CIRCULAR ECONOMY 4.0

Enabling the circular economy using smart data

Mario Drobics
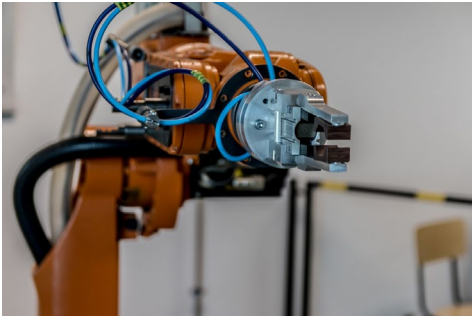
Head of Competence Unit Cooperative Digital Technologies

AIT Center for Digital Safety & Security

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

A SHORT HISTORY OF DIGITALIZATION

Phase 1: Digitalization of machines and isolated process steps

➔ efficiency of singular working steps

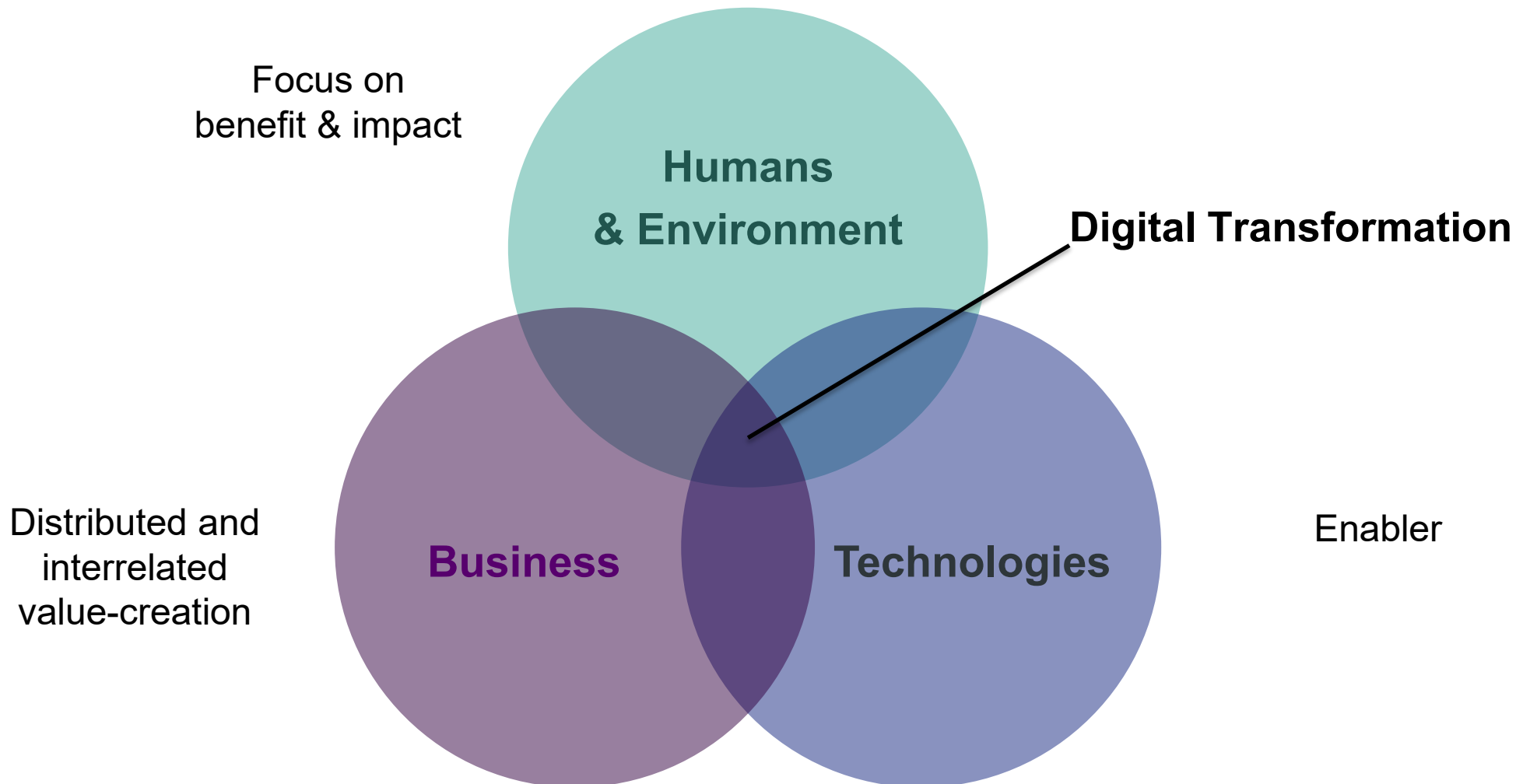**Phase 2:** Digitalization of production environments and process chains
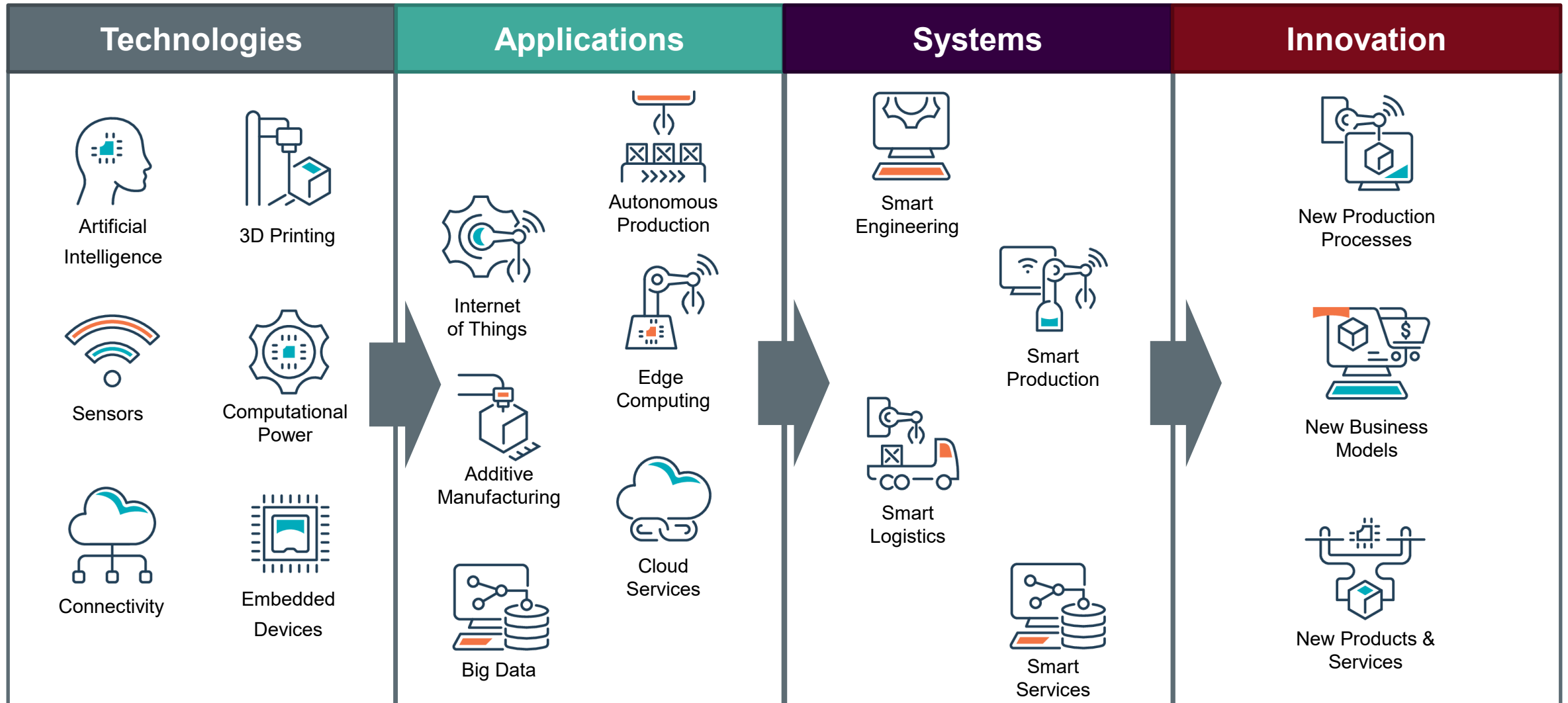
➔ efficiency of integrated processes

Phase 3: Digitalization of ecosystems & business-processes
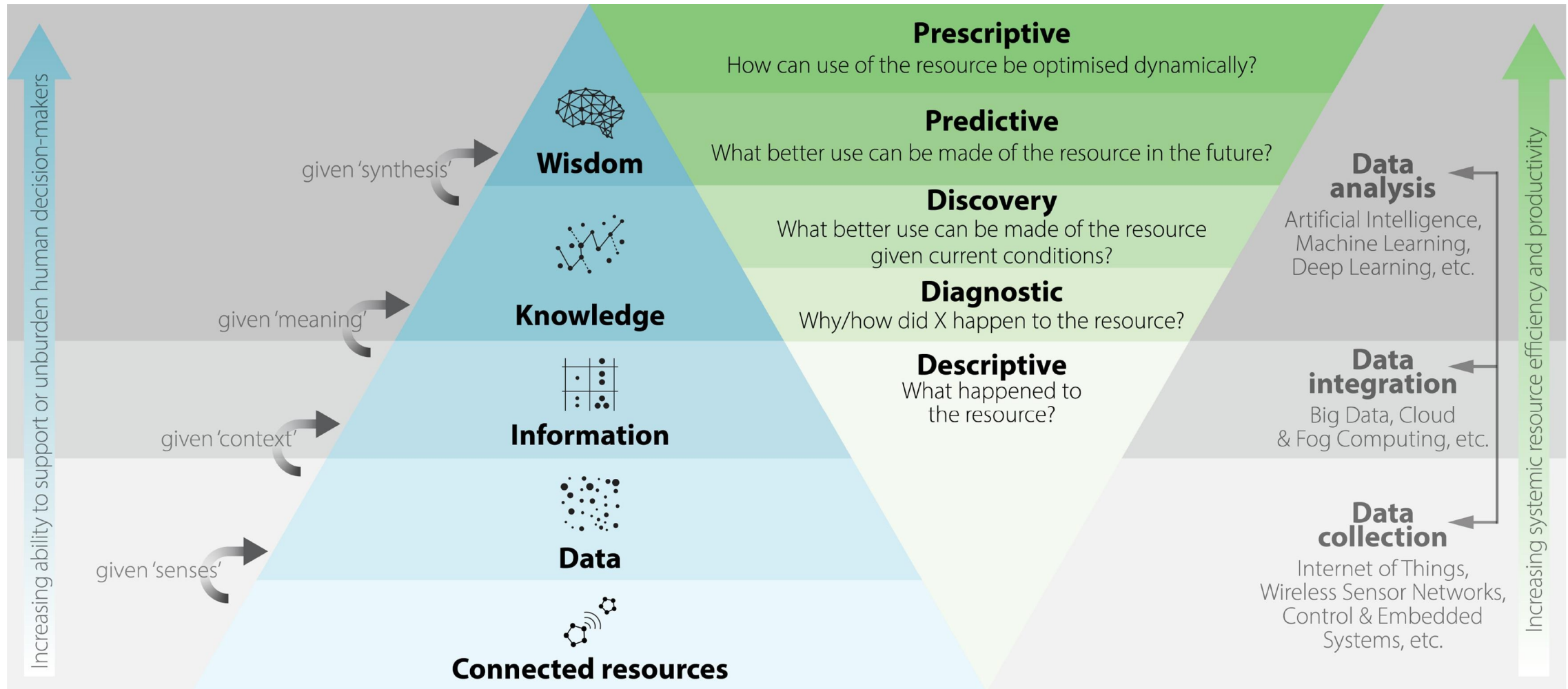
➔ holistic view

DIGITAL TRANSFORMATION UTILIZES
A HOLISTIC APPROACH

Focus on
benefit & impact

Humans
& Environment

Digital Transformation

Distributed and
interrelated
value-creation

Business

Technologies

Enabler

TECHNOLOGY ENABLES THE CREATION OF COMPLEX INNOVATION ECOSYSTEMS

Technologies	Applications	Systems	Innovation
Artificial Intelligence	Internet of Things	Smart Engineering	New Production Processes
3D Printing	Autonomous Production	Smart Production	New Business Models
Sensors	Additive Manufacturing	Smart Logistics	New Products & Services
Computational Power	Edge Computing	Smart Services	
Connectivity	Big Data		
Embedded Devices	Cloud Services		

ADVANCED DATA SERVICES ENABLE OPTIMIZATION OF ENERGY & RESOURCE USAGE

Prescriptive
How can use of the resource be optimised dynamically?

Predictive
What better use can be made of the resource in the future?

Discovery
What better use can be made of the resource given current conditions?

Diagnostic
Why/how did X happen to the resource?

Descriptive
What happened to the resource?

given 'synthesis' → **Wisdom**

given 'meaning' → **Knowledge**

given 'context' → **Information**

given 'senses' → **Data**

Connected resources

Increasing ability to support or unburden human decision-makers

Increasing systemic resource efficiency and productivity

Data analysis
Artificial Intelligence, Machine Learning, Deep Learning, etc.

Data integration
Big Data, Cloud & Fog Computing, etc.

Data collection
Internet of Things, Wireless Sensor Networks, Control & Embedded Systems, etc.

Data transformation levels   *Resource optimization capabilities*   *Data flow processes*

Digital Transformation supports **Sustainable Development** by providing a **holistic view** integrating business, social, and environmental aspects of value chains **across organizations**

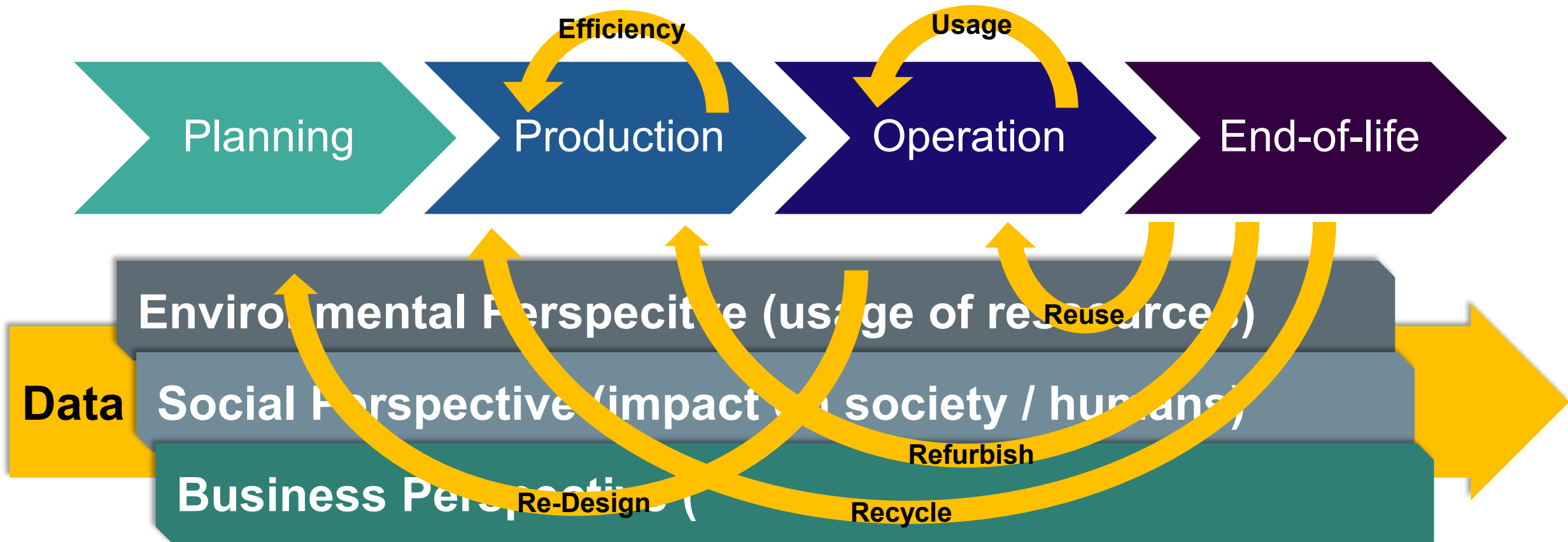![Circular Economy facilitating — United Nations Sustainable Development Goals logos]

CIRCULAR ECONOMY

- Aims to **minimize resource input**, as well as waste and emission production by
  - Maximum efficiency in the use of finite resources
  - Gradual transition to renewable resources
  - Recovery of materials and products and the end of their life-time.

- **Principles**:
  1. Minimize waste and pollution
  2. Extent useful life of products and materials
  3. Regenerate natural systems

19/10/2021

ENABLING THE CIRCULAR ECONOMY

Efficiency

Usage

Planning → Production → Operation → End-of-life

Data

Environmental Perspective (usage of resources)

Social Perspective (impact on society / humans)

Business Perspective (

Re-Design

Refurbish

Recycle

Reuse

CIRCULAR ECONOMY BUSINESS MODELS (CEBM)

Circular Supply Chains

- Sustainable usage of resources (e.g. recycleable materials, renewable energy, etc.)

➔ Requires data on availability of materials, synchronize energy demand/need, etc.

Resource Recovery

- Recover useful resources/energy out of disposed products or by-products

➔ Requires information on materials & quality along life-cycle

Product Life Extension

- Extend working lifecycle of products and components

➔ Requires data on spare parts (store/rebuild), product design, etc

Sharing Platforms

- Increased product usage by making possible shared use/access/ownership

➔ Requires planning of usage & flexible billing processes

Product as a Service

- Offer product access and retain ownership to encourage responsible use

➔ Requires flexible business processes & advanced product maintenance

Source: *Accenture (2014) "Circular Advantage"*

DATA SPACES

Integrating data & services along the value-chain

- Data spaces provide a **domain specific ecosystem** to
  - **utilize data & services** across organizations
  - **share & monetarize data**
  - provide **data-based services**
- **Key design principles**
  - federated
 - interoperable
  - managed
  - trustful
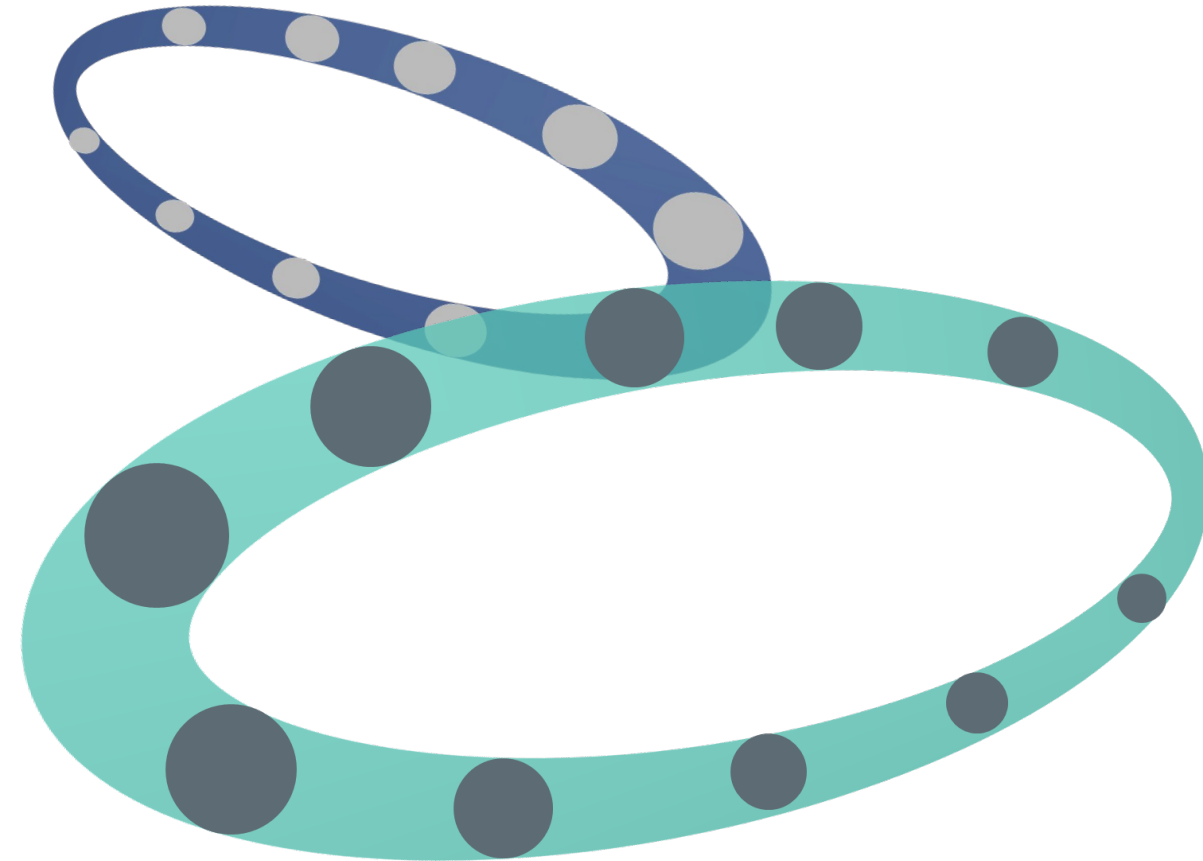
GAIA-X ENABLES DATA-DRIVEN SERVICES

Source: BMWi
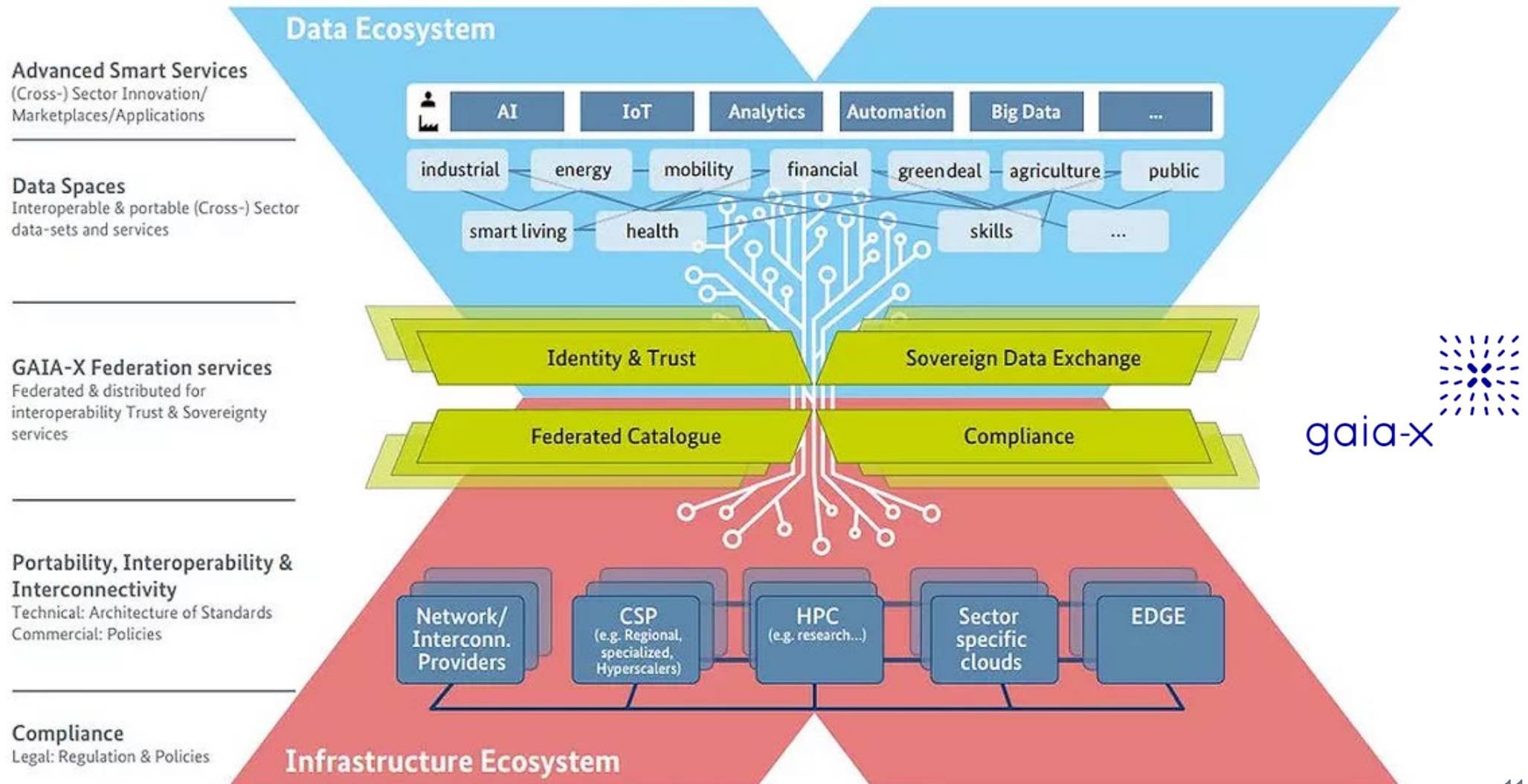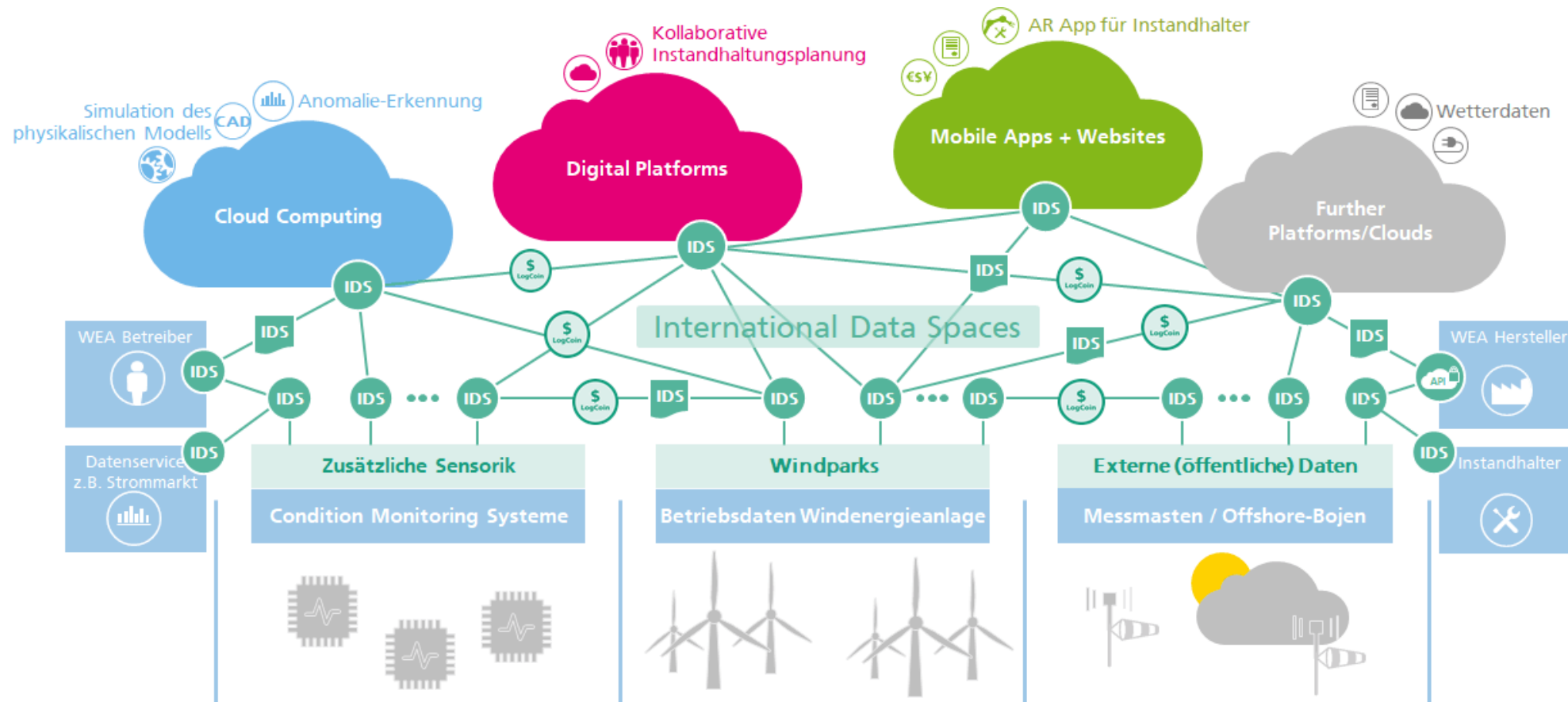
EXAMPLE FOR BATTERY DATA SPACE

Reducing waste and supporting reuse of batteries

- EU initiative to establish a **battery passport** to minimize environmental impact of batteries
  - Increase use of recycled material
  - Extend period of use
  - Reduce waste across life-cycle
- Batter data space enables **efficient refurbishment & recycling** by collecting information along the life-cycle
  - Raw materials used
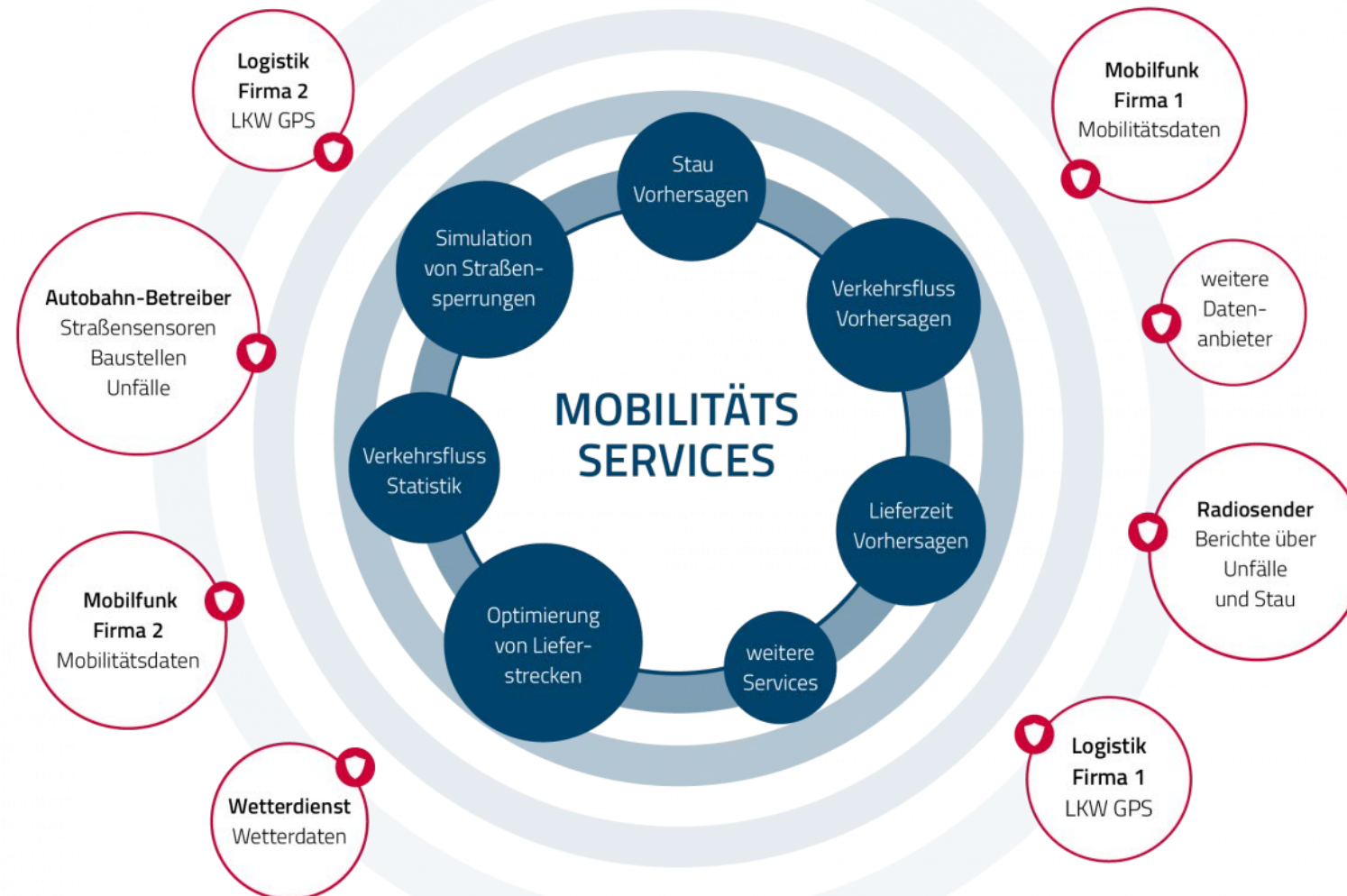 - Production parameters
  - Usage characteristics
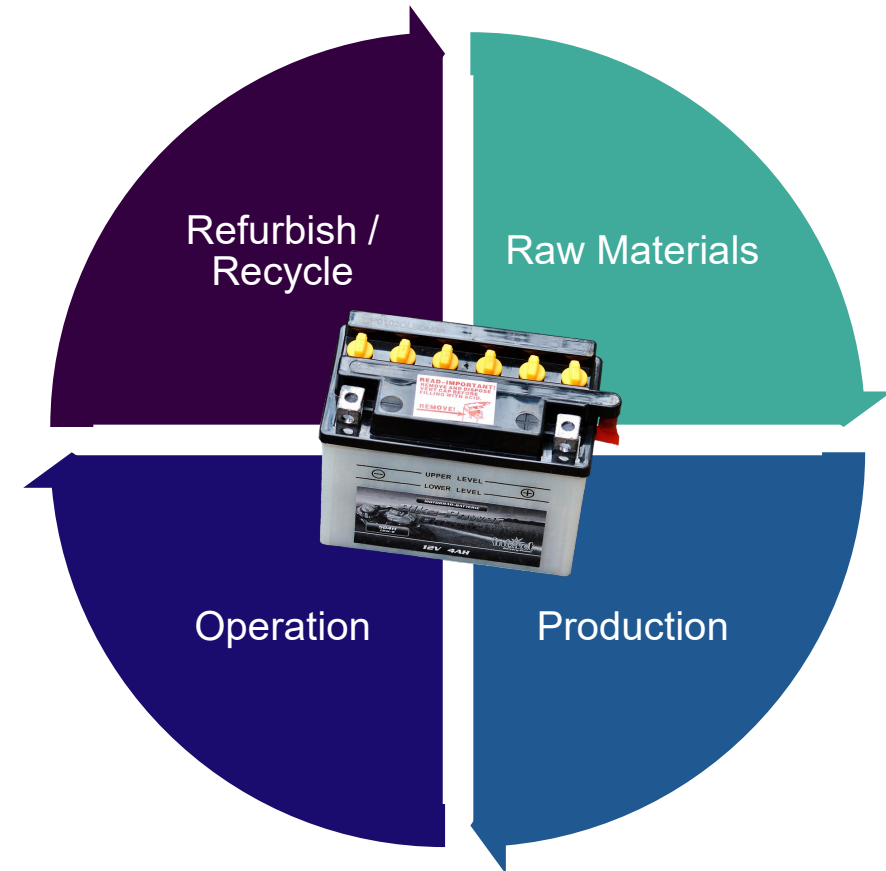
EXAMPLE FOR ENERGY DATA SPACE

Anomaly detection in operation of windmills to detect critical failures and prevent stand-stills

Image: Fraunhofer IML

EXAMPLE FOR MOBILITY DATA SPACE

Data integration to ensure traffic flow and offer new services

THANK YOU!

Contact

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