VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

© *Ansgar van Treeck*

Digital Technologies as Enabler for Resource Efficiency and Circular Economy

Wei Min Wang
Technology Consultant, VDI Technology Centre GmbH

13th German-Japanese Environment and Energy Dialogue Forum
Kawasaki, 26.01.2024

VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

VDI Centre for resource efficiency (VDI ZRE)

- Competence centre for demand-oriented provision of technical resource efficiency knowledge for SMEs
- Focus on resource efficiency in industrial practice through connection to the VDI
- Setting standards by developing VDI guidelines on resource efficiency in cooperation with VDI e. V.

VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Resource efficiency and current limitations

$$\text{Resource Efficiency*} = \frac{\text{Benefit}}{\text{Expenditure}}$$

Benefit
- Product
- Functionality
- Functional unit

Expenditure
Natural resources
- Raw material
- Energy resources
- Water
- Air
- Land area
- Ecosystem services

Limitations in a linear economy
- Focus on phases of value creation
- Selective consideration of later life cycle phases
- Lack of attention for the end-of-life phase
- **No change to the elimination of value**

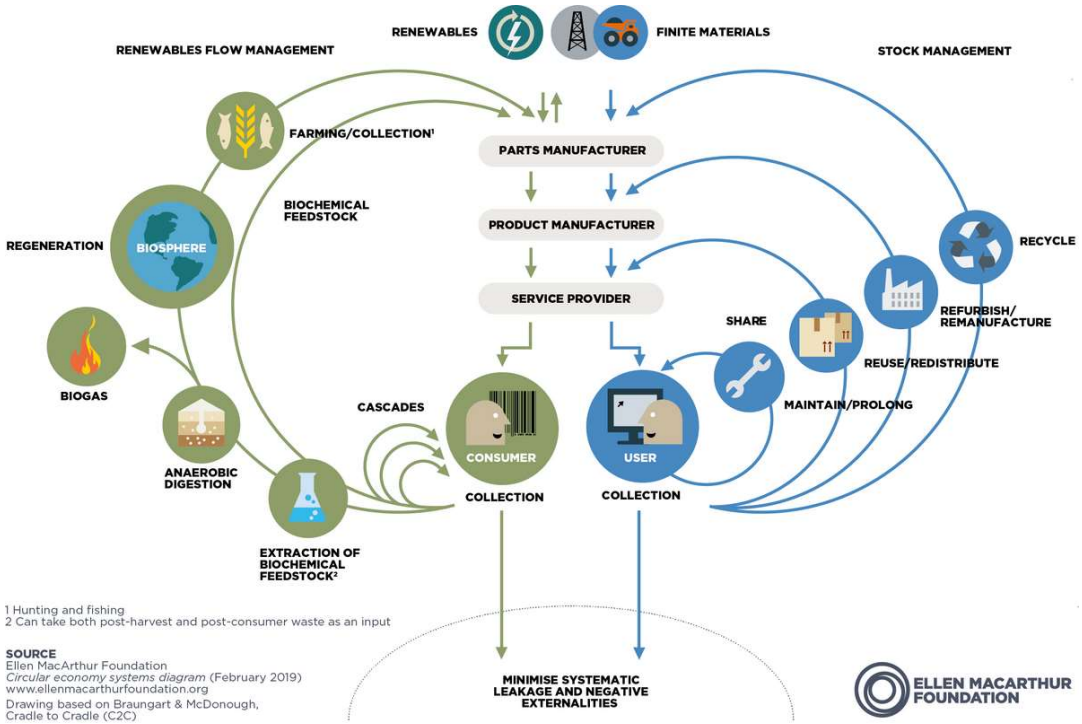
*Source: VDI e.V., VDI 4800 Blatt 1 Ressourceneffizienz – Methodische Grundlagen, Prinzipien und Strategien, 2016

VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Resource efficiency through circular economy

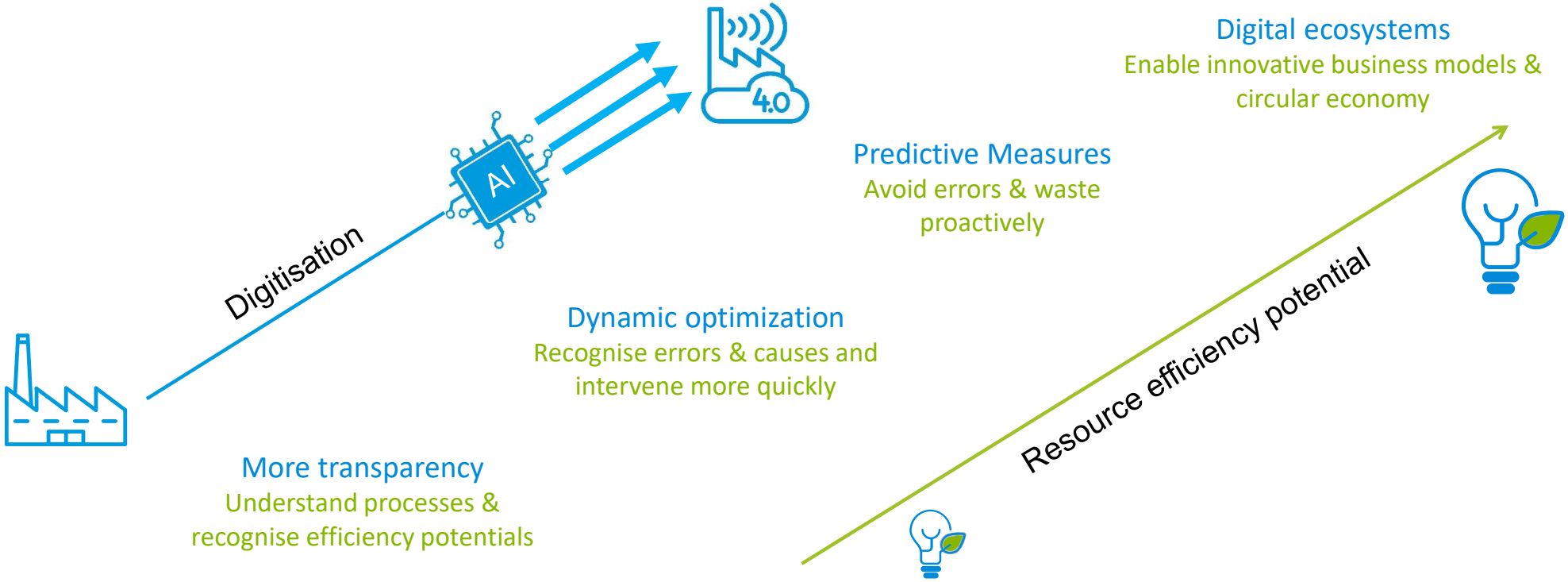
- Increase benefit by conservation of created value (products)
  - Extend useful life of products
  - Intensify usage
- Decrease resource expenditure
  - Use refurbished or remanufactured products and parts
  - Recover raw materials through recycling



VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Potentials of digital technologies for resource efficiency



Source: Institut der deutschen Wirtschaft, IW-Gutachten: Digitalisierung als Enabler für Ressourceneffizienz in Unternehmen 2021

VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Drivers for resource efficiency and circular economy – Business


© PantherMedia / Rawpixel

Growing public demand for a climate-friendly economy


© PantherMedia / TTstudio

Volatile supply chains & resource availability


© Fotolia / Manfred Ament

Increasing costs for raw material & energy

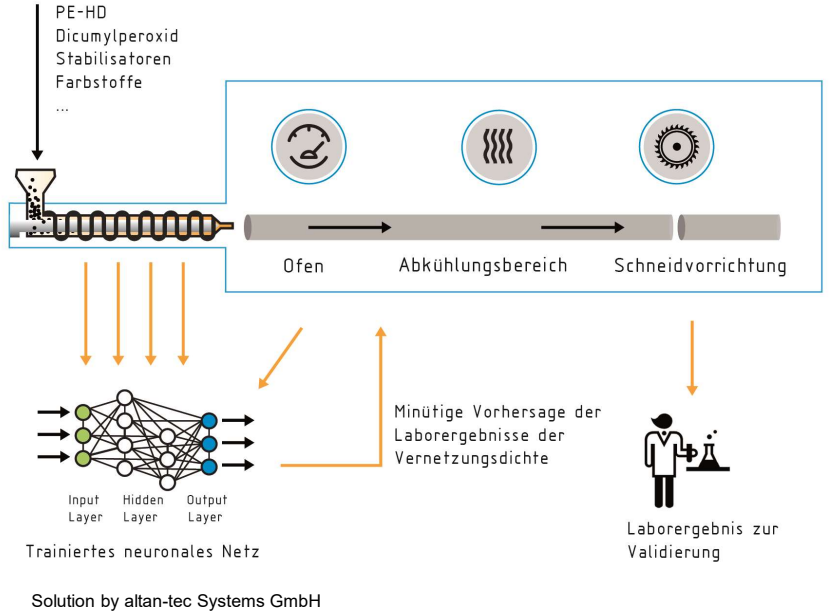
VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Application example – Neural network for predictive quality

Production of HDPE pipe systems

- **Problem:** Determination of the cross-linking density of the material using laboratory tests takes up to 48 hours
  - No delivery to customers until results are available
  - **The entire batch (up to 4.000 m) is scrapped in the case of defects**
  - **10-20 % scrap on average**
- **Solution:** Neural network predicts the cross-linking density every minute with 98.5 % accuracy
  - Real-time adjustments reduce scrap rate
  - Amortisation within six months (60.000 EUR)



Solution by altan-tec Systems GmbH

Source: VDI ZRE, Potentials of weak artificial intelligence for operational resource efficiency, 2021

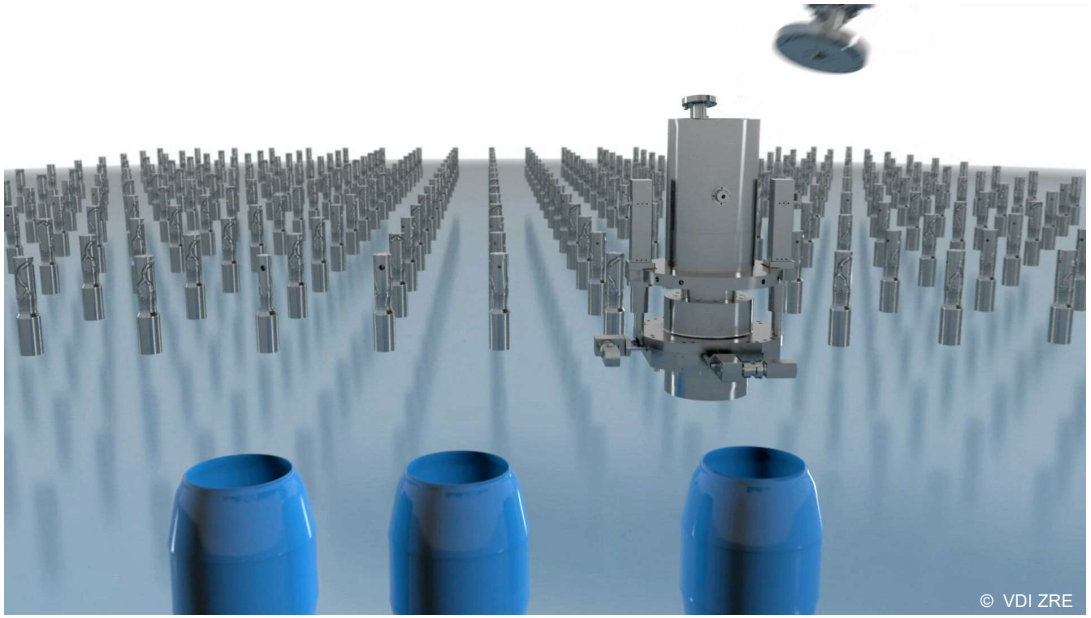
VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Application example – Product optimisation for the use of recyclats

Production of three-layer plastic barrels with extrusion blow moulding system

- **Problem:** Use of recycled material is difficult due to fluctuating quality
  - Limited use of recycled material
- **Solution:** Development of a digital twin of the spiral mandrel distributor to combine virgin and recycled plastics
  - Optimisation through the use of AI-supported evolutionary algorithms and simulations
  - Use of up to 85% recycled plastics



Solution by IANUS Simulations GmbH and BBM Maschinenbau und Vertriebs GmbH

Source: VDI ZRE, Recycling plastics 4.0: Artificial intelligence and digital twin save resources, 2021, online: https://youtu.be/gOsVjdZZCOg?si=XOif8Kgr_u-TJ_sW

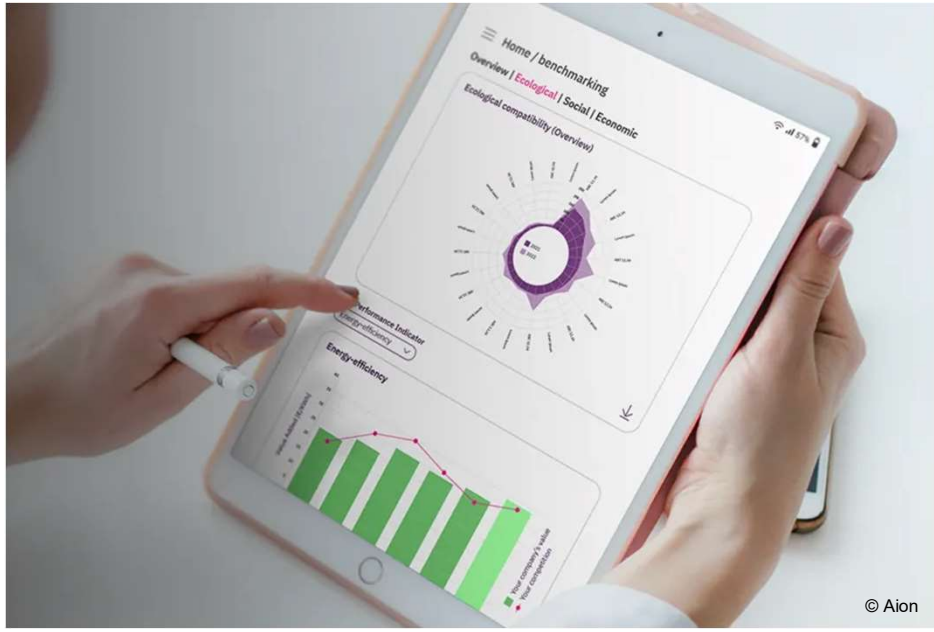
VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Application example – AI support for sustainability management

Data-based performance controlling, reporting and AI-based action recommendation

- **Problem:** Continuous management of corporate sustainability performance
  - Uncertainty regarding KPIs and relevant data
  - Additional compliance reporting
  - Lack of strategic planning for further actions
- **Solution:** Guided data acquisition process with predefined key indicators
  - Comprehensive performance analysis
  - AI-based recommendation of sustainability actions
  - Automated generation of reporting for legal obligation and public communication



Source: www.aion.earth

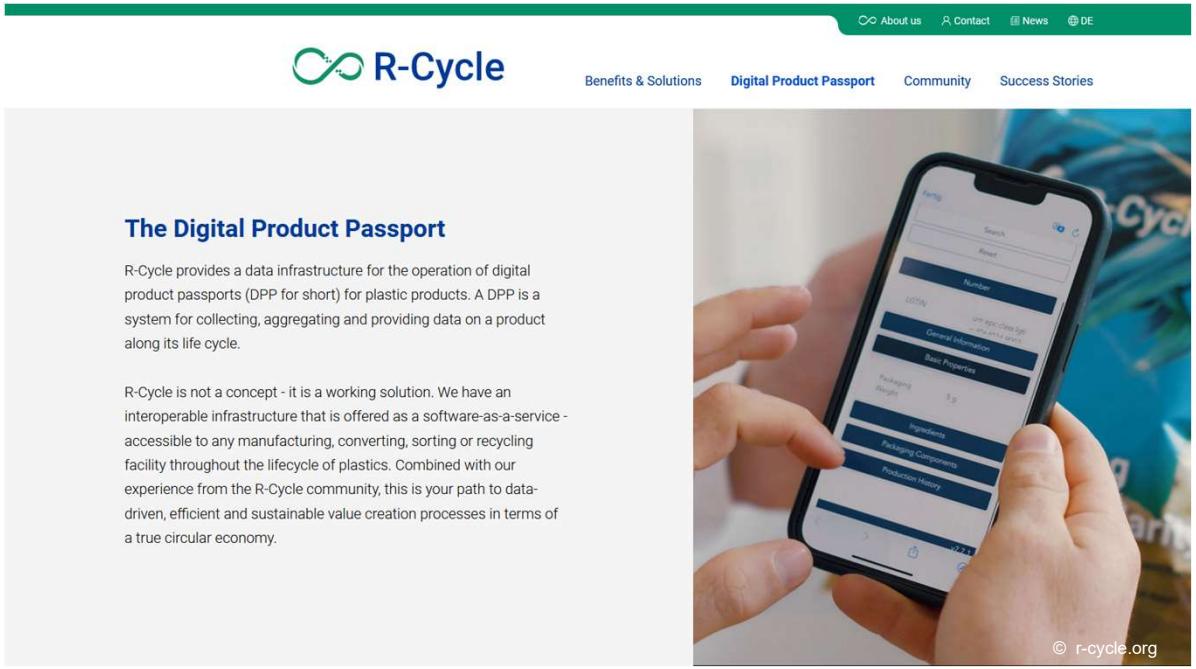
VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Application example - Digital product passport

Improve circularity of plastic products

- Development & provision of infrastructure services for DPP based on the GS1-Standard
- Combination of digital watermarks and data platform service*
  - Enables continuous flow of product data
  - Improves the recognition and sorting of plastics
  - Enables the high-quality use of recycled plastic products, e.g. for the food sector

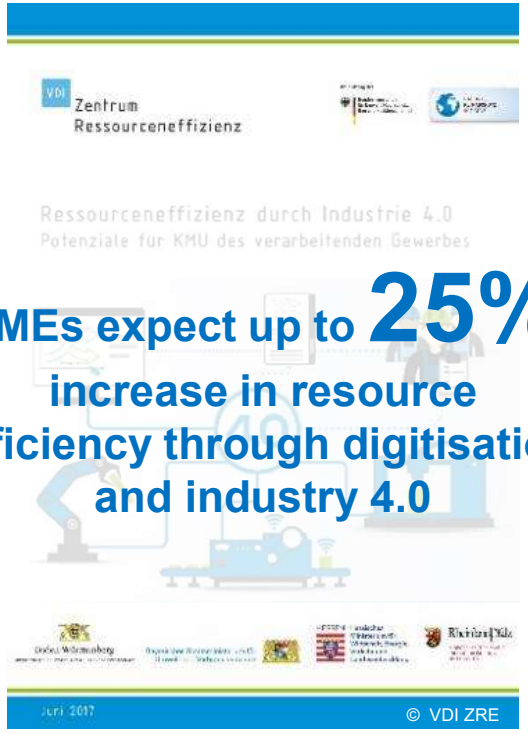


*Source: https://www.r-cycle.org/wie-daten-die-recyclingf%C3%A4higkeit-von-lebensmittelverpackungen-steigern.html

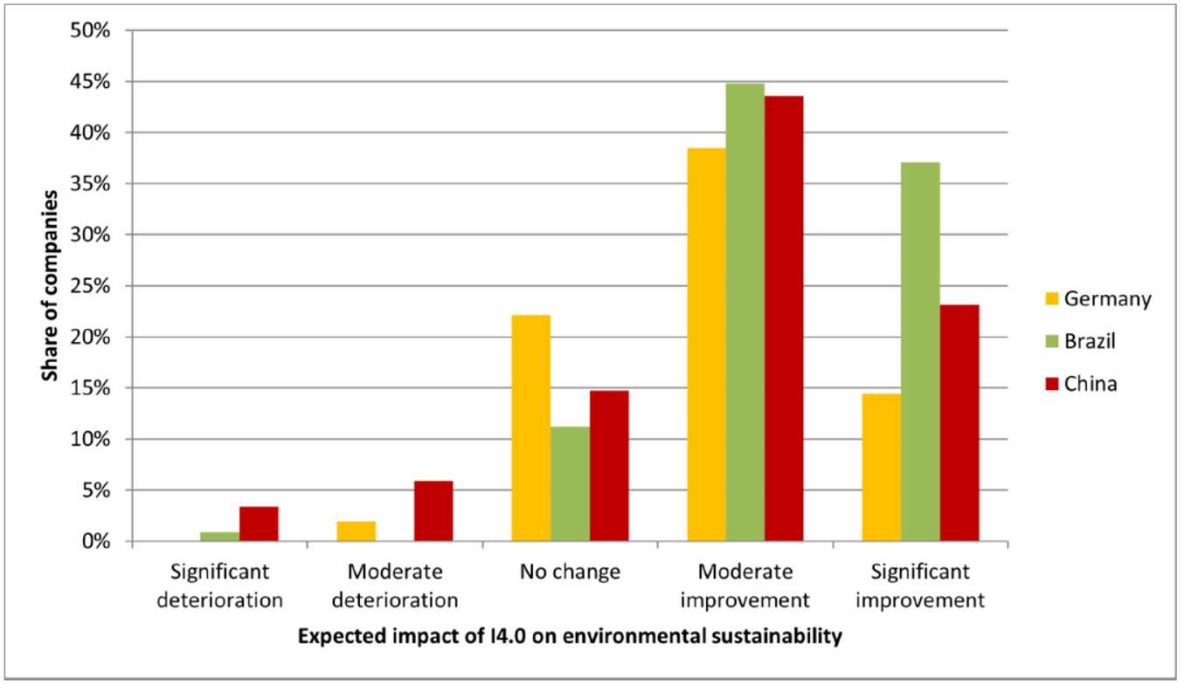
VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Conclusion - Potentials of digital technologies



SMEs expect up to 25% increase in resource efficiency through digitisation and industry 4.0



Source: Project ProMUT, Research Institute for Sustainability Potsdam, 2023

VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

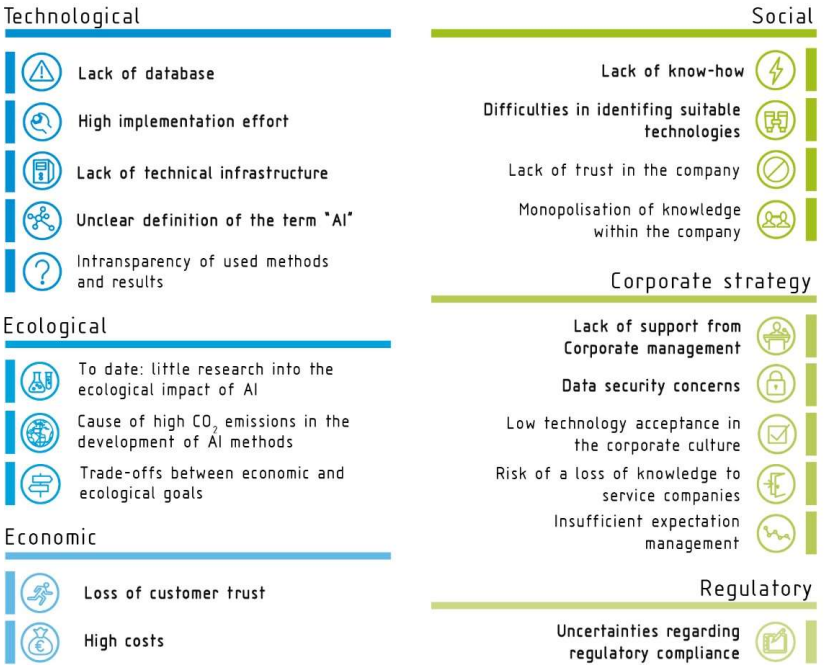
Conclusion - Barriers for SMEs to introduce digital technologies

KNOW-HOW

TIME

FUNDING

REGULATIONS



Source: VDI ZRE, Potentials of weak artificial intelligence for operational resource efficiency, 2021

VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Conclusion – Examples of funding activities of the German BMUV

DigiRess

- Focus on SMEs and implementation of practical solutions
- Funding priorities:
  - Digital optimization of production processes
  - Digital optimization of product design
  - Digital business models for resource efficient and circular value creation
- Planned from 2022 – 2024 (but funding exhausted after three calls)

Green-AI Hub Mittelstand

Eine KI-Initiative des Bundesumweltministeriums

- Identifies the potential of AI for efficient processes
- Develops prototype solutions together with SMEs
- Offers mobile consulting and demonstration services
- Helps to save resources & costs for energy, raw materials, waste & repairs with AI
- Enables networking and direct exchange with AI developers

VDI Zentrum Ressourceneffizienz

On behalf of:
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
of the Federal Republic of Germany

Thank you for your attention!

Contact

Wei Min Wang

Email: wang@vdi.de

Phone:+49 30 27 59 506-659

VDI Technologiezentrum GmbH

Bülowstraße 78

10783 Berlin

For more information see:
www.ressource-deutschland.de