Circular TwAIn

Circular TwAIn: integrating Data Spaces, Digital Twins and Artificial Intelligence for Sustainable and Circular Manufacturing

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Project Info

- **Project number:** 101058585
- **Project name:** AI Platform for Integrated Sustainable and Circular Manufacturing
- **Project acronym:** Circular TwAIn

- **Call:** HORIZON-CL4-2021-TWIN-TRANSITION-01
- **Topic:** HORIZON-CL4-2021-TWIN-TRANSITION-01-07 - Artificial Intelligence for sustainable, agile manufacturing
- **Type of action:** HORIZON-IA

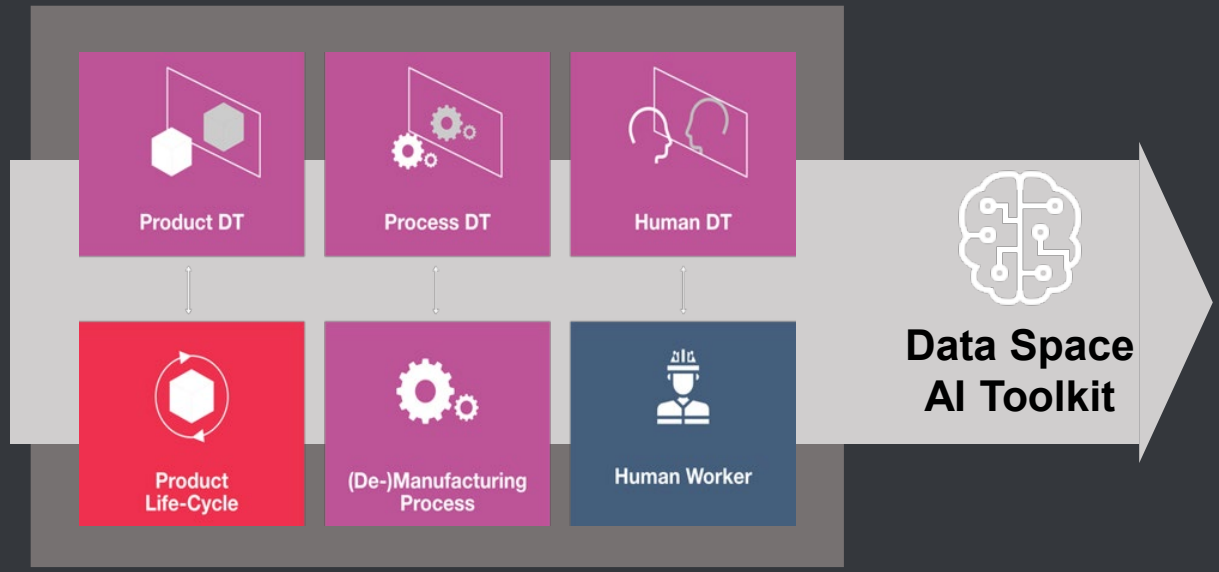
- **Project starting date:** 1 July 2022
- **Project duration:** 36 months
- **Total budget:** 7 156 951.25 €
- **EC funding:** 5 937 356.00 €
- **Partnership:** 21 partners, 11 countries

WHY is Circular TwAIn unique?

A short introduction

Circular TwAIn in a nutshell

Deliver a **unique AI platform** to support manufacturing and process industry towards a **sustainable, eco-friendly and circular production**. The key factor is a full integration among systems, reached through the usage of **AI and Digital Twins** for each level (product/process/value chain) leading to the **'Circularity by-design'**.



OUTCOME1 :: Seamless Data Sharing
Data Spaces with product-specific information and sustainability and waste data, to improve the overall product/production (life)cycle.

OUTCOME2 :: Collaborative AI
AI will exploit the knowledge provided by Digital Twins and models built within the Data Space for: (i) product/part recognition through machine vision; (ii) disassembly operations; and (iii) production and shopfloor process optimization.

BATTERY Pilot

Demonstrating the improvements in **de-/re- manufacturing** lead by **DPP and AI**

WEEE Pilot

PETRO-CHEMICAL Pilot

Showcasing how the process industry benefits from **DT and AI**

Circular TwAIn Unique Value Proposition

Holistic, domain-agnostic approach to enhance the sustainability and the circularity of product and process industries, with **tailored** and easy to scale technological solutions, mainly based on **open-source components**.

- Adaptation of current AI/DT (as-a-Service) technologies to **circular manufacturing models**, adopting DPP Semantic and Data Models
- Design and development of **interoperable circular twins** for end-to-end sustainability, exploiting data coming from different sources
- Creation and management of the DT for realizing **sustainable manufacturing** processes along the edge-to-cloud digital continuum
- Create new **circular Business Models** through digitalization along the value chain

WHAT is Circularity by-design?

The BATTERY Pilot Example

Circular TwAIn – Circular Value Networks

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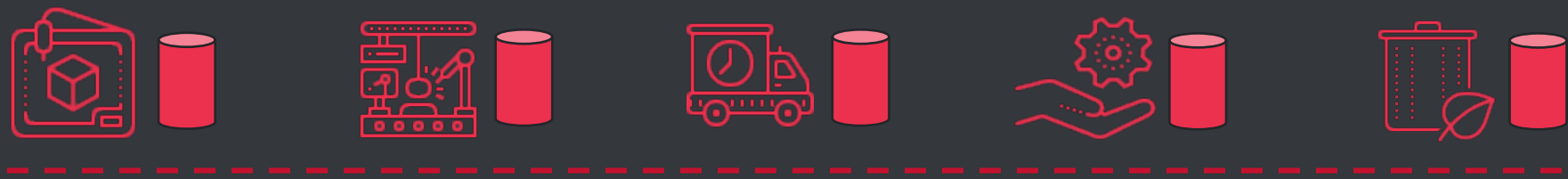
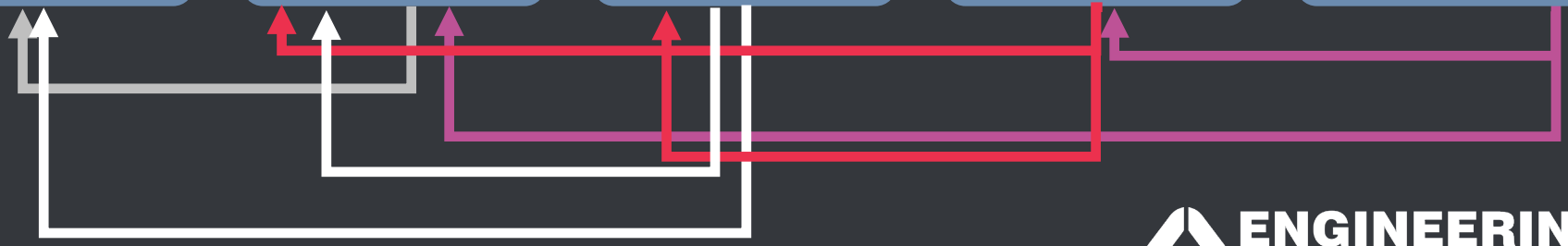
AI-enabled Digital Twins

Circular Manufacturing Data Space (DPP Economic Operators)

Circular Value Chain Stakeholders



Design → Manufacturing → Operations → Maintenance → End of Life / Landfill



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The Circular TwAIn BATTERY Pilot

De- and Re-manufacturing of Li-Ion battery packs in e- mobility

Remanufacture and the re-use of the disassembled cells with proper residual characteristics into second-life stationary applications

The mission of this pilot is implemented in five use cases

1. Computer-vision driven collaborative robotics for the disassembly of LIB packs
2. Machine learning aided automated disassembly of LIB modules
3. AI tool for the characterization of the LIBs state -of-health combining historical and testing data
4. AI tool for optimised mechanical recycling of degraded LIBs
5. Market oriented holistic decision-support-system for the LIBs de - and remanufacturing

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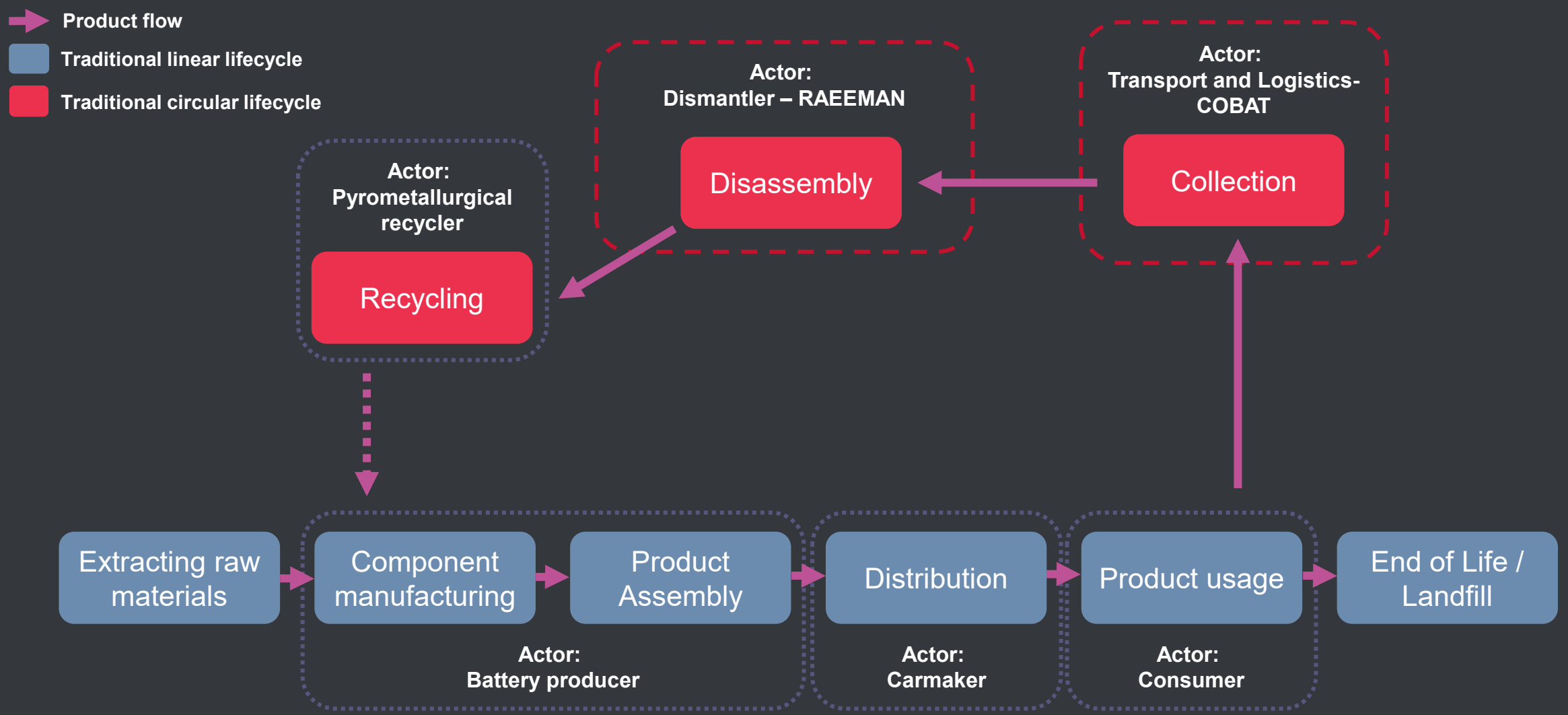
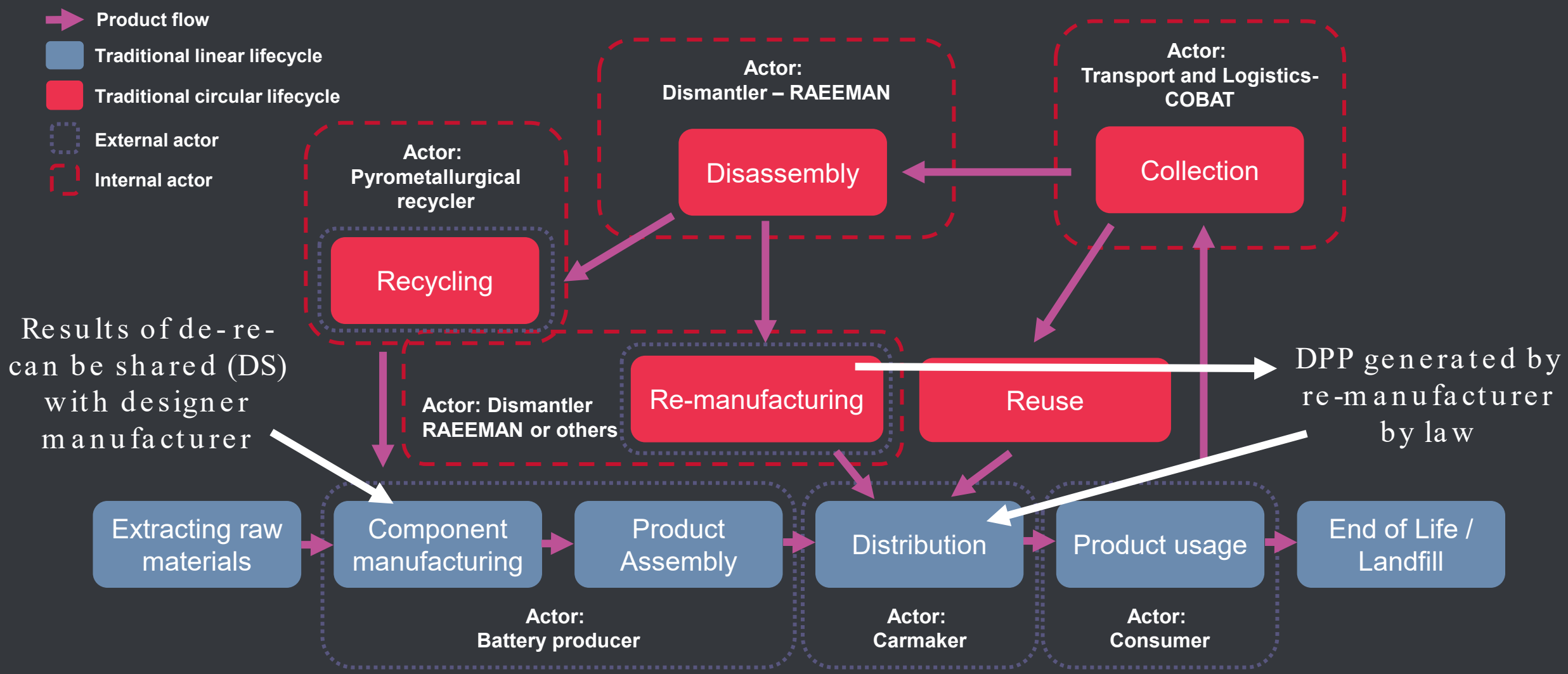
BATTERY Pilot: AS-IS Scenario



BATTERY Pilot: The Circularity by Design approach



A BATTERY Lifecycle Data Space with Product vs. Process viewpoint

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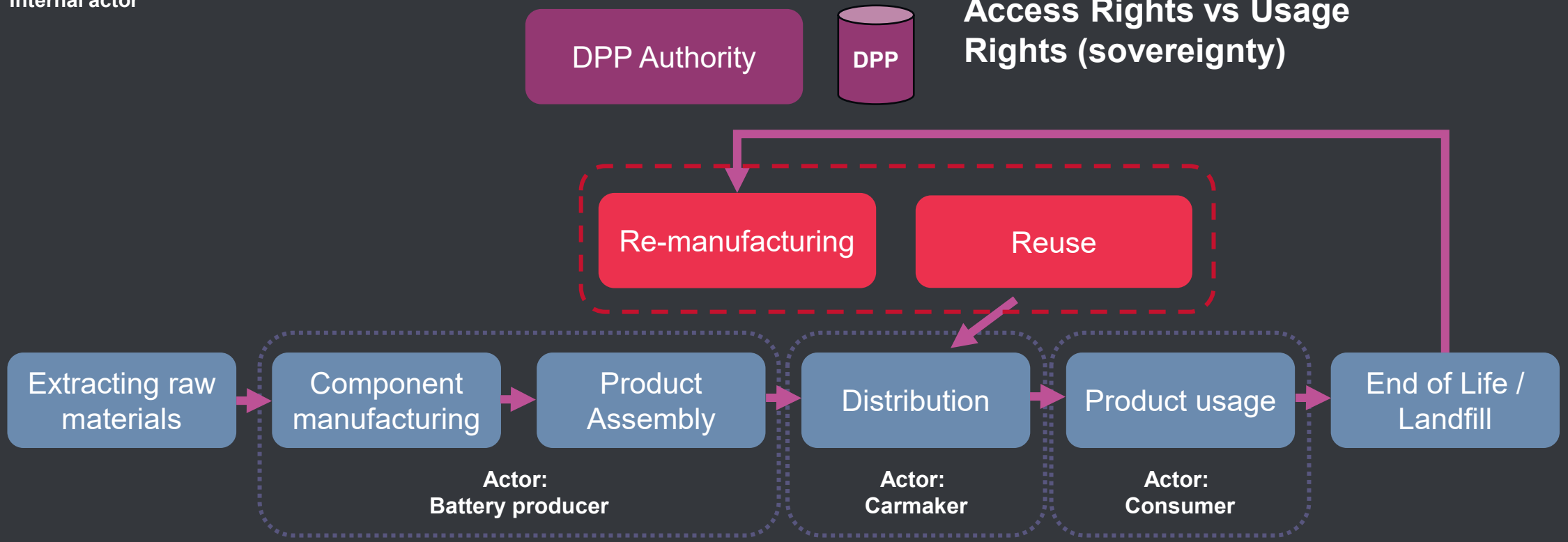
- Product flow
- Traditional linear lifecycle
- Traditional circular lifecycle
- External actor
- Internal actor

Access features:
Static vs Dynamic
Pull vs Push
Seldom vs Frequent
Access Rights vs Usage Rights (sovereignty)



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A BATTERY Lifecycle Data Space with Product data sharing flows

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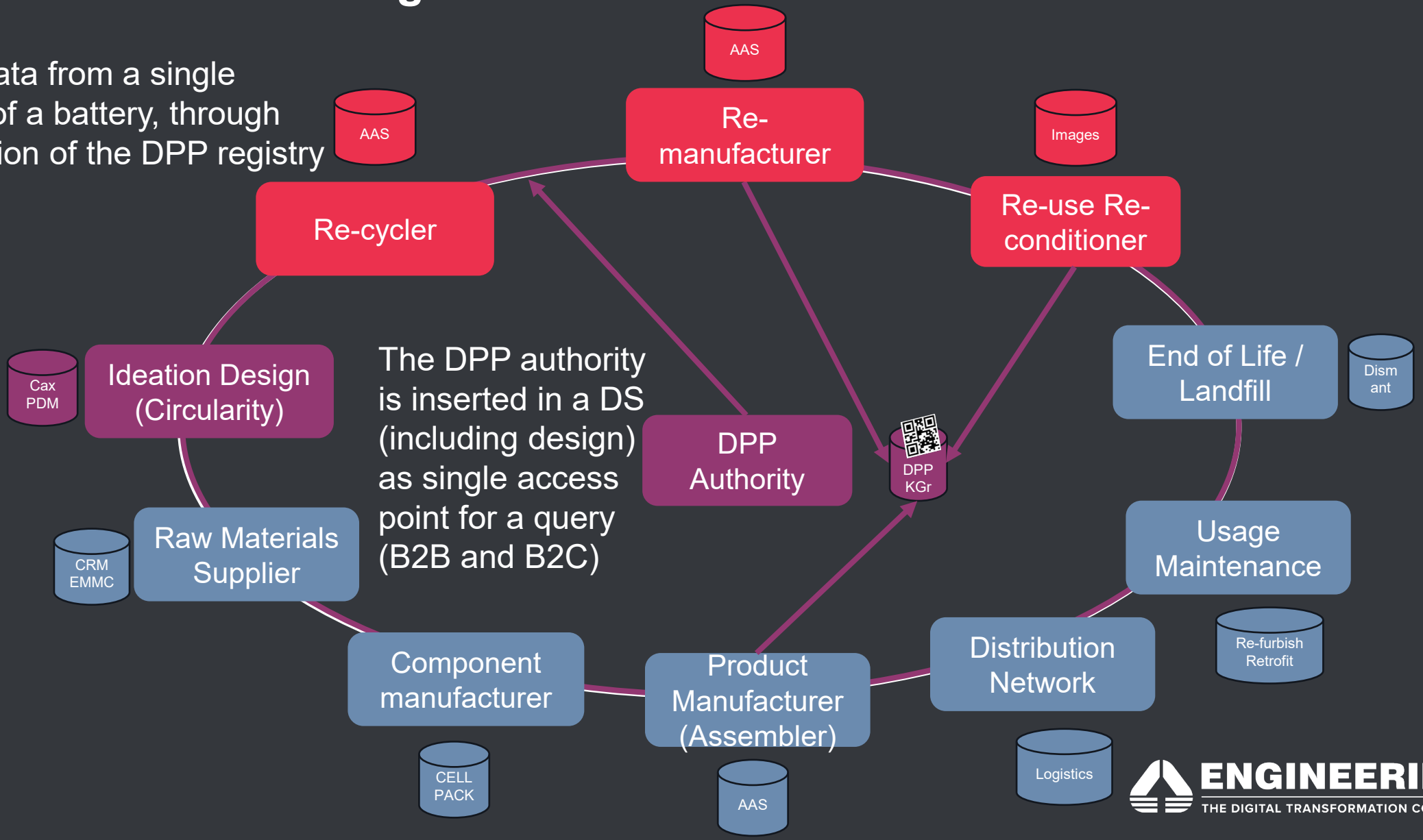
Get the data from a single instance of a battery, through interrogation of the DPP registry



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A BATTERY Lifecycle Data Space with Process data sharing flows

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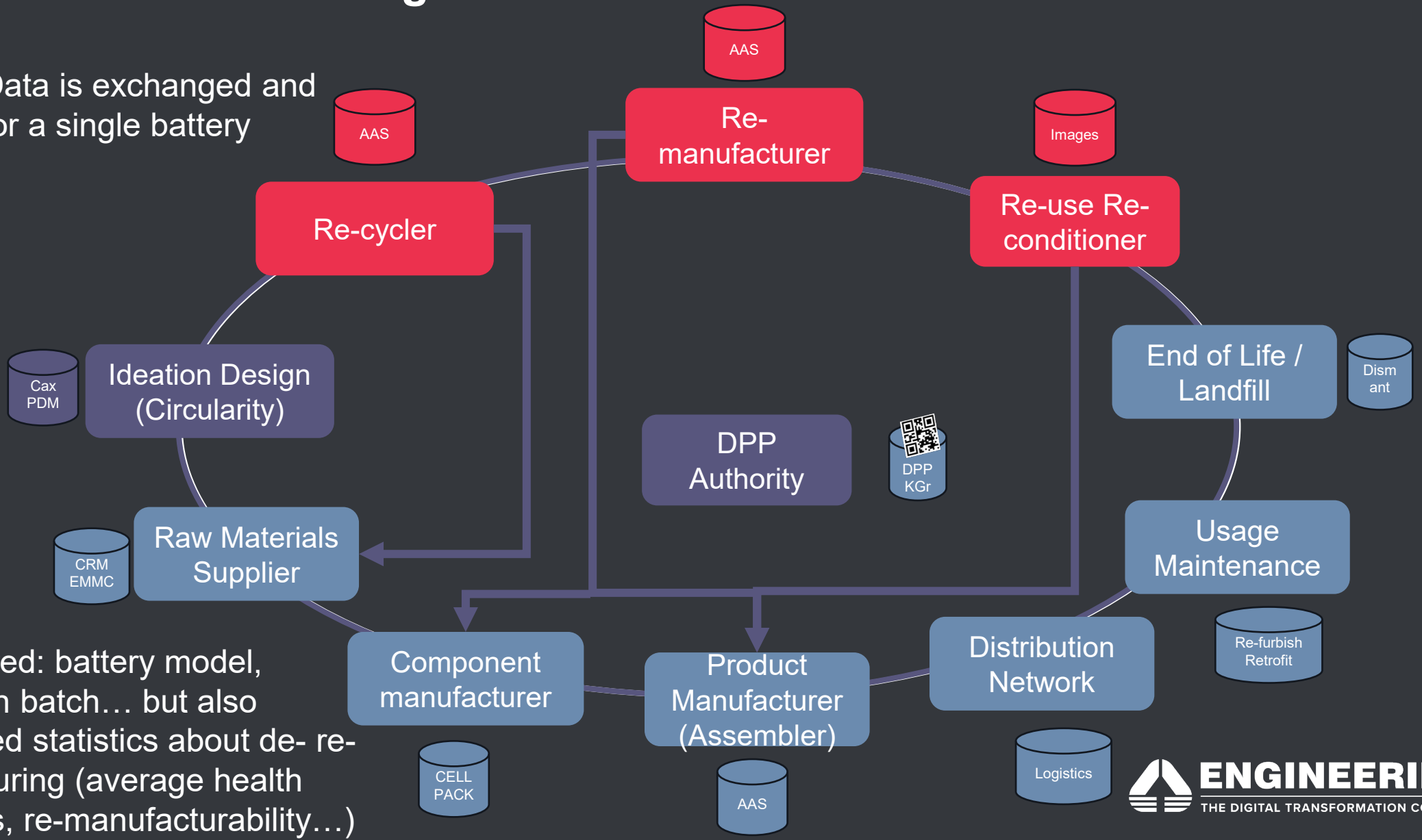
Process Data is exchanged and not data for a single battery instance.



Data shared: battery model, production batch… but also aggregated statistics about de- re-manufacturing (average health conditions, re-manufacturability…)

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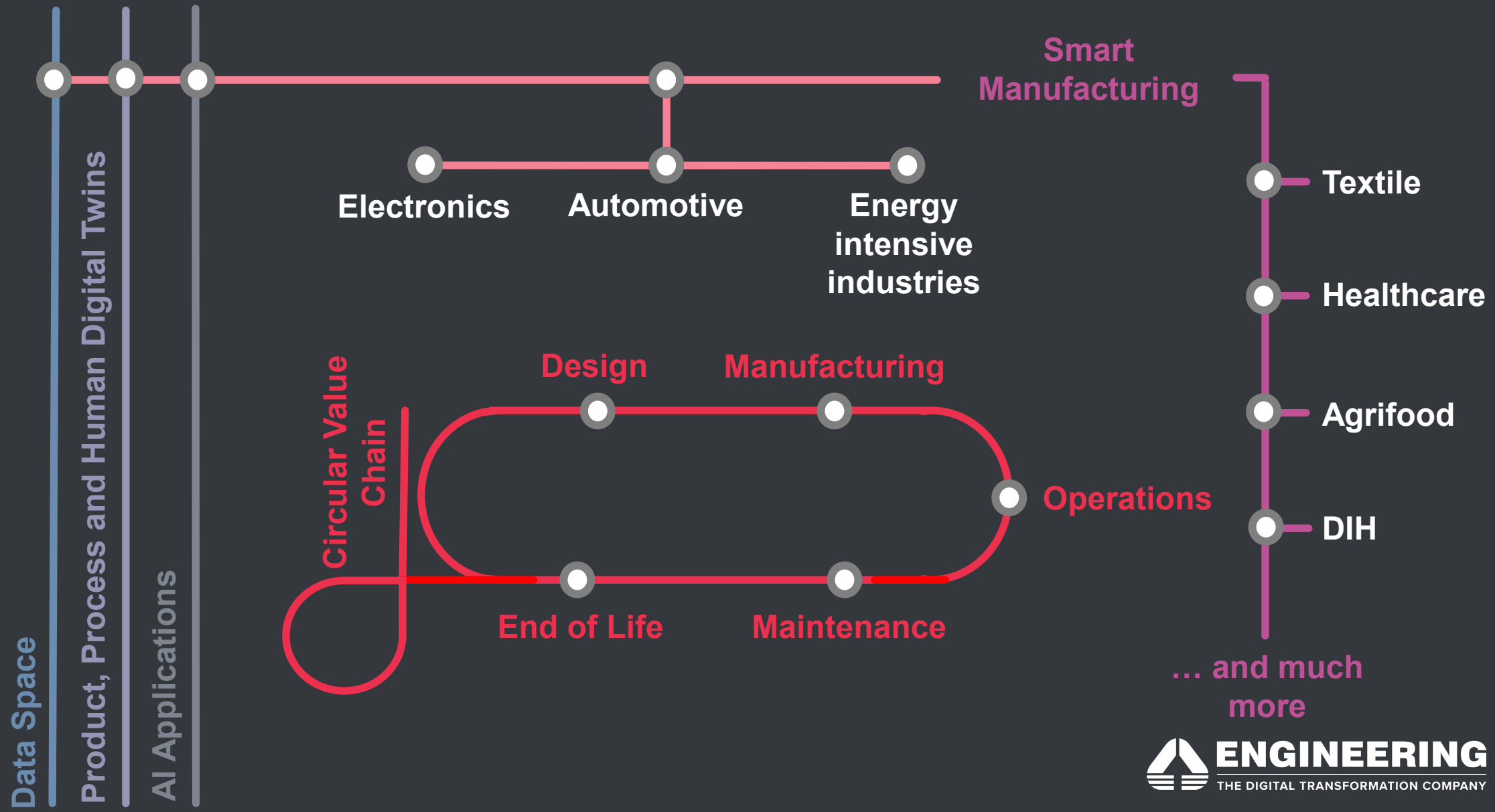
HOW to build a wider impact

A quick view on the market uptake

Circular TwAIn Industrial Uptake



Circular TwAIn Gaps and Barriers

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Technical

- Some technologies are still not **mature**
- **Interoperability issues** and poor standard compliance
- Lack of **models** for Circular Applications

Societal

- Lack of **awareness** on newest technologies
- Many/All stakeholders of the **Circular Value Chain** have to be involved to be successful

Legal & Ethical

- **AI Act** still to be effective
- Different maturity levels of **DPP regulation** (WEEE vs BATTERY)

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https://www.circular-twain-project.eu/

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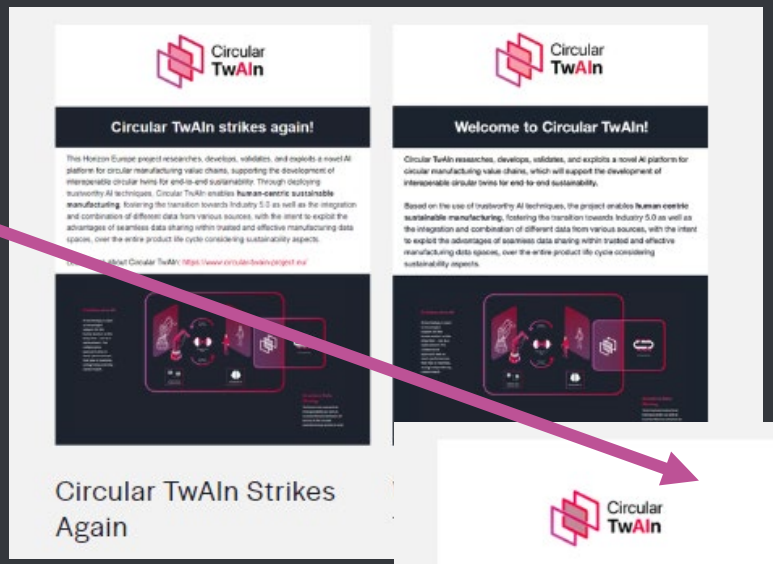
Newsletters



Press Releases

Publications

On the Role of Digital Twins in Data Spaces

A Performance Evaluation of OWL 2 DL Reasoners using ORE 2015 and Very Large Bio Ontologies

Open-Source Implementations of the Reactive Asset Administration Shell: A Survey

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Thank you!

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