

Digital manufacturing

V1.0 – April 2026

CATAPULT
High Value Manufacturing



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Digital manufacturing

The application and development of connected data, automation, digital twins and cyber-physical systems to plan, control and optimise production processes, improving efficiency, quality, agility and real-time operational performance within factories and supply chains.

Why: Demand drivers

- Advanced, data-driven and digitalised manufacturing to improve productivity and competitiveness
- Address knowledge capture and retention challenges through digital technologies
- Robust data governance and management frameworks to ensure secure, decentralised and effective use of manufacturing data
- Increase digital literacy, trust and industry-wide data sharing to drive effective digitalisation and meet rising user expectations
- Circularity, sustainability and future-proofing through advanced analytics, life cycle analysis and resilient supply chains.

What: Priority industry capability needs

- Agile, connected manufacturing through interoperable reference architectures, digital threads and distributed supply chains
- Integrated process optimisation linking automation, digital twins and connected enterprise systems
- AI insights that are trustworthy, validated, ethical and transparent
- Intelligent and flexible production utilising connected supply chains
- UK-wide manufacturing digital skills framework encompassing education and professional development
- Manufacturing scalability of quantum technologies, i.e. sensing, computing, timing and cryptography.

How: Priority innovation requirements

- Development of ontologies, interoperable frameworks, digital passports and collaborative platforms to establish robust data and knowledge management
- AI-integrated modelling, simulation and process control using statistical, machine learning and advanced analytics methods for manufacturing effectiveness and validation
- Implement and demonstrate validated end-to-end data-sharing platforms, visualisation and digital passports within a governance framework to ensure consistent data models and interoperability
- Demonstrators for interoperable, cyber-secure and governed data management and sharing platforms advocating industry standards.



HVM Catapult's digital manufacturing vision and roadmaps chart a path to a connected, data-driven ecosystem where interoperability, AI and digital twins drive agility, resilience and sustainability. Our centres are already delivering collaborative, human-centric solutions, from federated factories to digital threads, that empower the workforce and accelerate innovation. Our ambition is to make the UK the global benchmark for high-value, digitally enabled manufacturing.

Key HVM Catapult capabilities in digital manufacturing

Digital engineering, technology and innovation programme, NCC (Bristol)

Driving digital transformation across design, engineering and manufacturing with connected data environments, simulation-driven workflows and industry collaboration to accelerate innovation, reduce development time and enhance competitiveness in advanced sectors.

Digital Factory, NMIS (Renfrew)

Enabling connected engineering and manufacturing, supporting industry with additive and subtractive manufacturing, robotics, automation, AI and data analytics to boost productivity, sustainability and innovation.

Digital factory hub, AMRC Cymru (Broughton)

Empowering high-value manufacturing through integrated digital infrastructure, cyber-physical systems, real-time data analytics and automation to accelerate smart production, workforce upskilling and industrial adoption across advanced sectors.

Digital manufacturing accelerator, MTC (Liverpool)

Advancing intelligent production through industrial digitalisation, robotics and automation, data-driven optimisation and cyber-physical systems to enhance productivity, resilience and high-value manufacturing capability across regional and national supply chains.

Factory 2050, AMRC (Sheffield)

Delivers advanced automated assembly, large-volume metrology and digitally assisted assembly using VR, AR and manufacturing intelligence for complex, low-volume, high-value components.

Digital manufacturing test bench, WMG (Coventry)

With human-in-the-loop tool development for tool and operator tracking, enhanced by AR/VR. Advanced factory and process planning and optimisation enabled through 3D modelling and scalable visualisation, with the integration of discrete event simulation and digital twin technologies, supported by the use of structured data for AI across the automation life cycle, alongside vendor-agnostic control code generation.

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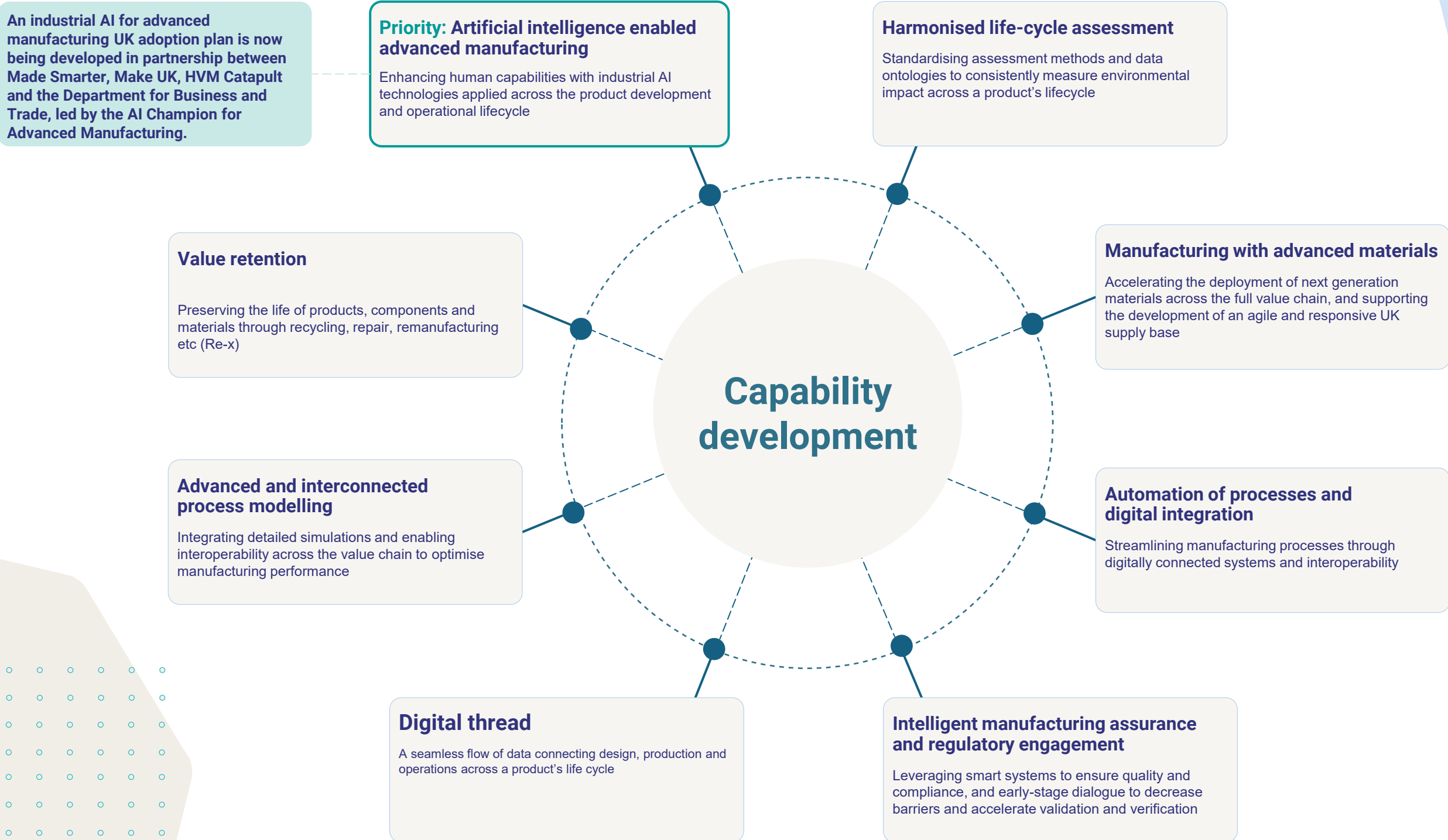
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Connected technology platforms

Through cross-domain analysis, eight connected technology platforms have been identified. They underpin both the core advanced manufacturing process technologies and the cross-cutting enabling technologies set out in this strategy.

They provide a shared foundation of insight and collective capability, showing where coordinated effort across our domains can best strengthen, connect and accelerate the technologies that matter most to UK industry.



Interpreting our roadmaps

The strategy structure

Why: Demand drivers

External pressures or opportunities that create the need for new or improved manufacturing capabilities.

What: Industry capability needs and priorities

The practical abilities industry must have to remain competitive in the future and the priorities for HVM Catapult.



Priority industry capability needs

The most critical capability gaps identified through industry consultation that must be addressed first to deliver impact.

How: Innovation requirements and priorities

The specific technologies, tools, processes, data, skills or system enablers that must be developed, improved or integrated to meet future industry capability needs, and the priorities for HVM Catapult.

Connected technology platforms

Highlight where coordinated effort across our domains can best strengthen, connect and accelerate the technologies that matter most to UK industry

Roadmap activity examples

Establish test beds to develop, integrate and validate novel inspection, measurement and test techniques and processes.

Demonstrated the trustworthy comparative robustness of emerging inspection, measurement and test technologies

The above 'what' items are linked and dependent – denoted by the overlapping boxes

Deployment of increased mechanization to remove variability and increase standardization linked to respective process specifications

Standardised digital weld procedures, reusable qualification libraries, harmonised standards

The above 'how' discrete items that are not linked and occur in different time horizons

IUK Strategic imperatives



Alignment with the Innovate UK vision

Each demand driver is colour-coded to align with the four imperatives of the Innovate UK materials and manufacturing vision 2050.

Innovative and digital

Businesses drive continuous and transformative innovation and create, adopt and export advanced digital technologies

Resource-efficient and regenerative

Sectors maximise circularity of materials, energy and water and aim for a net positive impact on the environment

Resilient and responsive

Mitigating risks from supply chain disruptions, national/global crises, and climate change.

Skilled and empowered

Workforces are highly skilled in executing advanced tasks and are empowered by configurable, open technology stacks

Digital manufacturing



Further details of the demand drivers, industry capability needs and innovation requirements are available online. Follow the QR code or [click here](#).

Vision

By driving widespread adoption of digital manufacturing across UK industry, we can unlock transformative gains in productivity, efficiency and global competitiveness. These advancements will not only strengthen supply chains and sustainability but also create high-quality jobs, elevate skills and deliver long-term prosperity for the nation.



2026

2030

2035

2040

Advanced, data-driven and digitalised manufacturing to improve productivity and competitiveness

Address knowledge capture and retention challenges through digital technologies

Robust data governance and management frameworks ensure secure, decentralised and effective use of manufacturing data

Increase digital literacy, trust and industry-wide data sharing to drive effective digitalisation and meet rising user expectations

Circularity, sustainability and future-proofing through advanced analytics, life cycle analysis and resilient supply chains

Advanced simulation for manufacturing optimisation, uncertainty quantification and process qualification to reduce costly trials and accelerate innovation

Intelligent and flexible production utilising connected supply chains

Unified digital demonstrators, automation, sensors and robotics for efficient, traceable and sustainable manufacturing adoption

Digital platforms for knowledge capture, traceability and skills frameworks supporting assurance and lifelong engineering development

Sustainable design and digitalisation to minimise waste and maximise resource recovery

Integrated process optimisation linking automation, digital twins and connected enterprise systems

AI insights that are trustworthy, validated, ethical and transparent

UK-wide manufacturing digital skills framework encompassing education and professional development

Agile, connected manufacturing through interoperable reference architectures, digital threads and distributed supply chains

Demonstrate operational cyber security monitoring and resilience of digitally connected assets

Development of ontologies, interoperable frameworks, digital passports and collaborative platforms to establish robust data and knowledge management

Manufacturing scalability of quantum technologies, i.e. sensing, computing, timing and cryptography

Validated AI models enabling optimisation, transparency and advanced analytics for manufacturing

Demonstrators for interoperable, cyber-secure and governed data management and sharing platforms advocating industry standards

AI-integrated modelling, simulation and process control using statistical, machine learning and advanced analytics methods for manufacturing effectiveness and validation

AI-powered personalisation, generative models and automation for enhanced manufacturing efficiency and learning

Autonomous and remotely operated systems to support predictive maintenance and real-time monitoring for extending component life

Key

Demand drivers

Why change is needed.

Industry capability needs

What capabilities industry needs to respond to these changes.

Innovation requirements

How capabilities must develop.

Priority industry capability needs

The most critical capability gaps identified through industry consultation that must be addressed first to deliver impact.

Digital manufacturing – demand drivers

Advanced, data-driven and digitalised manufacturing to improve productivity and competitiveness

Data-driven process control and simulation models increase productivity, performance, and energy efficiency.

Robotics, automation, and control systems enable scalable, flexible manufacturing for diverse applications.

Digital twins and lean manufacturing principles support continuous improvement and process intensification.

Adoption of digitalisation enhances quality, cost savings, and sustainability across manufacturing operations.

Advanced simulation for manufacturing optimisation, uncertainty quantification, and process qualification to reduce costly trials and accelerate innovation

Address knowledge capture and retention challenges through digital technologies

Workforce development initiatives build digital skills across the entire manufacturing value chain.

Addressing the knowledge cliff ensures continuity as experienced workers retire from the sector.

Digital capabilities support compliance with cGMP and advanced manufacturing requirements.

Upskilling enables adaptation to new technologies and evolving industry standards.

Circularity, sustainability, and future-proofing through advanced analytics, LCA, and resilient supply chains

Standardised LCA and carbon accounting frameworks quantify sustainability benefits and ecological impact.

Circularity principles drive resource efficiency, waste reduction, and sustainable manufacturing practices.

Advanced analytics and digital threads enhance traceability and transparency in supply chains.

Future-proofing strategies include agile development and resilient, sustainable design methods and tools.

Remanufacturing strategies extend product lifetimes, retain embedded value, and significantly reduce material use, energy demand, and carbon emissions

Increase digital literacy, trust and industry-wide data sharing to drive effective digitalisation and meet rising user expectations

Promoting digital literacy and awareness fosters organisational readiness for digital transformation.

Ethical frameworks and trust-building support responsible adoption of digital technologies.

Flexible working models and automation complement human roles in manufacturing environments.

Industry-wide collaboration on data sharing and security drives sector-wide innovation and resilience.

Robust data governance and management frameworks ensure secure, decentralised, and effective use of manufacturing data

Implementing data management systems supports ownership, security, and decentralised data access.

Knowledge management frameworks enable effective sharing and utilisation of manufacturing information.

Data governance ensures compliance with regulations and industry standards for data protection.

Decentralised data strategies enhance collaboration and innovation across manufacturing networks.

Industrial cybersecurity frameworks and digital resilience solutions for secure, authorised, and standards-compliant manufacturing operations.



Strategic summary

Digitalisation and automation are driving productivity and sustainability across manufacturing. Secure data governance combined with a skilled workforce enables transformation and innovation. Circularity and resilient supply chains ensure the industry remains future-proof and competitive.

IUK Strategic imperatives

- Innovative and digital
- Resource-efficient and regenerative
- Resilient and responsive
- Skilled and empowered



Digital manufacturing – Industry capability needs

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Technology domain specific

Integrated process optimisation linking automation, digital twins and connected enterprise systems

Unified digital demonstrators, automation, sensors, and robotics for efficient, traceable, and sustainable manufacturing adoption.

Digital platforms for knowledge capture, traceability, and skills frameworks supporting assurance and lifelong engineering development.

Digital Thread

Configurable, interoperable digital stacks enabling agile development, digital threads, and standardised datamodels integration

Integrated digital twins and material passports powered by advanced analytics

Agile, connected, manufacturing through interoperable reference architectures, digital threads and distributed supply chains

Artificial intelligence enabled advanced manufacturing

AI insights that are trustworthy, validated, ethical and transparent

AI-driven analytics with digital threads and interoperable twins for traceability

Manufacturing with advanced materials

AI-driven analytics with digital threads and interoperable twins for traceability

Value retention

Sustainable design and digitalisation to minimise waste and maximise resource recovery

UK-wide manufacturing digital skills framework encompassing education and professional development.

Harmonised life cycle analysis

Standardised LCA and carbon accounting frameworks for process optimisation and quantifying manufacturing sustainability benefits.

Automation of processes and digital integration

Intelligent and flexible production utilising connected supply chains

Intelligent manufacturing assurance & regulatory engagement

Comprehensive data and AI governance frameworks ensuring secure, FAIR, and quality-driven manufacturing data management and visualisation.

Industrial cybersecurity frameworks and digital resilience solutions for secure, authorised, and standards-compliant manufacturing operations.

Digital manufacturing – Innovation requirements

2026

2030

2035

2040

Technology domain specific

Digital manufacturing tools supporting scale-up of quantum technologies

Integrated systems engineering, quantum technologies, and hybrid cloud solutions for robust digital manufacturing infrastructure.

Workforce upskilling in digitalisation, data-driven manufacturing, cyber security and leadership through targeted training, literacy programmes and frameworks.

Validated AI models enabling optimisation, transparency, and advanced analytics for manufacturing

Testbeds, demonstrators, and learning labs for validating digital transformation strategies, de-risking investments of emerging manufacturing technologies.

Strategic partnerships with academia, other RTOs for innovation, IP development, and integration of digital manufacturing capabilities.

Leveraging digital manufacturing to attract investment, access funding, and enable innovative financing models.

Autonomous and remotely operated systems to support predictive maintenance and real-time monitoring for extending component life

Next-generation sensors, IoT, and automated inspection for comprehensive, real-time manufacturing data acquisition.

Advanced wireless, edge computing, and open APIs enabling seamless communication across manufacturing environments.

Open-source platforms and shared data repositories for technology agnostic, scalable infrastructure supporting accelerated adoption of industrial digital technologies.

Advanced ontologies, semantic frameworks, and digital tools for capturing and structuring manufacturing knowledge

Platforms and standards for secure data sharing, governance, and digital thread integration in manufacturing.

AI-driven modelling, simulation, and analytics for process optimisation, validation, and productivity improvement

AI-powered personalisation, generative models, and automation for enhanced manufacturing efficiency and learning.

Tools and platforms for circularity, sustainability, and traceable materials across the manufacturing value chain.

Testbeds, demonstrators, and learning labs for validating digital transformation strategies, de-risking investments of emerging manufacturing technologies.

Demonstrate operational cybersecurity monitoring & resilience of digitally connected assets

Value retention

Automation of processes and digital integration

Digital thread

Advanced and interconnected process modelling

Manufacturing with advanced materials

Intelligent manufacturing assurance & regulatory engagement

Digital manufacturing: Priority pathways

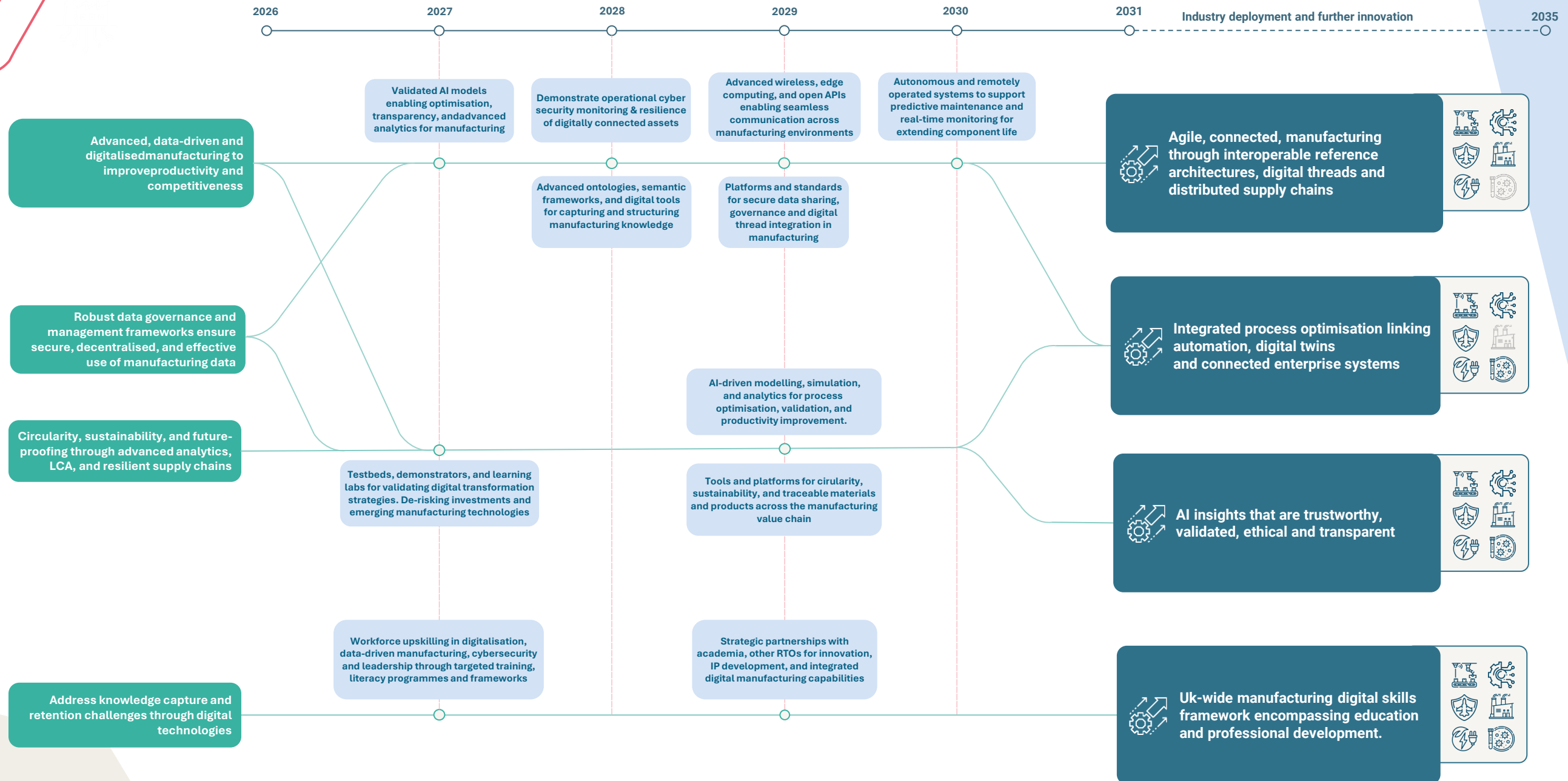


Diagram Legend

- Demand drivers**
Why change is needed
- Innovation requirements**
How capabilities must develop
- Industry capability needs**
What capabilities industry needs to respond to these challenges
- Priority industry capability needs**
The most critical capability gaps identified through industry consultation that be addressed first to deliver impact

Industrial strategy growth-driving sectors

- Foundation Industries
- Clean Energy Industries
- Digital & Technologies
- Life Sciences
- Advanced Manufacturing
- Defence