ONTO COMMONS
ONTOLOGY-DRIVEN DATA DOCUMENTATION FOR INDUSTRY COMMONS

Towards a Materials Commons

Materials Digitalisation in AMI2030 Roadmap

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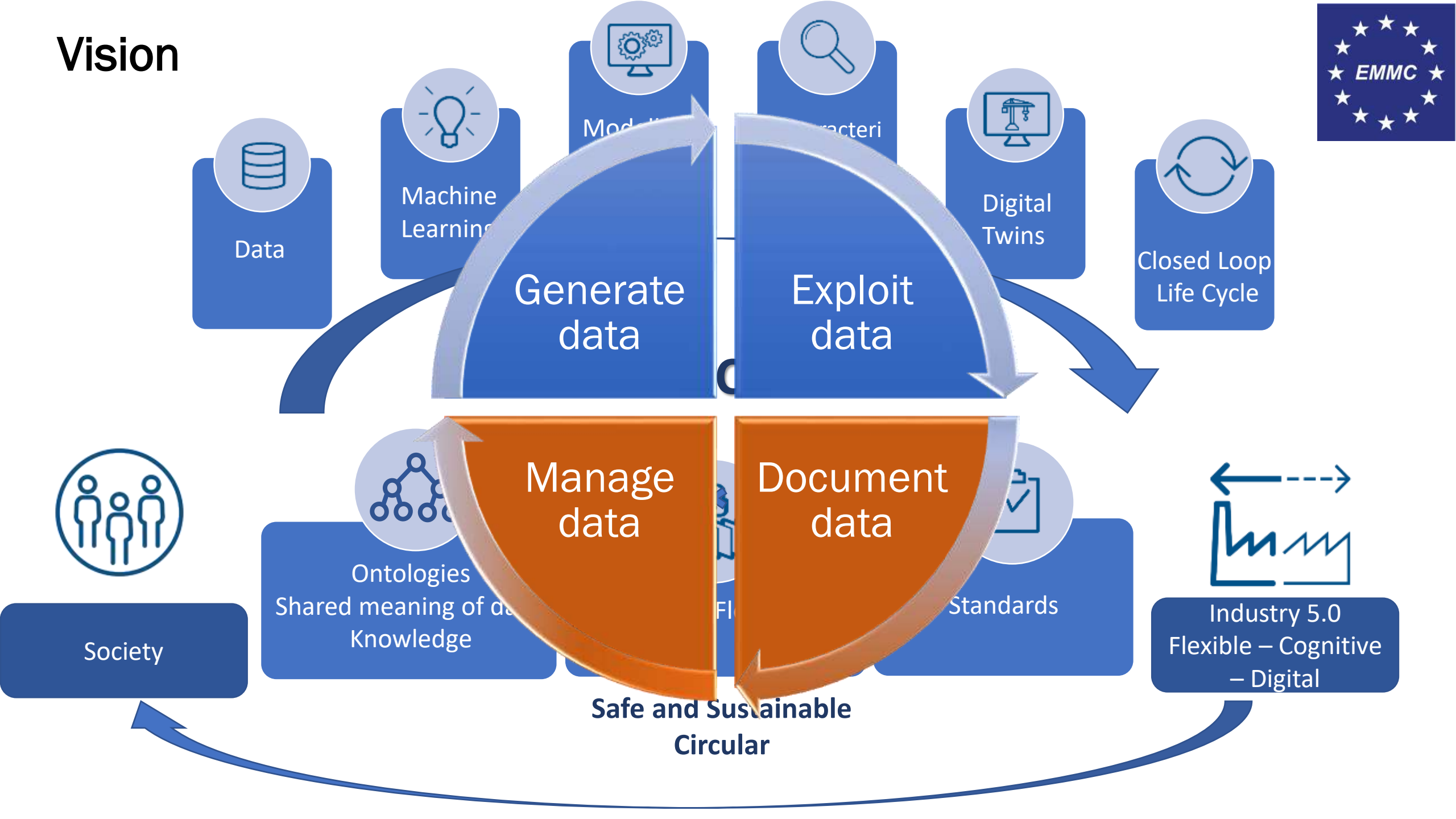
Vision


Data
Machine Learning
Digital Twins
Closed Loop Life Cycle
Generate data
Exploit data
Manage data
Document data
Ontologies
Shared meaning of da
Knowledge
Standards
Society
Industry 5.0
Flexible – Cognitive – Digital
Safe and Sustainable
Circular

Current Situation and Problems
Scattered materials data and knowledge resources

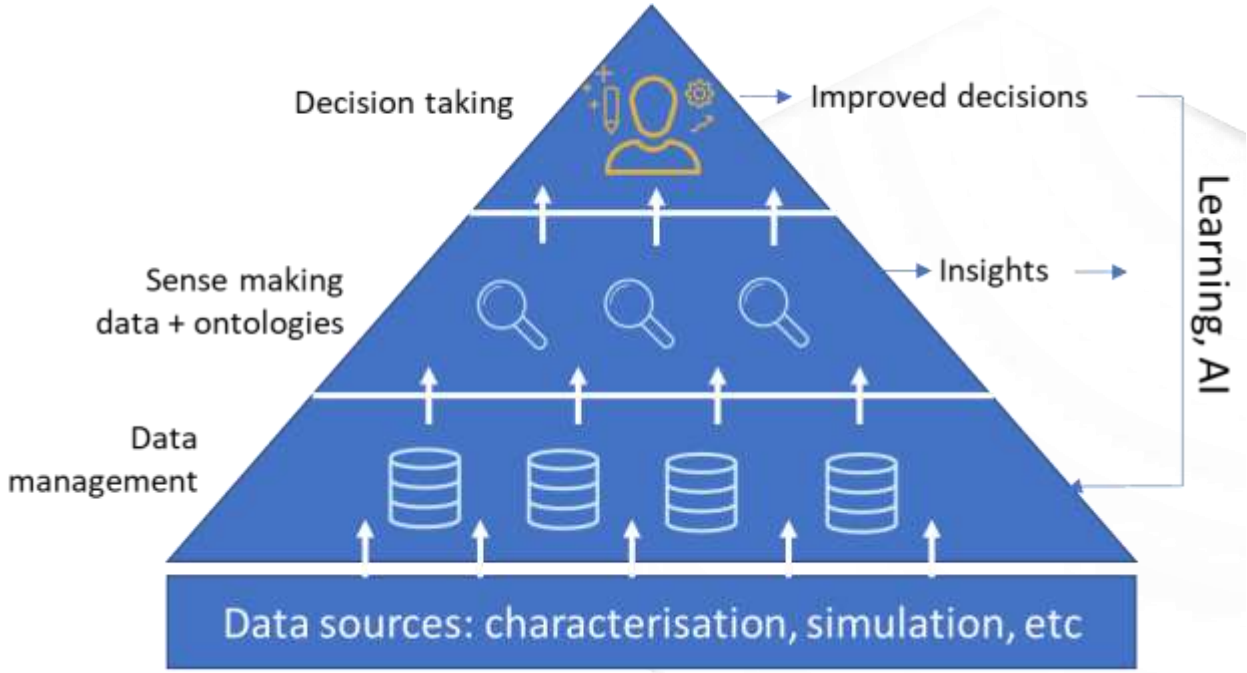
- **Data**
  - various levels of quality
  - in a wide range of separate repositories as well as publications, many un-structured.
  - lack context and meaning to others
  - single time use, not much re-used
- **Knowledge generation methods** (models, characterisation etc)
  - Not interoperable
  - Often not digitalised (e.g. results stored in Excel)
  - Not standardised regarding data and metadata.
  - Each project (e.g. in characterisation) develops its own schema.

Roadmap Topics

1. **Building the Digitalisation and Data Interoperability Foundations**
   - Documentation of data and knowledge for FAIRness
   - Develop digital strategies combining semantics and AI
2. **Developing Capacities and Capabilities**
   - Advancing modelling and simulation capabilities including harmonized materials multi-technique (e.g. modelling and characterisation) workflows
   - Education on digitalization and development of new roles of Knowledge Management Translator and Benefits Advisor
3. **Integration in a Materials Commons Ecosystem**
   - Development, implementation and governance of a Materials Data Space
   - Development of new repositories for reliable, curated materials data

Materials Commons for outcome-driven, accelerated materials design, development and use

- **Data exploitation and decision making**
  - Exploration of complex information
  - Support multi-criteria decision making
  - AI boosted by ontologies
- **Data documentation**
  - FAIR data, sense-making based on ontologies
- **Data management**
  - Federation, security, trusted exchange
- **Data/knowledge generators**
  - Materials models (physics and data-based)
  - Characterisation, sensing



Will require collective efforts of a diverse community of materials science, data science and semantic technologies expertise and innovations from a broad spectrum of disciplines.

The Advanced Materials 2030 Initiative ambition

Advanced Materials, a source of prosperity for the EU society

Main challenges, failures, gaps,…

The need of developing increasingly complex advanced materials at an ever faster pace to meet unprecedented market needs driven by a profound aspiration for a safe and sustainable society (and by supportive EU policies such as the Green Deal)

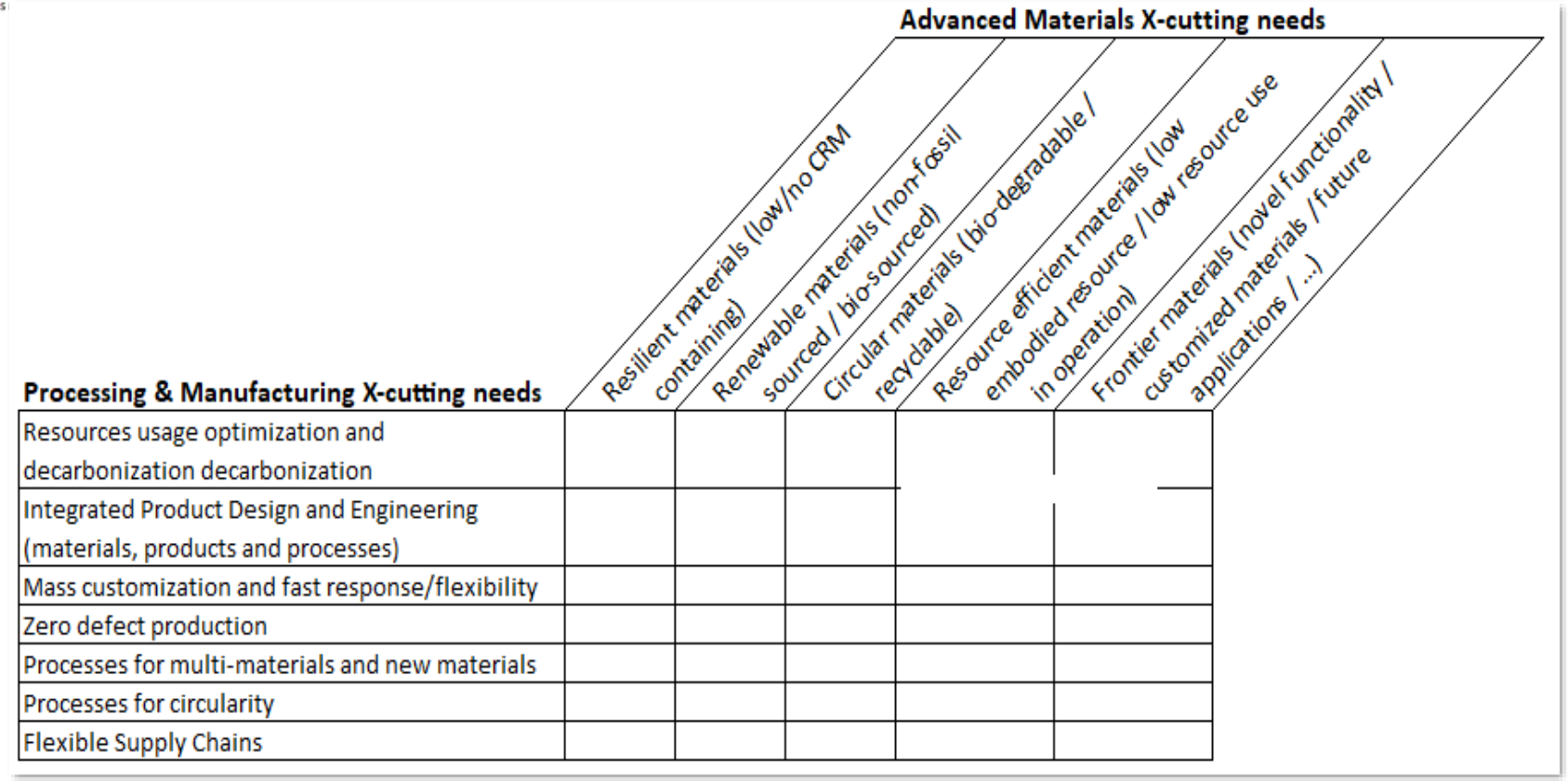
A fragmented landscape of the stakeholders, competences, resources and initiatives, both at EU and national levels, notably inducing an increasing gap between SMEs and large companies (uneven innovation capabilities and access to digital technologies and skills)

EU leadership at risk in AdMat innovation and industrial competitiveness challenged in strategic markets, compounded by slow take-up of digitalisation

Lack of resilience and sustainability of AdMat value chains (mainly with regard to critical raw materials, resource efficiency and waste)

A multi-sectoral accelerator for the design, development and uptake of sustainable advanced materials towards a circular economy

Cross-cutting needs of Markets and Priorities



Processing & Manufacturing X-cutting needs	Resilient materials (low/no CRM containing)	Renewable materials (non-fossil sourced / bio-sourced)	Circular materials (bio-degradable / recyclable)	Resource efficient materials (low embodied resource / low resource use in operation)	Frontier materials (novel functionality / customized materials / future applications / ...)
Resources usage optimization and decarbonization decarbonization					
Integrated Product Design and Engineering (materials, products and processes)					
Mass customization and fast response/flexibility					
Zero defect production					
Processes for multi-materials and new materials					
Processes for circularity					
Flexible Supply Chains					

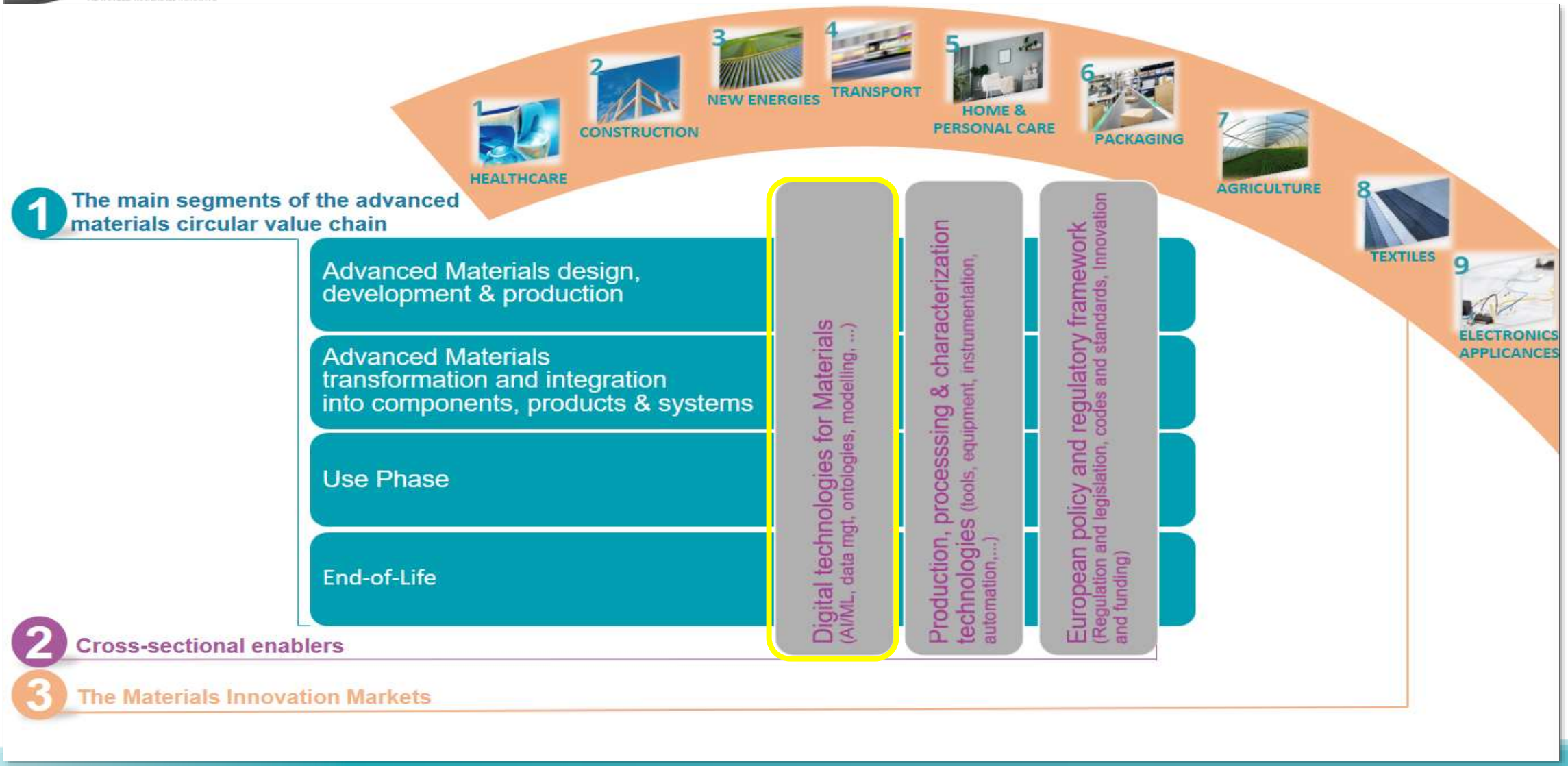
Advanced Materials X-cutting needs

Priority on activities directly impacting most strategic application sectors

- achievement of the Green Deal objectives
- strengthening of EU's open strategic autonomy

(in line with recent EU policy initiatives - Chips act, CRM act, Net-zero industries act,...)

Areas of Intervention



Materials Digitalisation

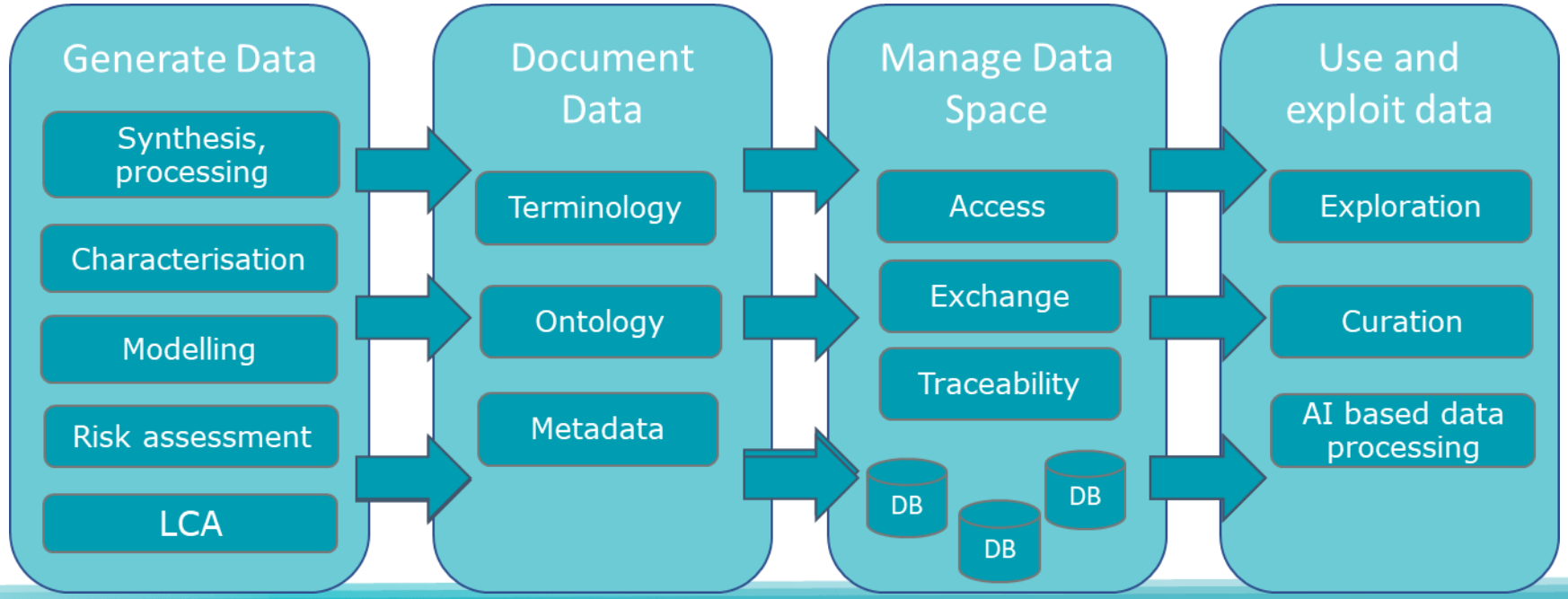
Gerhard Goldbeck, EMMC Executive Secretary
AMI WG1 (Materials Digitalisation) Chair

Materials Digitalisation objectives

- **Delivering a Common Digital Ecosystem**
  - Interoperability between all horizontal enabler technologies
  - Capitalise on commonalities, integration and synergies
  - A federated but highly harmonised and interoperable materials data infrastructure
- **Outcome**
  - Manage and control materials use and behaviour along the entire lifetime and during closing-the-loop processes at End of Life (EoL) based on a rich set of data.
  - Better decisions regarding increased efficiency, reliability, safety and sustainability.
  - Better utilization of the value of the materials by extending lifetimes and increased circular material flows, minimise the environmental impact and improve health.

SCOPE & Priorities identified in the MATERIALS 2030 Roadmap

- ❑ Digitalise and integrate materials investigation technologies — Generate
- ❑ Harmonised and interoperable data across all domains — Document
- ❑ Federated data space with trusted data access and exchange — Manage
- ❑ Created value from data using digital and AI strategies — Exploit



AMI2030 EXPECTED OUTPUTS & RESULTS
FOCUSING ON MATERIALS DIGITALISATION

EXPECTED OUTPUTS

1. **Game changers** (e.g. MAPs, OITBs, digital twins, modeling tools, data spaces,…) for AdMat
2. **Systemic collaborations** integrating all stakeholders along the AdMat Value Chains
3. **Common toolbox (the "Materials Commons")** to support the development of safe and sustainable Materials/Products compliant with regulations, standards, frameworks, product passport, …
4. **Synergies between regional, national, European and international initiatives and programmes**

EXPECTED RESULTS

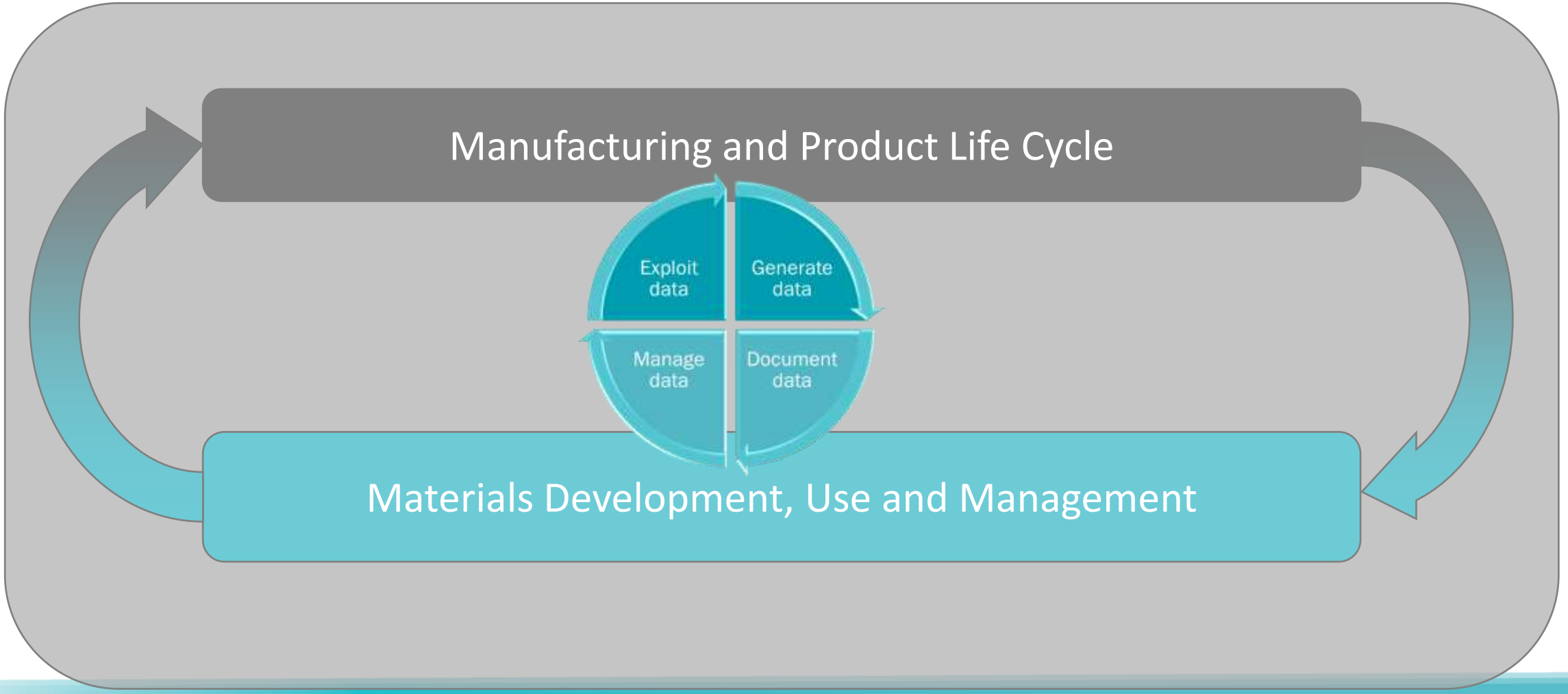
Exploit existing and generate new data with harmonised and digitalised techniques: modelling, characterisation, production and testing technologies, semantic tech and AI

Develop and disseminate a common **documentation** language (ontology) for data exchange and knowledge management and in support of materials standards and regulations

Common materials data space using distributed data respositories with trusted **data management**, access and exchange for all stakeholders

D. **Maximising the overall impact** of all funding & financing levels in Europe

Vision: A Common Materials Data Space
interconnected with Manufacturing and PLM



EMMC 2023 https://emmc.eu/emmc-2023/

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