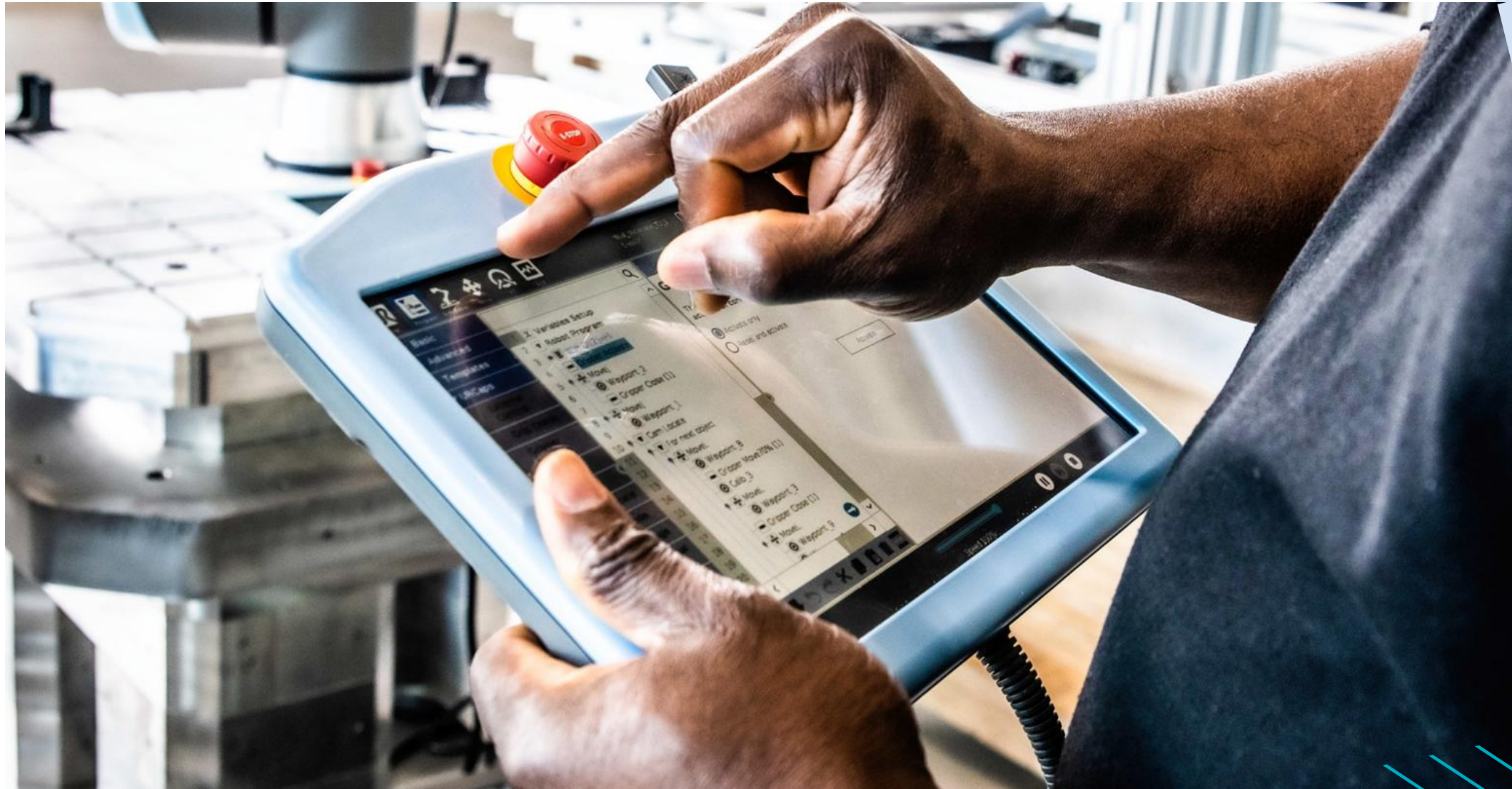


Robotics and automation

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Connect with us

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Robotics and automation

The use of robotics, machines and control systems to perform previously manual tasks, improving productivity, quality and safety.

Why: Demand drivers

- Automation enhancing manufacturing productivity and scale-up
- Mass customisation manufacturing through scalable, flexible and reconfigurable automation solutions
- Assembly / disassembly of high-mix, low-volume products and recovery or remanufacture of critical components and materials
- Maximise the value from the compliant use of data, digital threads and digital product passports
- Resource and energy efficient manufacturing through advanced design, virtualisation and innovative materials.

What: Priority industry capability needs

- Agile, intelligent, AI-powered automation systems, including autonomous systems supported by humanoid robotics for variable, customisable, reconfigurable and flexible production, with integrated quality control and safe operation in human-centric manufacturing environments
- Data-driven manufacturing using digital twins, real-time verification and cloud platforms for smart decision making
- User-friendly, plug-and-play systems with AI-enabled robotics to lower adoption barriers
- Targeted training programmes that upskill workers to operate, maintain and optimise advanced robotic automation technologies effectively
- Robotics systems capable of learning and adjusting operations autonomously in response to changing production conditions.

How: Priority innovation requirements

- Modular digital platforms for data, AI, digital twins and design components
- Sensor-integrated automation for process control, defect detection and quality
- AI embedded in robot controller systems for faster processors, smart network of sensors and application-driven sensing response
- Flexible automation, mobile robots and dexterous grippers
- Develop AI-enabled embodied autonomy for advanced manufacturing to enable autonomous and humanoid robotic systems to operate reliably in dynamic production environments.

The future competitiveness of UK manufacturing will be shaped by the targeted deployment of robotics and automation to raise productivity and enable rapid scale-up of manufacturing capability. Scalable, flexible and reconfigurable automation will support high-rate assembly in high-mix, low-volume production, reducing unit costs and accelerating industrialisation. Automation will also underpin recovery, repair and remanufacture of critical components, extending high-value assets life. Robotics-enabled virtualisation and advanced design methods will improve resource efficiency, strengthening manufacturing performance and operational resilience.

Key HVM Catapult capabilities in robotics and automation

Advanced autonomous systems, AMRC (Sheffield)

Delivers deployment-ready autonomous and robotic platforms capable of high-precision operation at full industrial scale and production rates, integrating advanced sensing, AI-driven control and real-time data feedback to ensure repeatability, productivity and quality assurance.

Automation and robotics accelerator programme, MTC (Coventry)

Supports SMEs and industry with rapid feasibility studies, system design, simulation and pilot-scale demonstration to accelerate the adoption of robotics and automation technologies with reduced technical and financial risk.

Digital factory hub, HVM Catapult Baglan (Port Talbot)

Showcases digitally connected automation, smart production lines and cyber-physical systems, enabling manufacturers to trial Industry 4.0 technologies and develop integrated, data-driven factory solutions.

Digital Process Manufacturing Centre (DPMC), NMIS and CPI, Renfrew

Delivers digitally enabled automation solutions integrating robotics, advanced process control, data platforms and virtual commissioning to optimise complex manufacturing workflows and support scalable, flexible production.

Innovate UK robotics proving ground, MTC, (Coventry)

Provides industrial-scale validation of robotic and autonomous systems in representative environments, enabling de-risked deployment, performance benchmarking, interoperability testing and accelerated commercial adoption across manufacturing sectors.

High-rate manufacturing testbeds, NCC (Bristol)

Open-access facility for industry to test, iterate and validate automated, high-rate processes for fundamental and novel materials manufacturing. Supporting digital infrastructure and IoT platform integrates adaptive manufacturing and verification technologies.

Digital automation lab, WMG (Coventry)

Supporting future factory development through advanced robotics and automation research, including tetrapod systems, AI-driven robotics, and sensing and perception solution development, while de-risking deployment via proof-of-concept laboratory build and testing. Also facilitating skills development through PLC and automation training suitcases, enabling practical engagement with industrial control systems.

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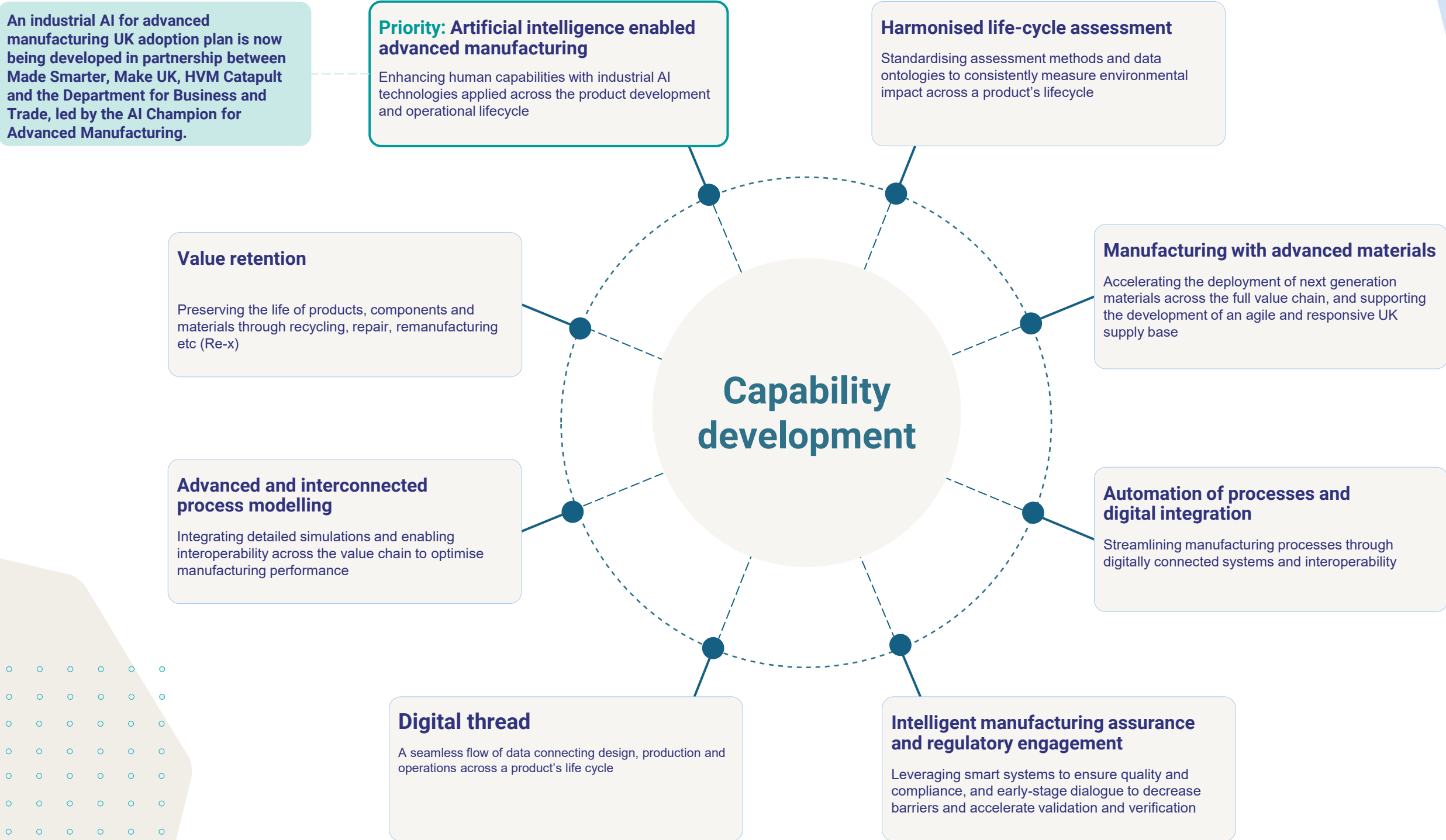
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Connected technology platforms

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

Robotics and automation



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

Vision

Agile, intelligent, AI-powered automation systems, including autonomous systems supported by humanoid robotics for variable, customisable and flexible production, with integrated quality control and safe operation in human-centric manufacturing environments.



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Maximise the value from the compliant use of data, digital threads and digital product passports

Automation enhancing manufacturing productivity and scale-up

Assembly / disassembly of high-mix, low-volume products and recovery or remanufacture of critical components and materials

Resource and energy efficient manufacturing through advanced design, virtualisation and innovative materials

Mass customisation manufacturing through scalable, flexible and reconfigurable automation solutions

Safe, adaptive human-robot work environments where cobots assist operators, boosting productivity and flexibility on the shop floor

Intelligent and adaptable automation and robotics solutions for sorting, segregation, disassembly and remanufacturing

Sensor-integrated automation for process control, defect detection and quality

Agile, intelligent, AI-powered automation systems for diverse and custom production with integrated quality control

Data-driven manufacturing using digital twins, real-time verification and cloud platforms for smart decision making

User-friendly, plug-and-play systems with AI-enabled robotics to lower adoption barriers

Widespread adoption of automation, with responsive UK-based supply chain with global recognition

Targeted training programmes that upskill workers to operate, maintain and optimise advanced robotic automation technologies effectively

Robotic systems capable of independent decision making, adapting dynamically to complex manufacturing environments without human intervention

Accessible training and low-code tools for automation adoption and development

A capable, UK-based automation supply chain

AI embedded in robot controller systems for faster processors, smart network of sensors and application-driven sensing response

Modular, adaptable robotic hardware platforms that can be rapidly reconfigured to suit changing production requirements

Innovative financial and operational frameworks to support sustainable investment and scaling of robotic automation technologies

Develop AI-enabled embodied autonomy for advanced manufacturing to enable autonomous and humanoid robotic systems to operate reliably in dynamic production environments

Physical process optimised by product performance through life via data

AI algorithms to assist operators and robots with predictive maintenance, quality control and process optimisation

Flexible automation, mobile robots and dexterous grippers

Modular digital platforms for data, AI, digital twins and design components

Intuitive, accessible human-machine interfaces that simplify robot programming, monitoring and interaction for diverse users

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.

Robotics and automation – Demand drivers

Mass customisation manufacturing through scalable, flexible and reconfigurable automation solutions

Reconfigurable robotic cells – Modular robotic stations can be rapidly retooled to accommodate frequent product variations seamlessly.

Flexible production lines – Automation enables real-time adaptation to shifting batch sizes and up-stream quality without interrupting manufacturing flow or efficiency.

Scalable automation architectures – Systems expand or contract capacity easily, supporting demand fluctuations and customised order requirements.

Integrated AI-driven planning – Intelligent scheduling optimised robot tasks for high-mix, low-volume personalised manufacturing environments

Rapid changeover technologies – Smart tooling and automated setup transitions significantly reduce downtime when switching between customised products

Assembly / disassembly of high mix, low volume products and recovery or remanufacture of critical components and materials

Robot learning for disassembly - Robots perform assembly tasks utilising novel AI techniques, handling variant parts, uncertainty and rework with minimal re-teaching and operator input.

Reconfigurable disassembly facilities - Modular cells and facilities utilising mobile robots, quick-swap tooling enable rapid changeovers for short runs and high mix of products.

Maintenance, Repair and Operations - Automated disassembly, defect removal, remanufacture and testing to reduce turnaround and reliance on scarce skills.

AI-guided remanufacture - Automated triage, disassembly, repair strategy with verification towards required spec.

Critical component and material recovery - Safe robotic disassembly, sorting , segregation and traceability maximise reuse/refurbish yield before recycling.

Maximise the value from the compliant use of data, digital threads and digital product passports

Digital threads for traceability - enables seamless data connectivity across design, production, and lifecycle improves efficiency and decision-making accuracy.

Product passports for compliance - supports structured digital records ensure regulatory adherence while facilitating lifecycle management and sustainability reporting.

Data-driven optimisation – Collected operational data enables AI and automation systems to enhance process performance and reduce waste.

Secure, compliant data sharing - ensuring sensitive information is safely exchanged across supply chains without violating privacy or regulations.

Lifecycle insights for innovation – Analytics from digital product data supports continuous product improvement and strategic planning.

Resource & energy efficiency through advanced design, virtualisation and innovative materials

Optimised energy use – Digital twins and simulations streamline workflows, reducing energy consumption and material waste across production cycles.

Virtualised process simulations – Simulation-driven layout and workflow design enable efficient automation, minimising resource use and downtime.

Innovative materials – Lightweight, advanced materials reduce robotic handling loads, improving system efficiency and energy requirements.

Precision and low-waste production – Advanced design tools guide robots to minimise scrap generation and maximise resource utilisation consistently.

Sustainable product development – Integrated eco-design and virtual modelling support environmentally conscious manufacturing with intelligent, energy-efficient robotics.

Automation enhancing manufacturing productivity and scale-up

Accuracy and consistency – Sensor-enabled automation improve task quality, allowing workers to focus on higher-value decision-making activities.

Agile production – Reconfigurable robotic stations enable rapid task changeovers, supporting efficient small-batch and personalised manufacturing.

Resilient intralogistics - AMRs/AGVs and automated goods-to-person systems reduce dependency on labour, improve material availability at point-of-use, and keep lines running during disruption.

Automated recovery and rework– Inline inspection plus robotic rework/sortation contains quality escapes early, preserving throughput when incoming parts or suppliers vary.

Scalable capacity with standardised cells - Replicable “copy-exact” robot cells and modular automation let manufacturers add, move or duplicate capacity quickly across lines and sites.

Strategic summary

The future competitiveness of UK manufacturing will be shaped by mass-customisation delivered through scalable, flexible and reconfigurable automation. Enabling high-rate assembly of high-mix, low-volume products, alongside the recovery and repair of critical components to extend asset life. Automation and Robotics adoption in UK manufacturing will significantly boost productivity and competitiveness. In parallel, resource and energy efficiency will be driven by advanced design methods, virtualisation and innovative materials, raising manufacturing productivity while strengthening supply-chain resilience in an increasingly volatile global environment.

IUK Strategic imperatives

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



Robotics and automation – Industry capability needs

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Technology domain specific

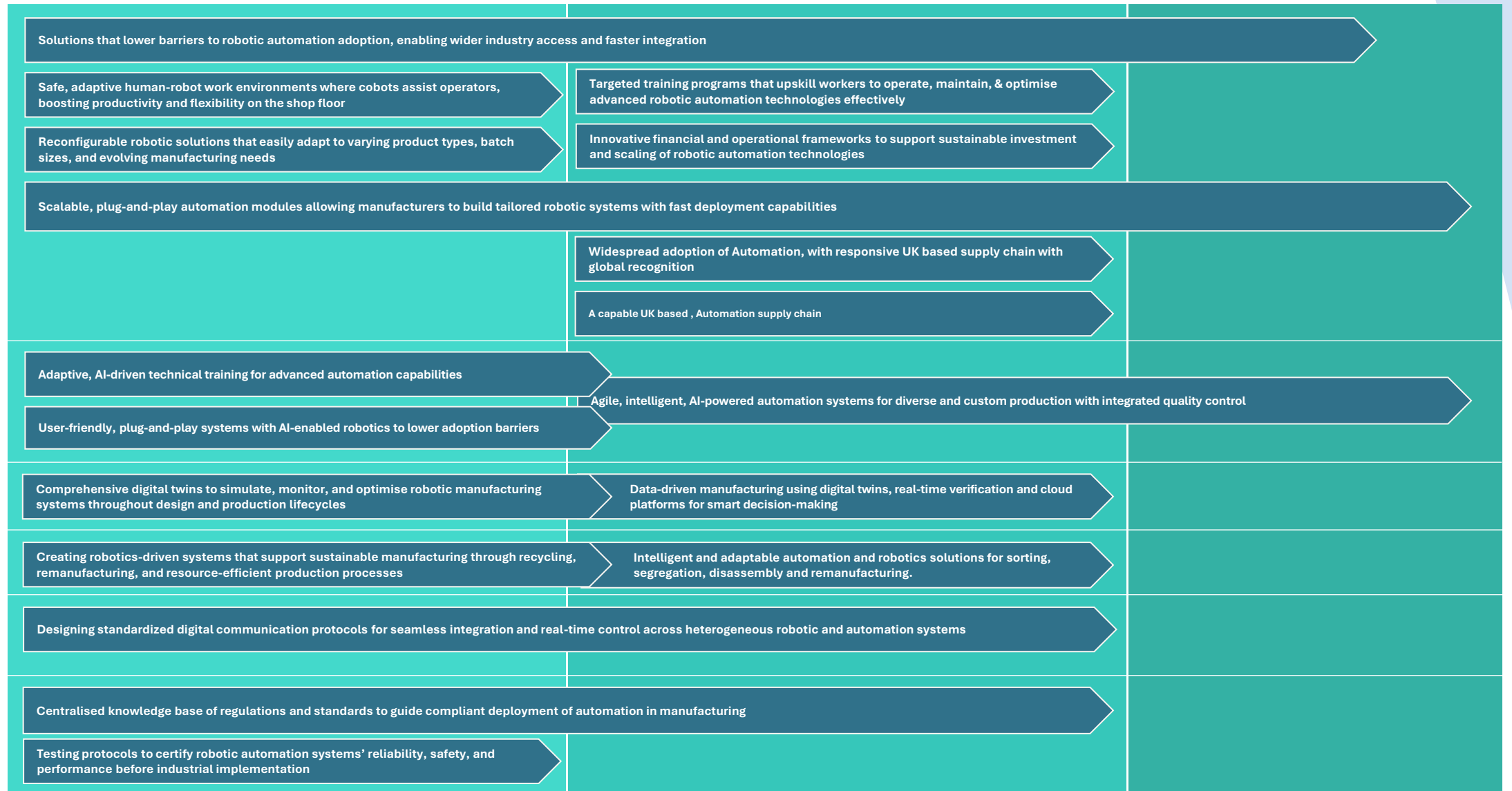
Artificial intelligence enabled advanced manufacturing

Digital thread

Value retention

Advanced and interconnected process modelling

Intelligent manufacturing assurance & regulatory engagement



Robotics and automation – Innovation requirements

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Technology domain specific

Secure cloud platforms to enable remote control, monitoring, and collaborative operation across sites

Modular robot systems that scale flexibly with production needs, enabling rapid deployment and reconfiguration

Scalable automation business frameworks that lower investment risks and enhance return on robotic technology adoption.

Accessible training and low-code tools for automation adoption and development

Modular, adaptable robotic hardware platforms that can be rapidly reconfigured to suit changing production requirements

Flexible automation, mobile robots and dexterous grippers

Intuitive, accessible human-machine interfaces that simplify robot programming, monitoring, and interaction for diverse users

Artificial intelligence enabled advanced manufacturing

Real-time sensor data streams for immediate process adjustments and enhanced robotic system performance

Advanced real-time simulation models and communication protocols to support precise, coordinated robot motion and control.

Robotic systems capable of independent decision-making, adapting dynamically to complex manufacturing environments without human intervention

Control architectures enabling robots to autonomously adapt to real-time manufacturing changes and unexpected conditions

AI algorithms to assist operators and robots with predictive maintenance, quality control, and process optimisation

AI embedded in robot controller systems, faster processors, smart network of sensors, application driven sensing response

Digital Thread

Detailed digital replicas of manufacturing systems to simulate, monitor, and optimise robotic operations in real time

Physical process optimised by product performance through life via data

Modular digital platforms for data, AI, digital twins and design components

Value retention

Tools for continuous monitoring, updating, and maintenance of robotic systems to extend operational lifetime.

Energy-efficient and resource-saving principles within automation design to support net-zero manufacturing targets

Intelligent manufacturing assurance & regulatory engagement

Accessible software libraries that accelerate development, integration, and reuse of robotic automation components and algorithms

Ergonomic, safety-conscious automation solutions that enhance operator wellbeing and seamless human-robot collaboration

Robust cybersecurity measures to protect automated manufacturing systems from cyber threats and operational disruptions

Standards to verify safety, reliability, and performance across robotic automation technologies

Open platform protocols to enable interoperability and seamless integration of heterogeneous automation and robotic components

Automation of processes and digital integration

Collaboration between software, hardware, and process engineers to accelerate integrated robotics innovation and deployment

Connected automation systems that improve supply chain responsiveness and enable synchronized manufacturing across distributed sites

Sensor-integrated automation for process control, defect detection and quality

Augmented and virtual reality tools for simulation, operator training, and remote robot monitoring and control

Collaborative, open-source digital design frameworks that enable faster, modular development of automated robotic manufacturing systems

Robotics and automation: priority pathways

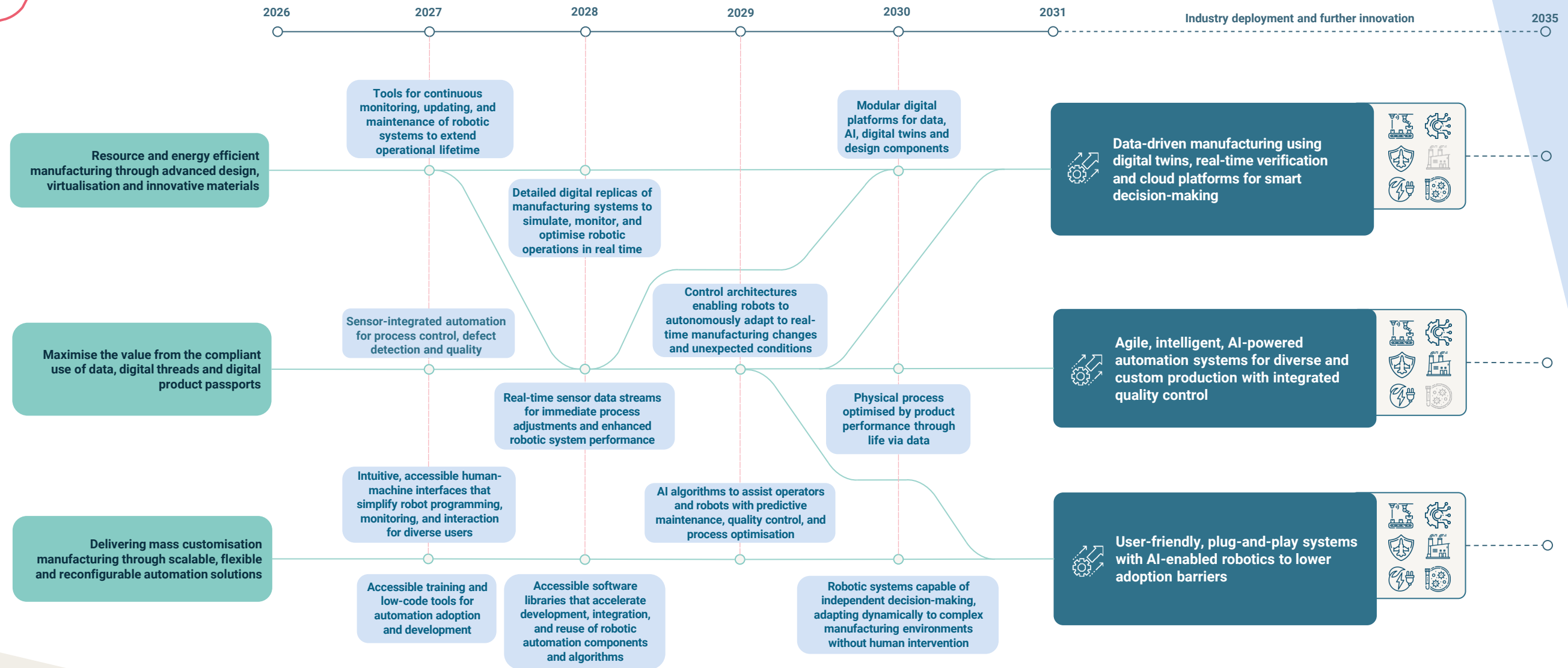


Diagram Legend

- 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