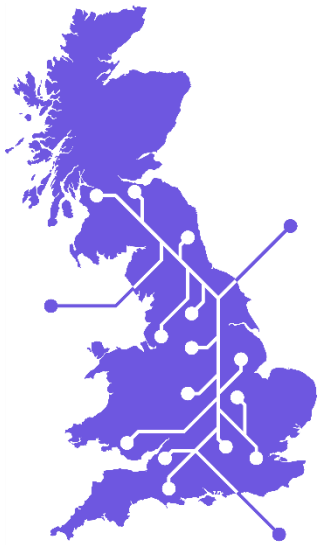
Centre for **A**utomation **T**echnologies to **A**dvance **L**aboratory **Y**ields, **S**tandards and **E**xperiments

Executive Summary: Chemical research is restricted by manual, one-off experiments that produce knowledge that is difficult to share, reproduce, or build upon. An automated centre will transform chemistry into a programmable science, allowing researchers to submit digital designs and print experiments, receiving reliable, standardised results for research and discovery. This approach will build an international library of validated knowledge for A.I. training and dramatically catalyse the creation of new medicines and advanced materials.

The Challenge: Over the past 200 years, chemical research has been executed manually. Each lab works in relative isolation, duplicating equipment and infrastructure, repeating work previously published. Data is fragmented and difficult to share in a usable way. **This systemic inefficiency wastes time, money, and talent, creating a critical bottleneck in fields from drug discovery, clean energy and materials science**. Ambitious ideas are frequently abandoned due to a lack of time and resources. The problem is not a lack of technology, but a lack of standardisation and coordination.

The Solution: CATALYSE will serve as a modern-day printing press for chemistry. The centre will be a shared, programmable platform where researchers submit digital designs and machines execute the experiments automatically, delivering standardised, reliable results. By outsourcing mechanical execution to automation, we enable users to "print" experiments and generate high-quality, national-scale datasets (including negative results) that fuel next-generation A.I. models**. Our core contribution is the missing digital backbone that links existing hardware, software, and analytics across academic, industrial, and governmental labs, transforming fragmented capacity into a coordinated, data-driven asset**. Automated workflows streamline operations, unlock 100x faster R&D pipelines for new medicines and materials, and train a new generation of researchers in programmable, reproducible science. *Figure 1: (Inter)National connectivity of existing infrastructure to maximise the autonomous output of UK R&D.*



To facilitate the adoption of this automated approach, the centre will exchange staff, tools, and expertise with users. To seed innovation directly, we will provide early-adopters with compact demonstration kits to practice new workflows, train users, and co-develop standards within their own laboratories, creating a grassroots network of expertise. Concurrently, the **insights gained from the distributed kits will infuse the centre with deep, domain-specific knowledge, ensuring our platforms are continually challenged to solve cutting-edge research problems**, creating a virtuous cycle of community-driven innovation. A structured secondment programme will then enable researchers from academia and industry to embed within our core teams, gaining direct experience with advanced digital workflows and centralised, high-value equipment not typically available in individual laboratories. This approach accelerates technology transfer as returning secondees serve as expert ambassadors, promoting the adoption of digital and automated chemistry across their home institutions. As a non-profit entity, the centre will function to democratise knowledge, prioritising openness, reproducibility, and community contribution. Access to the platform will be allocated through time-credit awards issued via competitive, peer-reviewed grant calls, ensuring that any researcher with a strong scientific vision can benefit from the system. This model complements rather than replaces local expertise, enabling researchers to maintain full intellectual leadership while outsourcing only the mechanical execution. Users retain all rights to resulting intellectual property, though non-proprietary datasets will be pooled within broader community resources to maximise scientific impact.

Why Now? The convergence of robotics, digital chemistry and A.I. and has finally matured to overcome a long-standing deficiency in the research ecosystem. Until today, the incentives and capabilities to build an open, shared platform did not exist. Universities naturally prioritised local needs, while private cloud-labs focussed on commercially-valuable contract research rather than transformative, pre-competitive infrastructure. This proposal brings the mission-oriented, collaborative approach required to unite existing capabilities into nationally-shared infrastructure that no single organisation could achieve alone.

The appetite is broad and immediate: researchers need access to world-class tools; pharmaceutical and materials industries require faster, more reliable innovation; the A.I. sector demands high-quality, standardised data; and the UK government seeks greater impact from its scientific investment. **Acting now launches the UK in a global race towards programmable, autonomous science.**

Costings for a centre on this scale is expected to be £50M over five years. This investment will cover capital and operational expenditure whilst accelerating the creation of a national ecosystem. Stage 1 will establish the centre as a legal and operational entity while developing the core software stack for remote execution. In parallel, demonstration kits will be deployed to thirty early-adopter research groups (£300K), seeding the community with the tools and training necessary to immediately refine our approach. Stage 2 will assemble a centralised hub embedded within existing, state-of-the-art university facilities to house thirty automation platforms across twenty fume hoods. The capital costs for this facility are at least £10 million, with ongoing operational costs for the five years estimated at £25M to support a dedicated team of fifteen scientific experts and fifteen technical staff. Stage 3 will commence once the centre is operational in year three and access is opened to all UK researchers through a competitive, peer-reviewed proposal system. The remainder of the initial investment (£15M) will be dedicated to ecosystem growth, providing substantial incentives for both academia and industry to iterate on our platforms. This funding will support secondments and joint development projects at no cost to our partners, ensuring the centre's technology and methods are continually co-developed with the community it serves. Once delivering value across chemistry, the centre will align within the UKRI's national infrastructure to secure long-term sustainability through established maintenance-grant mechanisms (~£2M p.a.). This hybrid funding structure ensures both the stability and the permanence required for the centre to become a cornerstone of UK science, explicitly, national in scope, community-driven in design, and built to innovate.

Impact: The centre will transform chemical sciences by establishing a national standard where human creativity pairs with automated, reproducible execution to "print" molecules on demand. Robotic platforms will raise scientific rigour, reduce costs, and accelerate the development of new medicines and sustainable materials, while freeing scientists from repetitive work so they can focus on innovation. By democratising access to advanced automation (vital in a constrained funding landscape) the centre ensures that no ambitious idea fails for lack of equipment and strengthens collaboration across the UK's research institutions.

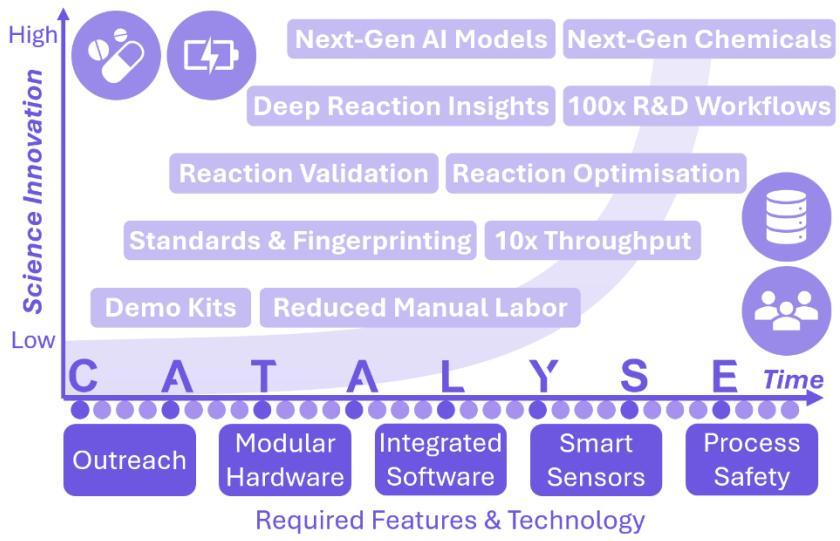


Figure 2: The foundational features and technologies developed within CATALYSE will drive parallel streams of scientific innovation, from dramatically reducing manual labour and enabling R&D workflows up to 100x faster, to deliver the next-generation of A.I. models and advanced materials.

Within five years, the centre will operate as nationally-recognised, mission-critical infrastructure with proven value, robust governance, and broad community support. The impact over ten years will extend far beyond chemistry. Biochemists will gain rapid access to small-molecule libraries, removing major bottlenecks in drug discovery. Computational and A.I. researchers will benefit from the high-quality, standardised datasets needed to power next-generation, predictive models with experimental grounding. **This will enable a truly closed-loop research where AI predicts molecules, robotic platforms test them, and the resulting data drives ever more capable models**. Ultimately, the centre will shift entire research fields from artisanal experimentation to reproducible engineering, boost national productivity, lower barriers for innovation, and train a new generation of automated scientists.