

BRIEFING SUMMARY

# Automatic Control Engineering: A Strategic Capability for the UK

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The UK's prosperity, security and long-term competitiveness increasingly depend on its ability to build, govern and operate complex automated systems. Automatic Control Engineering (ACE) provides the mathematical, computational and systems-engineering foundations that make this possible. It is the hidden infrastructure on which modern society depends.

AI models alone cannot guarantee safe behaviour under novel or uncertain conditions. Learning-based components must operate within stable, verifiable and constrained architectures. ACE provides the tools that make this possible, stability, fault detection, safety enforcement and system-level certification. Without strong control capability, AI cannot be deployed at scale in regulated sectors.

The UK has national programmes for AI, quantum technologies and engineering biology. It has no equivalent for the discipline that connects all of them to safe physical action. This briefing summarises the ACE Network's Position Paper and its main findings and recommendations.

## Why ACE Matters

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Control engineering makes physical systems do what they are supposed to do, reliably, safely and in real time, even under uncertainty. The demands on it are growing fast. Energy grids with high renewable penetration are harder to stabilise. Vehicles, surgical robots and defence platforms are being asked to act with greater autonomy. Manufacturing is combining physical machinery with AI in ways that create new control problems.

ACE is especially important in the age of AI. AI can predict what may happen; it cannot by itself guarantee what will happen next. The gap between prediction and safe physical action is what control engineering addresses. In transport, energy, healthcare and defence, regulators require assurance at the level of system behaviour. Stability guarantees, robustness, fault handling and system-level verification are what make intelligent systems deployable in safety-critical sectors.

The economic stakes are significant. ACE-dependent systems underpin over £500 billion in gross value added across energy, manufacturing, transport, healthcare, telecoms and defence. Advanced control strategies deliver 15–30% productivity improvements and 5–20% reductions in industrial energy use. The Made Smarter Review identified £183.6 billion of value at stake from automation and robotics in UK industry. ACE is the engineering foundation that unlocks it.

## The UK's Position

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The UK has genuine strengths in Automatic Control Engineering. There are over 1,000 active researchers across 30+ research groups and centres at 20+ universities. The EPSRC-funded ACE Network connects over 500 researchers and 23 industry partners, with demonstrated capacity for national coordination and roadmap development.

Critical gaps remain. The UK has around 111 industrial robots per 10,000 manufacturing workers, compared with 429 in Germany, 419 in Japan and over 1,000 in South Korea. UK labour productivity has grown at just 0.4% per year over the past decade. This is less than a third of the G7 average, and multiple analyses link this in part to weak adoption of automation, digitalisation and advanced process control.

Unlike AI, quantum and materials, ACE has no dedicated national programme, no nationally coordinated capability, limited shared testbed infrastructure, weak translational pathways to industry, and a constrained skills pipeline. Competitor nations are investing through sustained long-term programmes in industrial automation and autonomous systems. The UK is not.

## Five Mission Domains

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The Position Paper identifies five missions where strengthened UK capability in ACE would deliver the greatest national impact.

**Trusted Intelligent Autonomous Systems.** As AI systems move into vehicles, factories, hospitals and national infrastructure, ACE provides the control frameworks, assurance tools and verification methods that make them trustworthy, certifiable and deployable. Safe autonomy requires more than capable AI, it requires system-level guarantees.

**Clean and Secure Growth.** A renewables-dominated energy system requires advanced real-time control to maintain stability and affordability. Modern manufacturing relies on automation and optimisation to stay competitive. ACE drives clean growth while delivering reduced energy costs and higher industrial productivity.

**Health, Life Sciences and Ageing.** Control engineering underpins precision bioprocessing, medical device safety, robotic surgery and assistive technologies. Closed-loop control can reduce manufacturing variability in cell and gene therapy by 30–50%. ACE will improve NHS efficiency and accelerate life sciences manufacturing.

**Resilient Mobility and Infrastructure.** Rising demand, climate pressures and cyber-physical risks require robust control and resilience frameworks for transport networks and national infrastructure. ACE delivers predictive optimisation and distributed control for systems from rail and road to energy and water and provides the control foundations for next-generation autonomous mobility.

**Defence, Space and Sovereign Capability.** Every uncrewed platform depends on control engineering for guidance, navigation and safe operation. The quality of control algorithms is an increasingly decisive factor in defence capability. Sovereign capacity to verify, certify and assure autonomous defence and space systems cannot be outsourced.

## Three National Actions

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The Position Paper calls for three coordinated actions.

**Now: ACE Network+.** Transition the existing ACE Network to a sustained national coordination body. Deliver the 2025–2035 Research and Innovation Roadmap, seed funding for mission-aligned research and doctoral training support.

**Next: UK Centre of Excellence for Future Automation and Control Engineering.** A federated Centre providing shared infrastructure, national-scale cyber-physical testbeds, system-level verification and certification capability, and national workforce development. Hosted by a university consortium with satellite hubs aligned to mission domains and joint governance with UKRI.

**Destination: UK National Programme in Future Automation and Control Engineering.** Sustained investment positioning ACE as a recognised strategic capability within UKRI's mission-aligned programmes, funding competitive research, large-scale demonstrators and cross-sector pilots in energy, defence, health and mobility. The US, Germany and China already operate comparable programmes.

The three form a single integrated structure: the Network+ coordinates the community, the Centre provides national-scale infrastructure and technical leadership, and the National Programme funds mission-driven research and innovation.

## **Enabling Priorities**

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Four priorities support the national actions: investment in nationally coordinated testbeds and regulatory sandboxes across energy, healthcare, autonomous mobility and cyber-physical security; a sustained national skills pipeline from doctoral training to CPD and technician education; greater UK participation and leadership in international standards bodies for autonomy and cyber-physical systems; and accelerated industrial adoption through Catapult partnerships, Robotics Adoption Hubs and demonstrator programmes.

## **The Case for Action**

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The UK has world-class research in ACE. It does not have the infrastructure, coordination or strategic investment to turn that into the national capability required. A coordinated national effort will accelerate progress towards net zero, enable safe AI-enabled autonomy, strengthen UK life sciences, improve infrastructure resilience and boost manufacturing productivity. Investment is needed now.

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*The Automatic Control Engineering (ACE) Network is a UK-wide research and innovation community uniting leading experts from academia and industry to advance next-generation automation and control systems. For more information visit [ukcontrol.org](http://ukcontrol.org) or contact [info@ukcontrol.org](mailto:info@ukcontrol.org).*