

# Overview on the EMN's Strategic Research Agenda - First edition 2024 -

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- Current status of our SRA
- Key Industrial Sectors for metrology support
- Trends and Vision for Advanced Manufacturing Enabled by Metrology
- Cross Cutting Topics
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- Feedback and Open discussion



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# Purpose of the SRA document



- Collates and highlights key measurement challenges and opportunities for metrology in the theme of “Advanced Manufacturing”
  - Present metrology needs to support the EMN’s 13 identified key industry sectors
  - Record of the inputs obtained from stakeholder engagement
- Basis for formulating and sharing harmonised and sustainable European measurement infrastructure and metrology strategies
  - Helping to steer activities of European NMIs/DIs in a coordinated manner
  - Influence the wider metrology and advanced manufacturing community
- Facilitates prioritisation of metrology R&D activity in Europe
  - Increase capability of measurement infrastructure for advanced manufacturing
  - Supporting the European Partnership on Metrology



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# Structure of the SRA document



- The structure of this document is designed with a hierarchical level of detail to ensure that readers with different interests are engaged.

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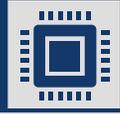
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# Key Industry Sectors for Advanced Manufacturing



- 1 Metrology equipment & service 
- 2 Machine tools & robotics 
- 3 Digitalized & integrated manufacturing systems 
- 4 Advanced materials & processing 
- 5 Energy generation, transmission & storage 
- 6 Nano- & microelectronics 
- 7 Nano- & microtechnology 
- 8 Optics & photonics 
- 9 Land & sea-based mobility 
- 10 Aerospace 
- 11 Complex infrastructure & civil engineering 
- 12 Life science technology 
- 13 Defense & security 

overarching KIS relevant for the other KISs

KIS related to manufactured products



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## Short- & Medium-term trends:

### i4.0 implementation and transitioning to i5.0

- Digitalisation and automation of remaining manual manufacturing and assembly processes, nullifying of quality blind spots
- Increased manufacturing system utilisation through implementation of reconfigurable manufacturing platforms and hybridised manufacturing cells.
- AI optimised design methods in prolific use.
- Batch of one/personalised production expected by default for wider variety of products and applications but particularly in health care
- Emergence of new sustainable manufacturing industry in Europe:
  - Circularity by biobased raw materials, recyclable or biodegradable products, mixed and recycled sources.
  - Manufacturing designed for recycling, including traceability.
- Resilient semiconductor supply chain established in Europe.



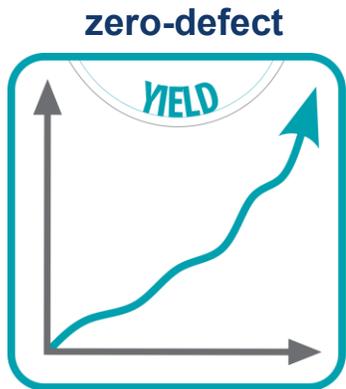
## Long-term trends: i5.0 transition and circular economies implemented for key products

- Circular economies fully implemented for majority of essential but high environmental impact products, ensuring sustainability.
- Key manufacturing capability transitioned in to “lights-out” factories, where systems are fully automated and able to self-adjust/maintain such that requirements for human activity are minimal and the facility can operate in the dark with zero humans onsite.
- Highly repetitive manual tasks in manufacturing environments eliminated/drastically reduced, freeing up resource for more valuable and engaging tasks
- Overall improvement to health, and quality of life through reduced exposure to manufacturing hazards, and development of new skills, increasing job satisfaction.
- Complex manufacturing facilities able to manufacture components for self-repair, replication, and ultimately self-optimisation.
- Highly resilient intelligently distributed manufacturing infrastructure, including a correspondingly distributed and self-validating metrology infrastructure.

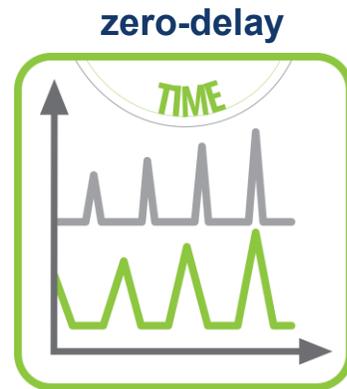


# A Vision for Advanced Manufacturing Enabled by Metrology

- Manufuture Vision 2030: Competitive, Sustainable And Resilient European Manufacturing



**Measure** to detect and eliminate defects



**Measure** to prevent delays



**Measure** to predetermine product variation



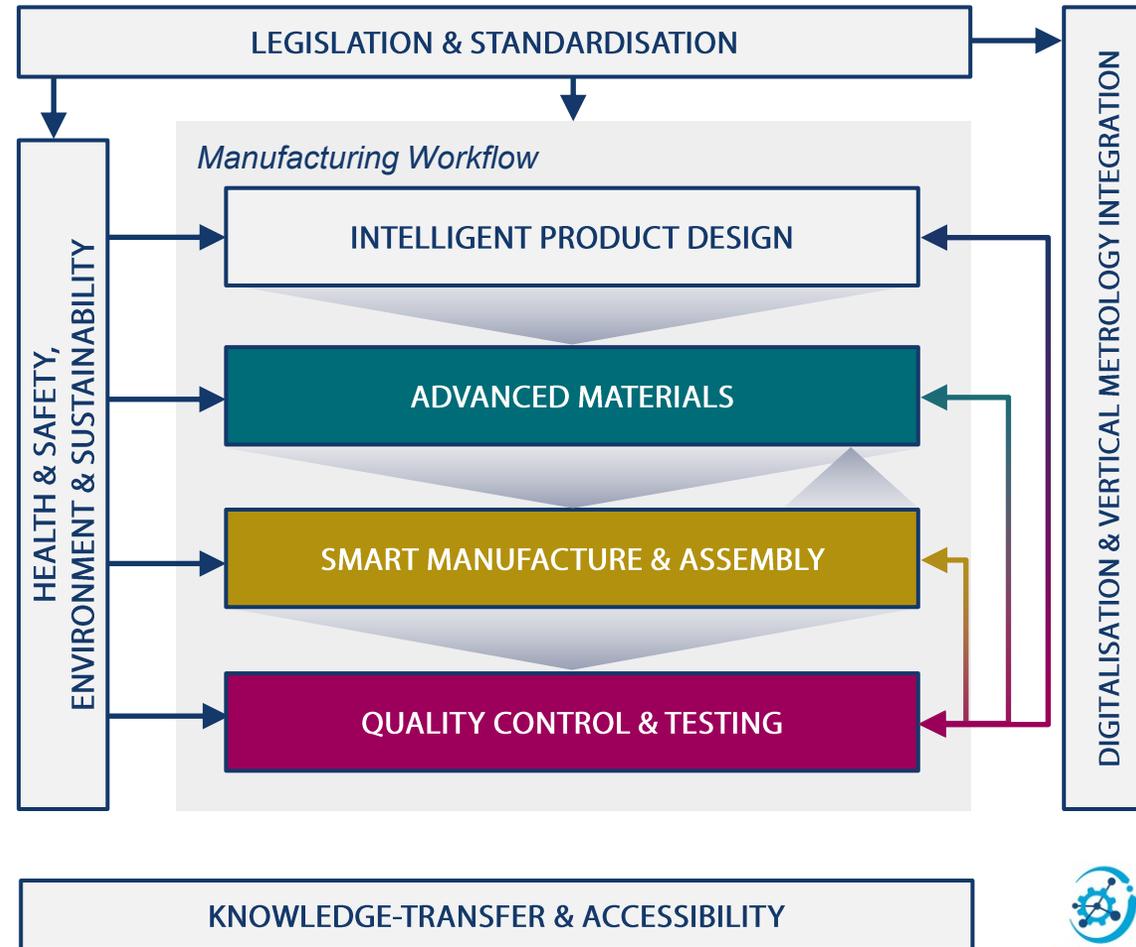
**Measure** to qualify circular production



**Measure** to increase confidence



# A Vision for Advanced Manufacturing Enabled by Metrology

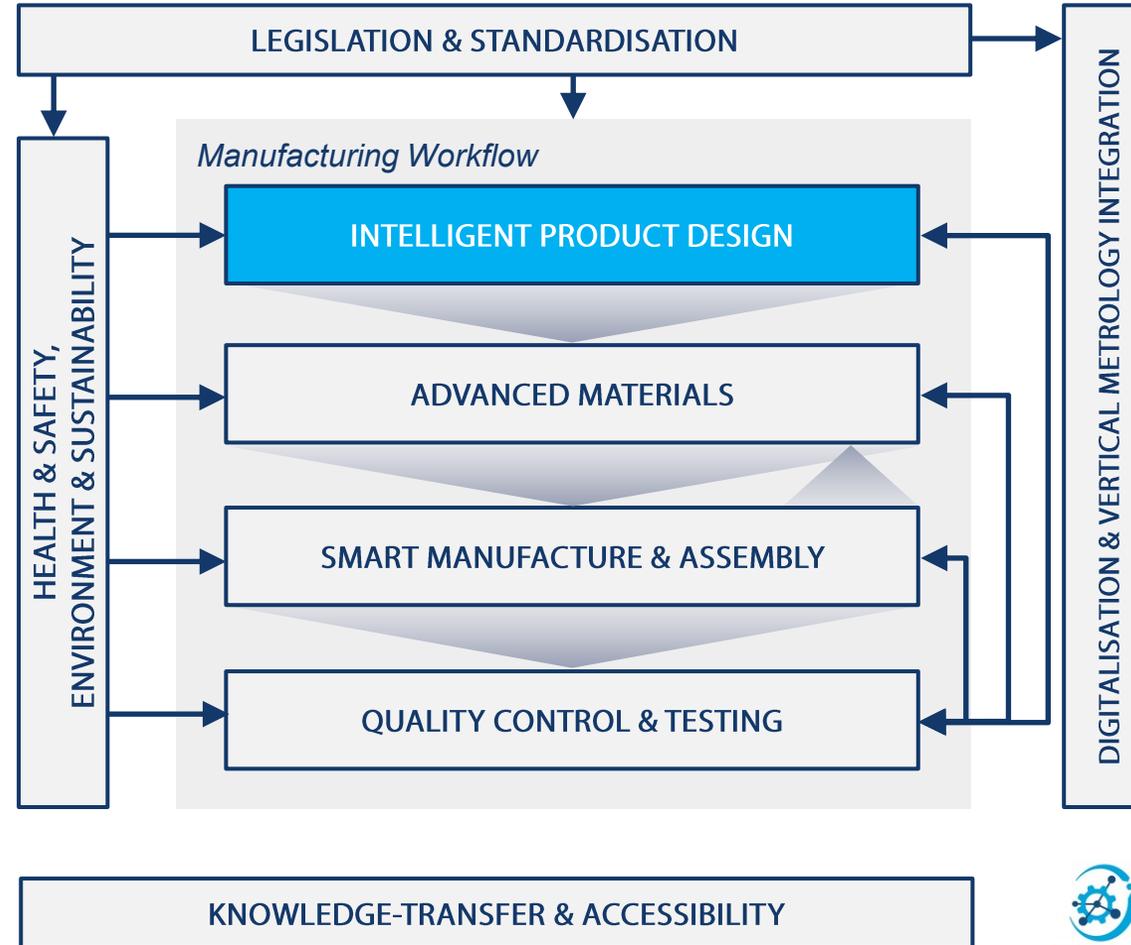


# INTELLIGENT PRODUCT DESIGN



Full implementation of digital product design tools

Artificial Intelligence (AI) methods to dynamically optimise specifications and accelerate new product introduction.



Digital twins of the product and the entire manufacturing workflow including the integrated metrology systems



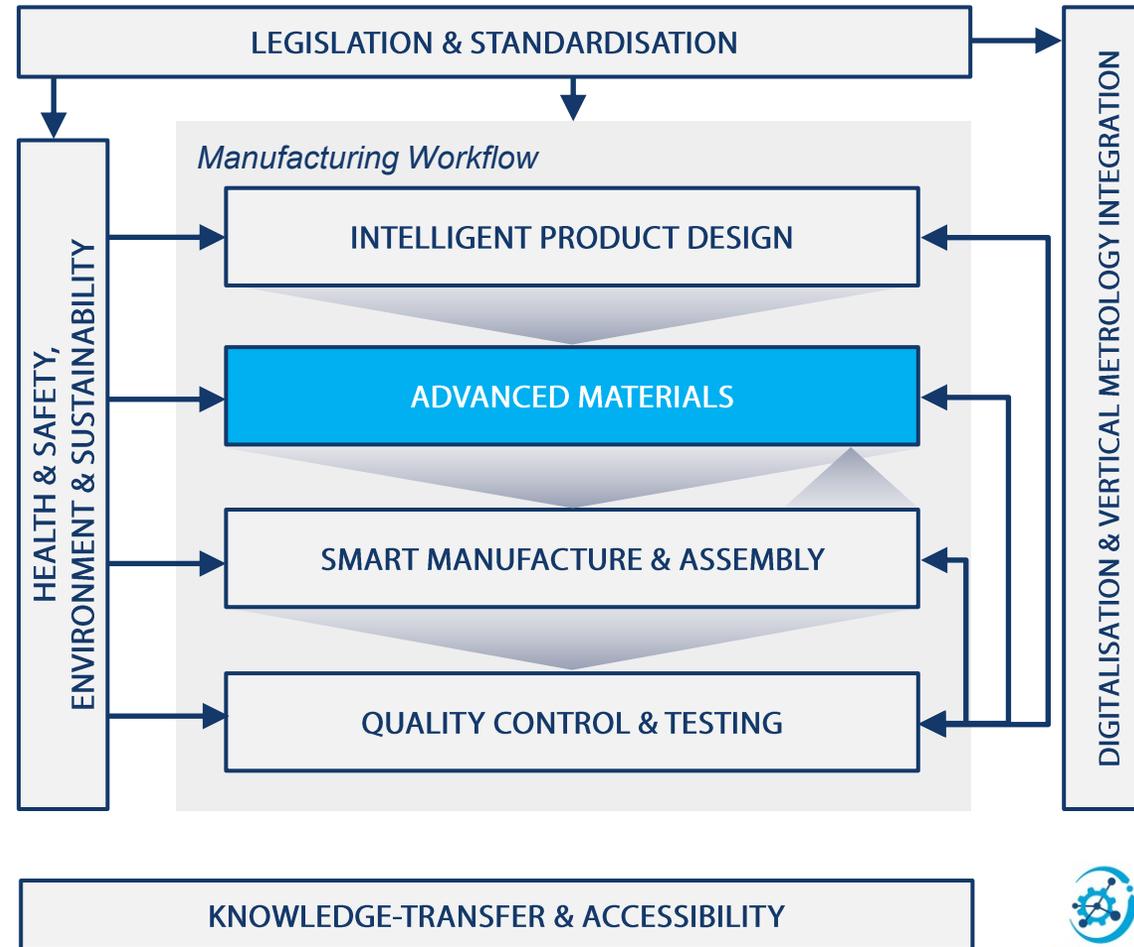
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# ADVANCED MATERIALS



Exploit the innovation potential of advanced materials

reproducible advanced material characterisation methods



Generate, obtain and use **holistic data** for material properties at key points throughout the manufacturing workflow

Push the limits of existing manufacturing processes and enable novel manufacturing paradigms



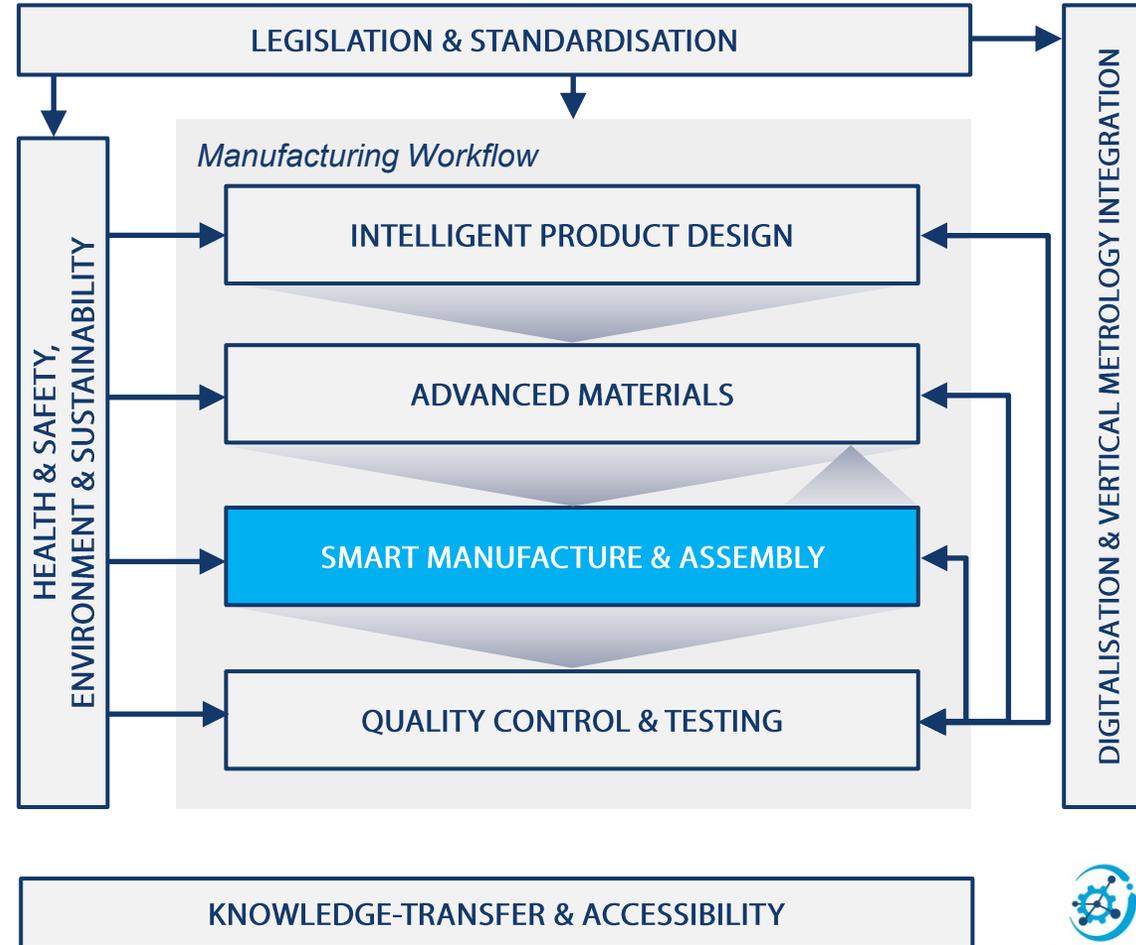
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# SMART MANUFACTURE & ASSEMBLY



**Smart process control**  
directly within  
**manufacturing &**  
**assembly systems**

**Generate, access, interpret,**  
**and act on metrology data**  
**with confidence at process**  
**relevant speeds**



**Seamless integration of**  
**measurement technologies,**  
communication subsystems,  
and data processing methods

**Adaptable, autonomous,**  
**intelligent, interconnected,**  
and **quality-oriented**  
manufacturing systems



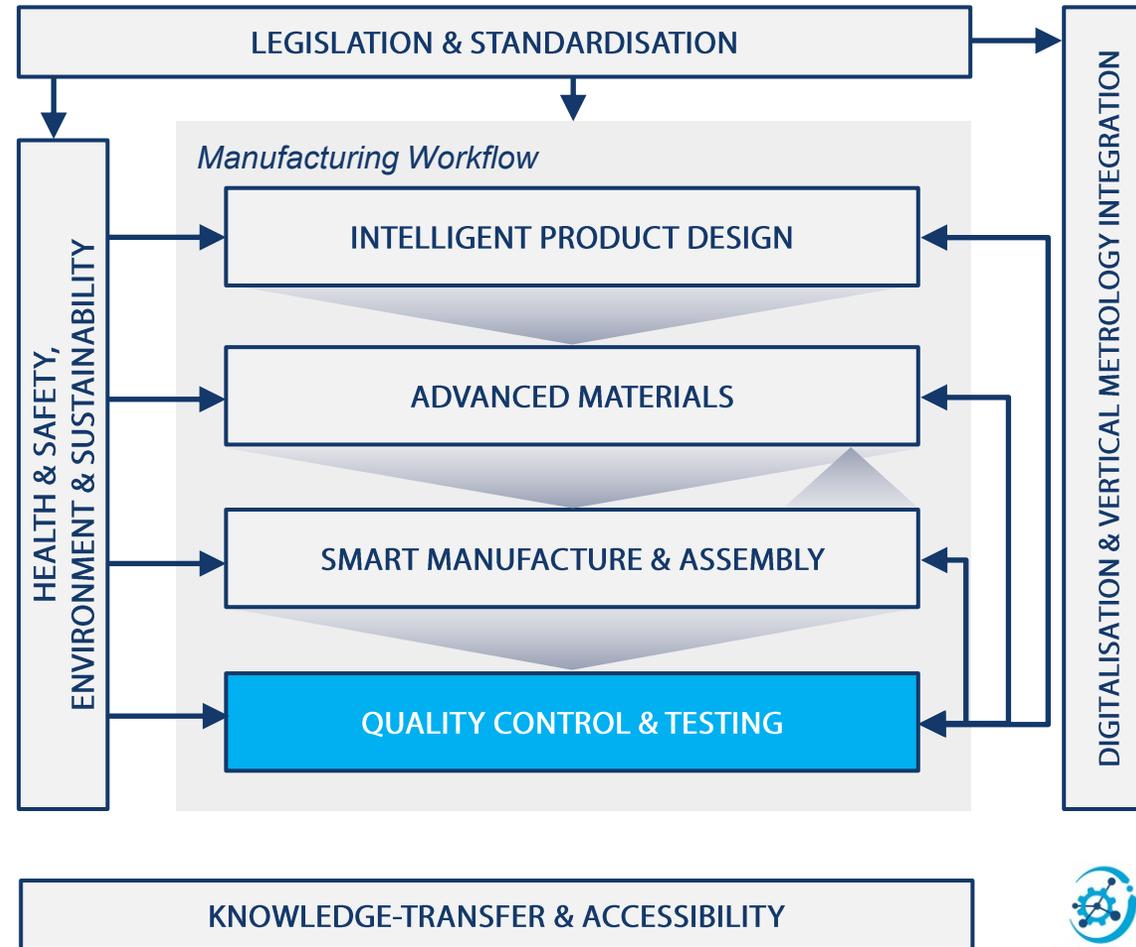
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# QUALITY CONTROL & TESTING



Optimise quality assurance of products in a circular economy

Iterative measurand (re)definition and optimisation of tolerances



virtual, distributed, in-service and end-of-life metrology

Increasing yield and throughput with optimal use of quality control & testing



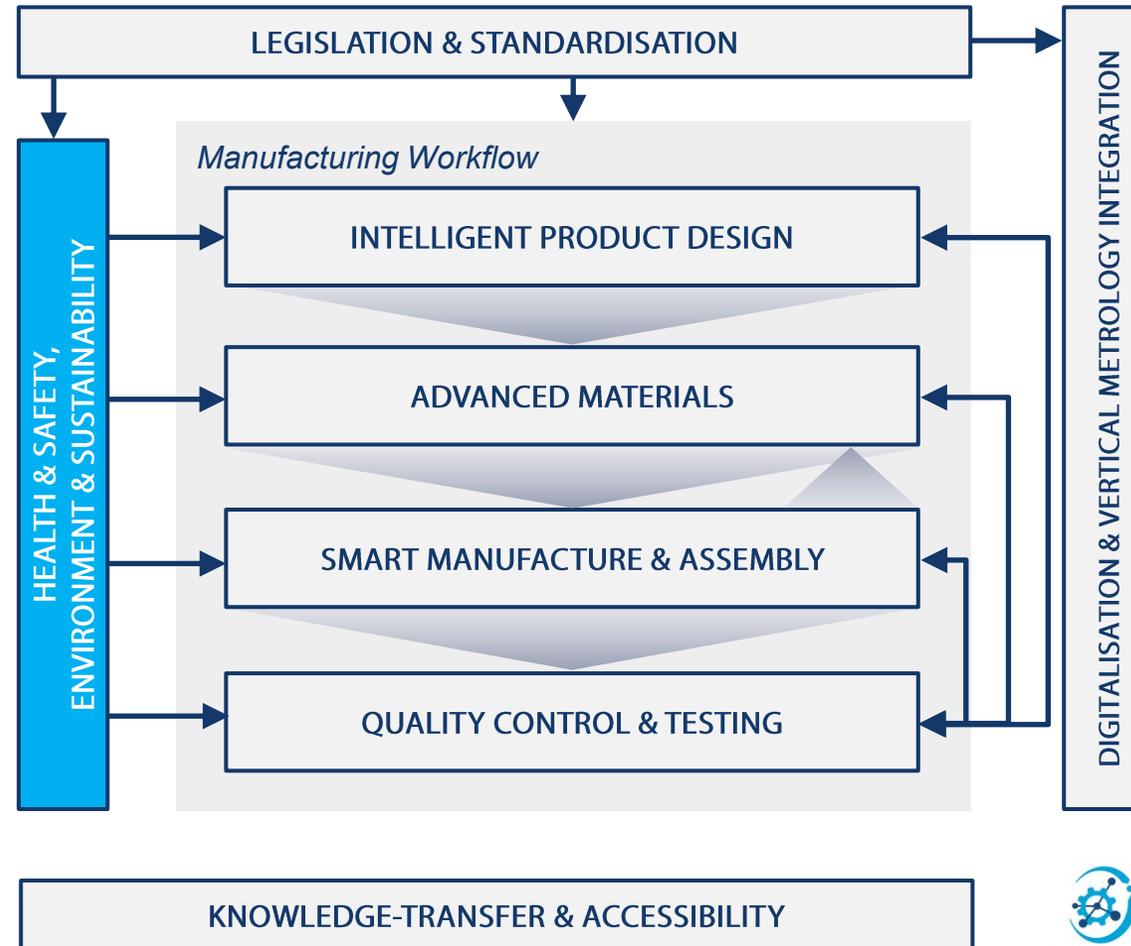
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# HEALTH & SAFETY, ENVIRONMENT & SUSTAINABILITY



Enable safe, environmentally friendly, and sustainable manufacturing of products in a fully circular economy

Metrology to characterise novel sustainable materials



Develop **safe/resource efficient, monitored machining** processes

**Assure the safety, quality & provenance of materials, components and products in support of the European Green Deal.**



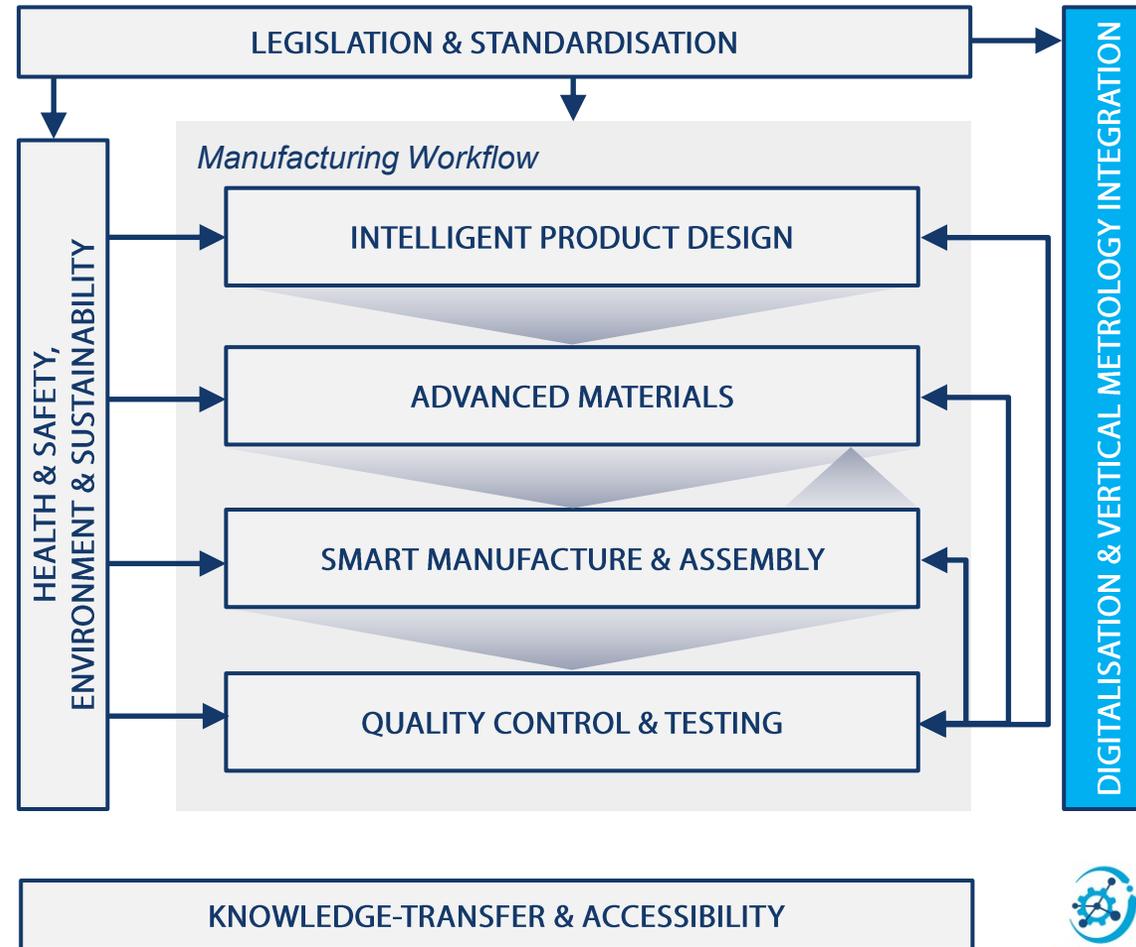
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# DIGITALISATION & VERTICAL METROLOGY INTEGRATION



Metrology required to support **resource efficient, agile, traceable production**

Implementation of metrology systems and infrastructure following FAIR principles



Fully exploit novel digitalised manufacturing processes in a **fully digitalised and vertically integrated supply chain**

**rapid, reliable, and secure access to holistic metrology data**

**Absolute confidence in decision making** at all points in the manufacturing workflow



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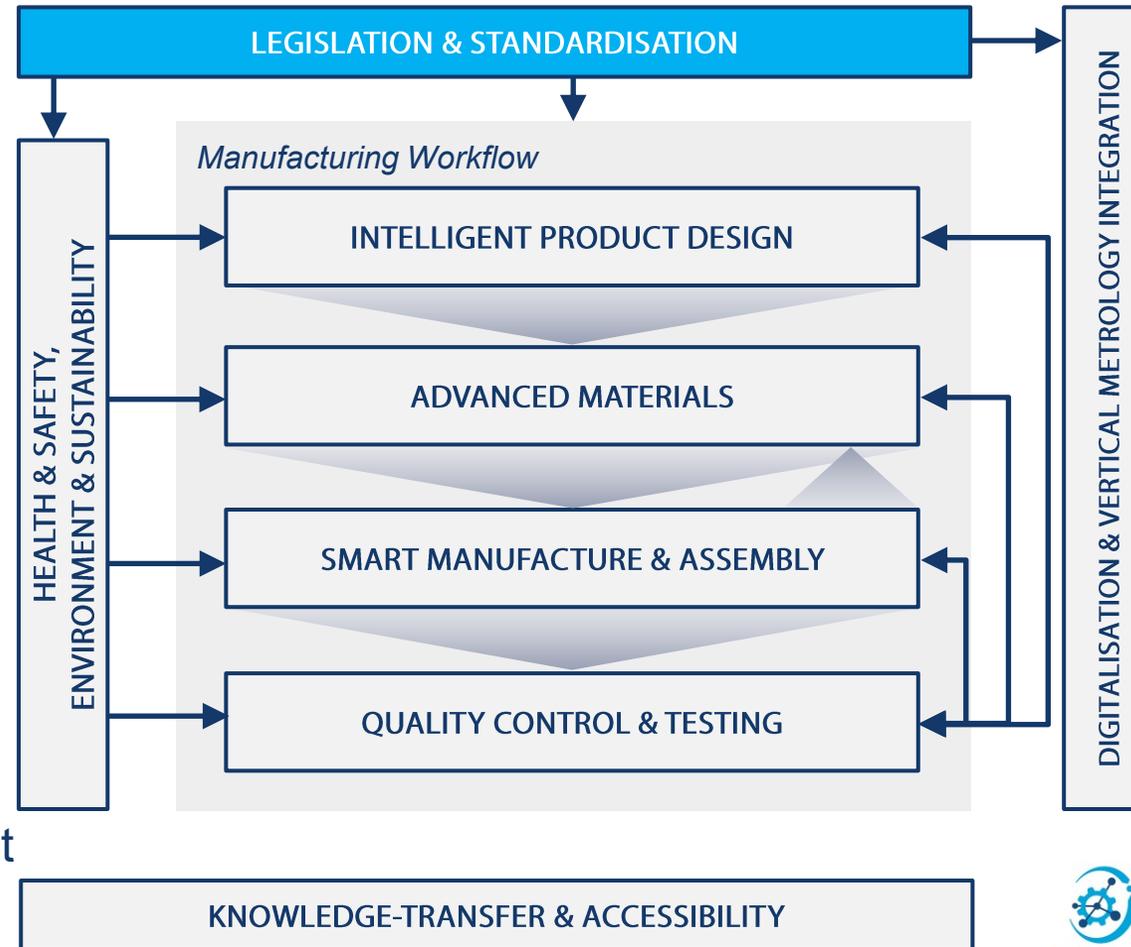
# LEGISLATION & STANDARDISATION



Harmonise metrology approaches

Establish a safe, sustainable, and globally competitive manufacturing infrastructure in Europe

Pre-normative research and standardisation of measurement and test methods



Implementation of machine-readable standards, protocols and certificates

Enabling rapid product conformance assurance concepts

Leverage the European Digital Transition



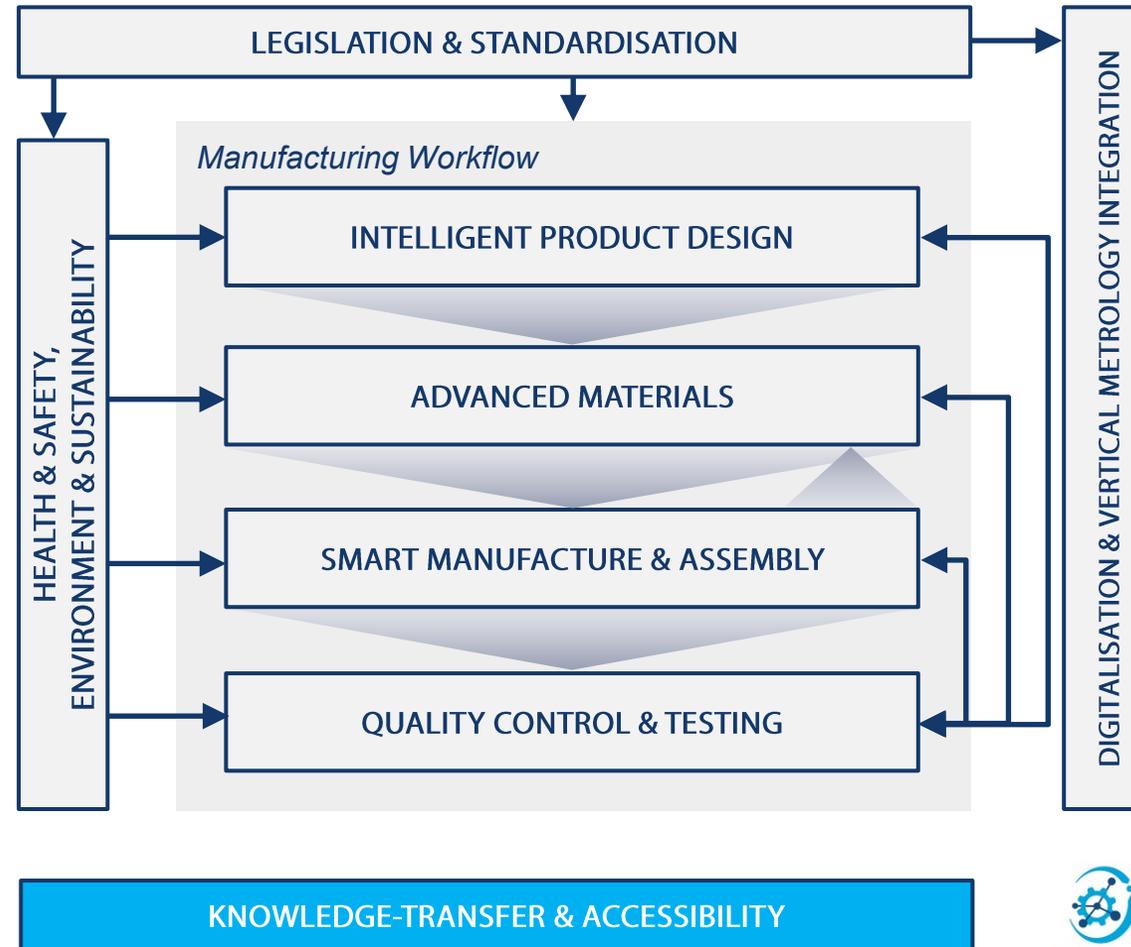
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# KNOWLEDGE-TRANSFER & ACCESSIBILITY



Transfer of metrology knowledge and skills into industrial application

Development of a **skilled knowledge base** for topics relevant in metrology for advanced manufacturing



Digitalised and harmonised metrology training (e-learning), good practice guides (wiki like), and standards (AI assisted translations and access)

Enable access to experts for both **bespoke** and **specific general metrology training**



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# Links, Contacts, & Acknowledgements



**Thank you** very much for your guidance, support, and input as stakeholders.

Further feedback and comments are welcome at anytime!

Website: <https://www.euramet.org/european-metrology-networks/advanced-manufacturing>

SRA: <https://www.euramet.org/european-metrology-networks/advanced-manufacturing/strategy/strategic-research-agenda>

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