyzing, comparing, and benchmarking supplier offers against extensive technical specifications—reducing expert effort, accelerating procurement cycles, and improving decision quality.



mAintenance Chat – Intelligent Assistentants for maintenance

With a ChatGPT-like solution, further developed using relevant maintenance knowledge—such as shift logs, maintenance plans, or equipment documentation—faults can be resolved quickly and cost-effectively, regardless of the experience level of the personnel.



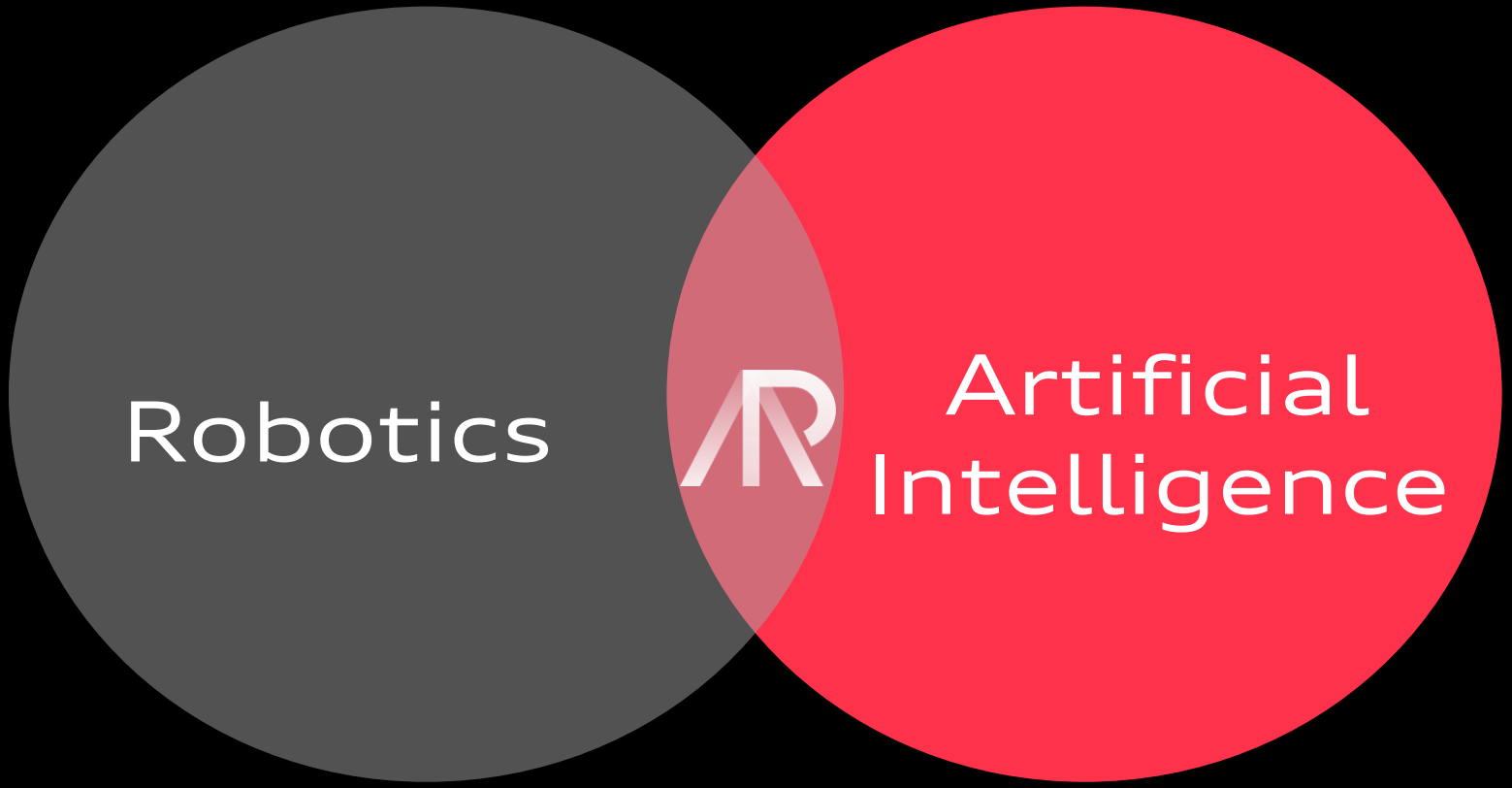
System control 2202001: Error “Connection interrupted”. How should I proceed to resolve the issue?

“In most cases, a short-term failure of a hardware component leads to a connection interruption.

The following steps can help resolve the fault:

1. Check that both control units are powered on
2. Manually re-establish the connection
3. …”

AI ROBOTICS



Systems that **sense**, **decide**, and **act autonomously**

in physical environments

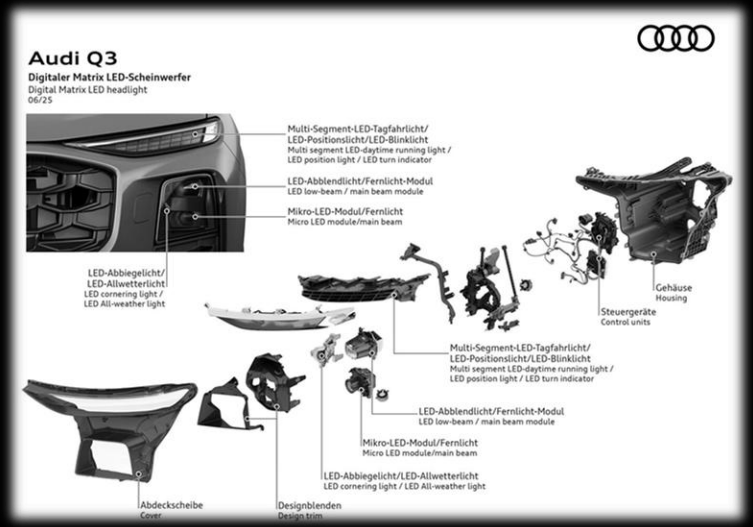
CHALLENGES

Main Challenges for standard process automation at Audi

Complex environments and components

Highly dynamic processes

High component variability



Standard **automation** technologies **reach their limits** in these settings!

ANATOMY

Sensors

Source: Zivid

Source: Nordbo Robotics

Control Unit

Source: tl-electronic

Robot

End-Effectors

Source: Robotiq

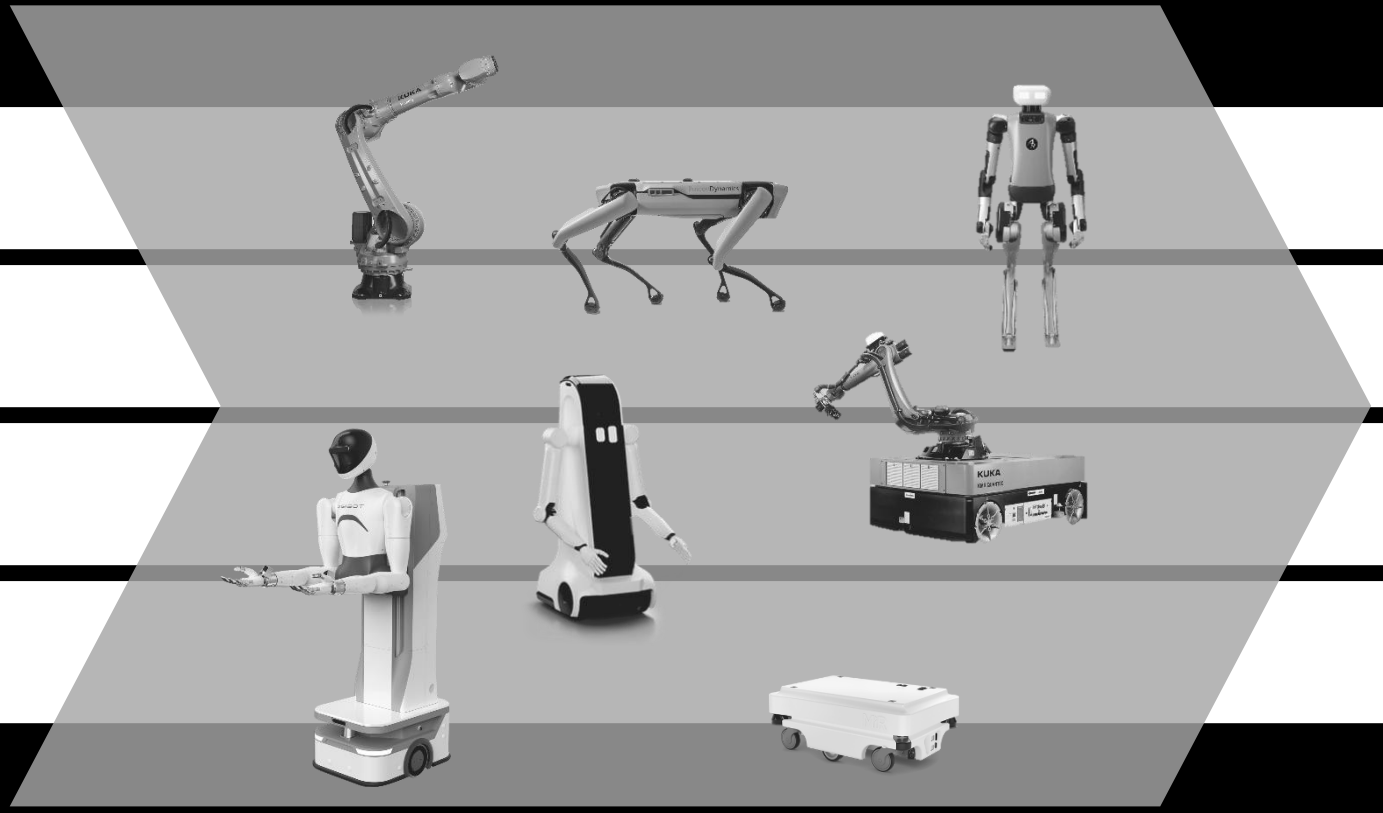
Software

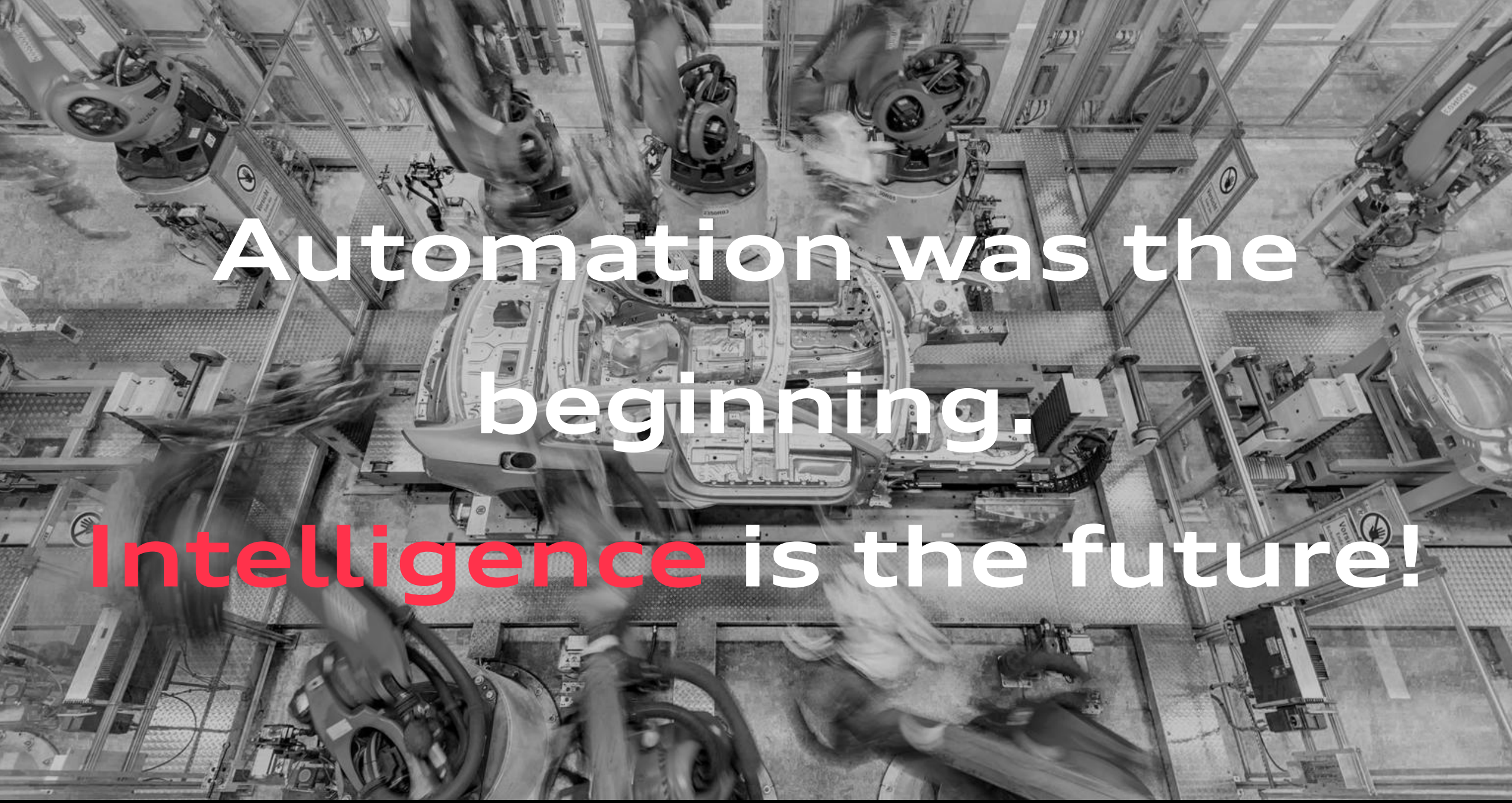
TRANSITION

TRADITIONAL

MODERN

Hard coded logic, limited flexibility	Dynamic decision Making
Pre-programmed rules	Autonomous Programming
Basic sensors	Intelligent Perception
Manual improvements	Self Optimization





ROBOT LEARNING

Quelle: https://de.wikipedia.org/wiki/Datei:Wall_e_und_Eve.jpg

To operate in a chaos, robots need ...

Perception	Reasoning	Action
See and understand their environment.	Think and decide what to do next.	Move their body or tools to act.

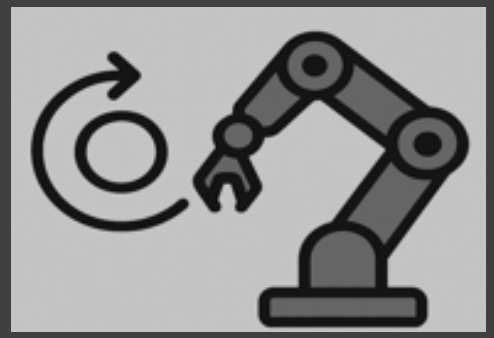
Robot Learning is ...

... a collection of **algorithms** and **methodologies** that help a robot to **learn new skills** such as manipulation, locomotion, and classification in either a simulated or real-world environment.

METHODS

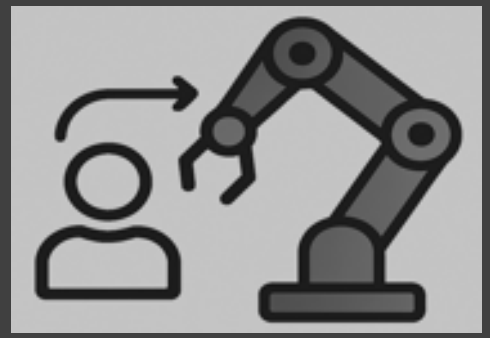
1

Reinforcement Learning



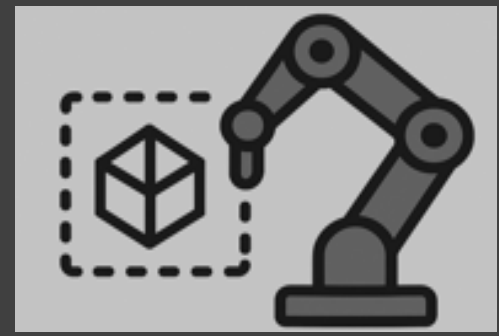
2

Imitation Learning



3

Foundation Models



EXAMPLE @ AUDI

Collaboration with Mimic robotics:
From Rule-Based Automation to Physical AI

- Deployment of AI-controlled humanoid robot hands on standard industrial arms
- Robots learn via imitation learning from human demonstrations, not manual coding
- Real-time adaptation to part variation, tolerances, and material flexibility
- Overcomes long-standing automation bottlenecks in fine assembly operations
- Pragmatic “minimal-humanoid” approach: dexterity where it matters, scalable by design

Spin-off | ETH zürich

mimic

Audi Vorsprung durch Technik

Questions?

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AUDI AG