

Annual Review

2025

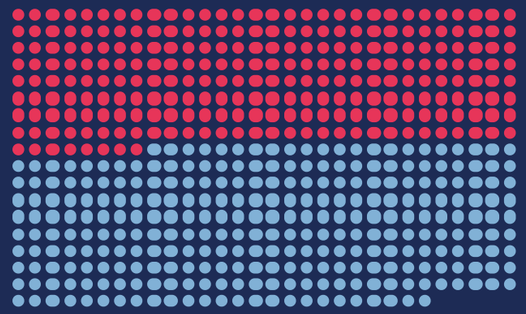
CMAC

15 YEARS AT A GLANCE

CMAC

01 / PROJECTS DELIVERED

535



248 INDUSTRY **287** ACADEMIC RESEARCH

Industry & academic research projects delivered with partners.

02 / FUNDING GBP

£90m



Secured across industry, EPSRC & innovation grants.

03 / PARTNERS ×139

139



64 INDUSTRY
52 ACADEMIC
23 TECHNOLOGY

Collaborative partners shaping our research agenda.

04 / PUBLICATIONS DOI

>300



+18% VS. PRIOR YEAR **72%** OPEN ACCESS

Peer-reviewed & open-access research publications.

05 / PHD RESEARCHERS EDD

173



PhD students trained across CMAC and partner universities.



inside this report

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A YEAR IN REVIEW

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Executive summary

From digital-first process design and self-driving DataFactories to sustainable manufacturing innovation and advanced material insights, our portfolio is delivering real impact.

Fifteen years of changing how medicines are made.

Since 2011 CMAC has grown from a partnership between three pharmaceutical companies and the EPSRC into a national capability of 170 people backed by £200m of cumulative investment and a network of 60 partners across 20 countries.

This year, our research moved from demonstration to deployment. MediForge proved an integrated digital workflow from synthesis to tablet, across Leeds and Strathclyde through secure, FAIR data sharing. The DM² Accelerator delivered six industry trials with partners including AstraZeneca, Shionogi and Lonza. With AstraZeneca, we scaled spherical agglomeration to 1000 L in Macclesfield.

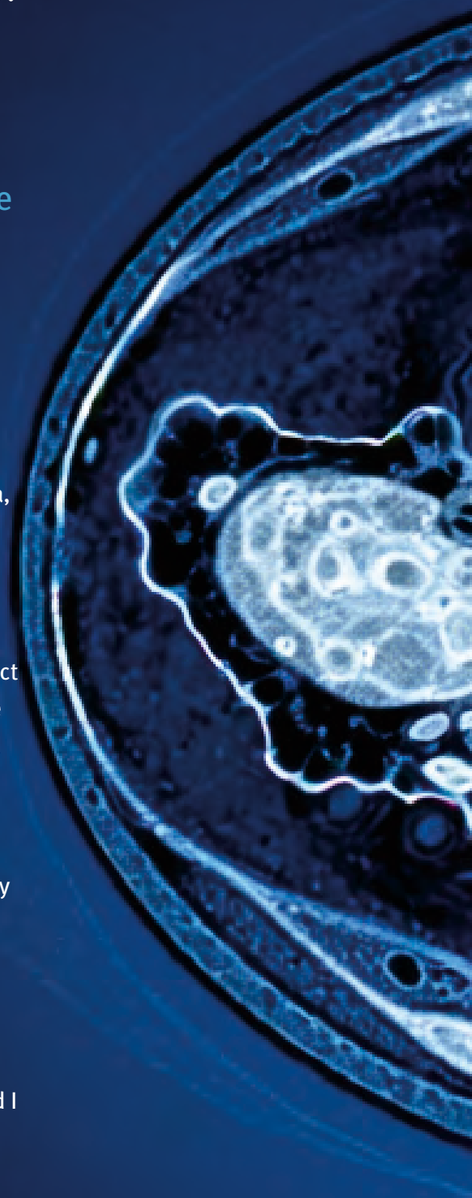
We also strengthened the routes that carry our science into industry. We launched OpenCMC™, a Strathclyde spin-out giving partners a direct route to deploy CMAC technologies. Through the Digital CMC CERSI, we trained more than 120 professionals and worked with five international regulators, including the MHRA and FDA, to build confidence in digital tools across the sector.

We supported 71 PhD researchers, 19 MSc students and 45 SkillsFactory courses. We also earned the Scottish Life Sciences 2026 Sustainability Award and three LEAF awards for our practices in sustainability.

Medicines shortages and supply pressures have made manufacturing resilience a national priority. CMAC is ready to lead that response. In March 2027, we will set out our 2031 strategy at our industry event, and I look forward to shaping it with you.

My sincere thanks to our colleagues, partners and funders, whose ideas, time and commitment make this ambitious, collaborative programme possible.

Professor Alastair Florence
Director, CMAC



OUR VISION

Vision.

To be a **globally leading research centre** to transform medicines **development, manufacture & supply.**

OUR MISSION

Mission.

To deliver **stakeholder value** through cutting-edge science, innovative technologies and workforce development to enable **advanced CMC approaches** for future drug supply.

THE WIDER CONTEXT

Responding to a system under pressure

Medicines shortages, rising supply costs and mounting pressure on manufacturing resilience have pushed pharmaceutical manufacturing reform to the top of the UK policy agenda. Government strategy, from the Industrial Strategy of Life Sciences Sector Plan to MHRA's 2025 guidance on modular point-of-care manufacture is actively reshaping the regulatory and investment landscape around advanced, distributed manufacturing.

CMAC's research portfolio is a direct response. Our work on continuous manufacturing and crystallisation shortens the path from molecule to medicine, building the science base and skills pipeline the UK needs to remain a world-leading life-sciences hub.

01 / THE CENTRE

Timeline.

From a 2011 partnership of three pharmaceutical companies to a national capability of 170 staff, researchers, academics and PhD students.

15
MILESTONE MOMENTS

£200m
CUMULATIVE INVESTMENT

170
TEAM IN 2025



2011

CMAC established in partnership with AstraZeneca, GSK, Novartis and the EPSRC Centre for Innovative Manufacturing.

2012

EPSRC Doctoral Training Centre launched welcoming 45 PhD students.



£11M
UK RESEARCH PARTNERSHIP INVESTMENT FUND

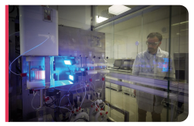
2013

Secured £11M UKRPIF investment.

2015

Relocated into £89M University of Strathclyde Technology & Innovation Centre.





2017

CMAC Future Manufacturing Research Hub launched.

2018

Milestone of 100 PhD students supported reached.



MADE SMARTER INNOVATION | DMV Digital Medicines Manufacturing

2021

CMAC celebrates its 10th anniversary. £5M Digital Medicines Manufacturing Research Centre (DM²) established.

2022

University of Strathclyde receives the Queen's Anniversary Award for Advanced Manufacturing. Net Zero UKRPIF.





2023

LEAF Award recognition. Total UKRPIF investment for Data Lab reaches £33.3M.

2024

CEDAR CDT launched. £11m MediForge programme begins. National Facility surpasses 1,000 project enquiries.





2025

CMAC hosts its 10th Open Days event.

2026

Strathclyde spinout OpenCMC™ launches to commercialise CMAC technologies.

OpenCMC

15 YEARS · 2011 TO 2026

Hero year Milestone

02 / THE CENTRE

Collaboration
that drives progress.

Through strong partnerships across academia, technology providers, and global pharma, we co-create and co-deliver solutions that have real impact.



60
PARTNERS

20
COUNTRIES

We work with a **network of organisations** spanning industry, academia, technology and strategy.

WHO WE WORK WITH

Tier One Industry Partners

AstraZeneca · Chiesi · Lilly · Pfizer · Roche · sanofi · SHIONOGI · Takeda · UCB

Translation to Industry Partners

CCDC · Ajinomoto Bio-Pharma Services · digiM · Lonza

Tier Two Industry Partners

ABITEC · ALTAIR · analytik · Applied Materials · Claire Scientific Limited · Dotmatics · DYNEVAL Dynamic Evaluation · Huxley Bertram · Laminar · Malvern Panalytical · M-Star · SHIMADZU Excellence in Science · SIEMENS · Snapdragon Chemistry · Syft · Technobis

Academic Partners

University of Bath · University of Cambridge · Ghent University · The Glasgow School of Art · Imperial College London · University of Leeds · Loughborough University · University of Strathclyde Glasgow · The University of Sheffield · The University of Nottingham · De Montfort University Leicester

Strategic Collaborators

Cancer Research UK · connected everything · cpi · diamond · UK Research and Innovation · Engineering and Physical Sciences Research Council · CMAC · Medicines & Healthcare products Regulatory Agency · Medicines Manufacturing Industry Partnership · NHS Calderdale and Huddersfield NHS Foundation Trust · NPL National Physical Laboratory · Research England · Scottish Enterprise · The Wolfson Foundation · NMIS National Manufacturing Institute Scotland · RESILIENCE UK Medicines Manufacturing Skills Centre of Excellence

03 / THE CENTRE

Strategic priorities.

CMAC is driving its strategic priorities for both Research and the Centre by: **(i)** continuing to strengthen **collaborative partnerships** across the research and innovation ecosystem and **(ii)** expanding a **diverse and sustainable programme portfolio** across our four strategic pillars.



Research Excellence and Intensity

01

See pp. 16-37

Outstanding Skills Development

02

See pp. 38-43

World-Class Facilities

03

See pp. 44-49

Exemplary Translation to Industry

04

See pp. 50-57

Research

Excellence and Intensity.



Research Excellence showcases the depth and impact of our research programmes as we shape the future of medicines manufacturing.

Our strategy is built on a diverse portfolio of research projects united by a clear vision: to transform Chemistry, Manufacturing and Controls (CMC) through the development of next-generation Cyber-Physical Systems (CPS) for the design, development and production of medicines. By integrating digital technologies with advanced manufacturing science, we are enabling faster, more reliable and more sustainable pharmaceutical development.

This work is built around an integrated framework that includes our Quality by Digital Design system, bringing together digital tools, experimental methods and automated workflows to design particles, products and processes efficiently and sustainably. Supporting this are three predictive, science-based classification tools.

Our academic community provides expertise across solid-state science, crystallisation and particle engineering, formulation, biorelevant performance, advanced characterisation and digital micro factories. Together, these capabilities deliver integrated, end-to-end solutions across the full medicines development pipeline.



QUALITY BY DIGITAL DESIGN · THREE CLASSIFICATION TOOLS

CCS

Crystallisation Classification System

Accelerates primary particle development.

MCS+

Manufacturing Classification System+

Guides route selection for optimal manufacturing pathways.

BPCS

Biorelevant Performance Classification System

Supports the design of products that deliver reliable therapeutic performance in the body.

PROJECT · RESEARCH EXCELLENCE · HEADLINE PROGRAMME



MediForge:

Advancing an Industry 5.0 future for sustainable medicines manufacturing.

> The way medicines are developed is changing, and so must the way they're made. Bridging this gap between scientific discovery and industrial application is at the heart of CMAC's mission.

£11m

DURATION
7 years

FUNDER
UKRI Engineering and Physical Sciences Research Council

ACADEMIC PARTNERS
Imperial College London, The Glasgow School of Art, University of Leeds, University of Sheffield, University of Strathclyde

INDUSTRY PARTNERS
13

CALL Manufacturing Hubs for a Sustainable Future Call 2.

THE PROGRAMME

About MediForge.

While drug discovery has become faster, smarter and increasingly data-driven, pharmaceutical manufacturing still faces challenges in flexibility, scalability and efficiency.

At its epicentre is MediForge, set to revolutionise the pharmaceutical landscape with its Industry 5.0 manufacturing approach, a vision championed by the European Commission that prioritises human-centric, sustainable, and resilient production while leveraging digital and green technologies to deliver societal value beyond efficiency. As CMAC's digital and physical testbed for continuous, digital and sustainable medicines manufacturing, MediForge is designed to bring together researchers, technology providers and manufacturers to accelerate innovation, de-risk implementation and shape the future of medicine production.

Now in its second year, MediForge has already achieved Milestone 1 and has already delivered major advances across sustainability, digitalisation, workforce capability and next-generation chemistry, manufacturing and controls (CMC).

The programme is built around the development of:

01

A novel **cyber-physical research infrastructure (CPRI)**.

02

A **world-first medicine development and manufacturing data fabric**.

03

An integrated, real-time **Digital Twin** for end-to-end CMC.

04

A reconfigurable **Make platform and microfactory test bed**.

05

A collaborative **Living Lab** embedding Industry 5.0 skills and principles.

06

A robust, human-centric **Quality by Digital Design (QbDD) framework**.

Collectively, these components create a step-change in understanding medicines design and manufacture, from molecule to finished product.

PROGRESS TO DATE · 01

Embedding sustainability
into research and operations.

Sustainability is a core pillar of MediForge and is being embedded systematically and measurably across research activities, infrastructure, and daily operations. **To date, the team has:**

01 **Baselined sustainability metrics** across the emerging CPRI.

02 **Started tracking impacts** from experimentation, modelling, travel and operations.

03 **Set initial targets** for improvement by Milestone 2 (Jan 2027).

04 Established a **network of sustainability champions** across teams.

This work ensures that sustainability remains an active design objective, shaping decisions on processes, technologies, workflows and infrastructure as the programme develops.



MILESTONE 2 HORIZON

Targets set **for Jan 2027**, with progress measured against the baseline established across the CPRI this year.

2027

PROGRESS TO DATE · 02

Establishing the
MediForge Living Lab.

The MediForge Living Lab is an open, collaborative ecosystem where academia, industry, regulators and healthcare partners can work together to co-create and test processes, technologies and products. **To date, we have:**

01 Embedded **new ways of working** across the entire research team.

02 Launched **MediForge-specific onboarding** and continuous professional development through the CMAC SkillsFactory online learning platform.

03 Established a **researcher community** that meets regularly to share insights.

04 Developed **human-centric digital tools**, led by The Glasgow School of Art, including:

- A Crystallisation Screening CMC DataFactory® augmented reality demo.
- An updated Tableting CMC DataFactory® AR demo.
- A prototype virtual AI lab assistant.



2026 HORIZON

The Living Lab will continue to expand in 2026 with the launch of an **Industry 5.0 Forum**, beginning with a community-led sustainability discussion.

2026

PROGRESS TO DATE · 03

Revolutionising CMC

through the cyber-physical research infrastructure.

MediForge is developing a fully integrated cyber-physical research infrastructure (CPRI) to enable system-level, data-driven CMC process design. Work in year two has focused on delivering **CMC Objective I**, targeting a fully integrated workflow from synthesis through purification to direct compression for immediate-release tablets. Achievements include:

01

Integrated DataFactories

A CPRI architecture has now been defined, and the following capabilities have been established:

- Closed-loop operation in DataFactories where predictive models autonomously optimise the next experiment.
- Demonstrated functionality in:
  - Crystallisation Screening CMC DataFactory® (CSDF)
  - Tableting CMC DataFactory® (TDF)
  - Integrated Dissolution CMC DataFactory® (DDF)
- Ongoing creation of a Synthesis Screening CMC DataFactory® (SDF) at the University of Leeds, linked to flow synthesis scale-up at the University of Strathclyde.

02

Knowledge Model & Digital Twin

MediForge is developing a **world-first system-level manufacturing knowledge model**, supported by:

- A curated MediForge model library.
- A new relational database system.
- An early-stage knowledge graph already demonstrated through two case studies delivered jointly with CMAC's DM² Accelerator and Data Lab projects.

03

MicroFactory Test Beds

MicroFactory test beds for **Drug Substance and Drug Product** have been established with drum drying capability set to complete August 2026. The team has:

- Demonstrated cross-unit-operation integration.
- Connected PharmaMV with the Drug Substance platform (with Applied Materials).
- Baselined capabilities ready for process research.

04

Applying the QbDD Workflow

To validate the CPRI, the team is applying the updated QbDD workflow using **paracetamol**, progressing it through Stages 1-4. Building on this, the first seven APIs have now been identified to take through the workflow, with work towards the next milestone focused on integrating screening, scale-up, and production-scale crystallisation, alongside upstream and downstream unit operations.

A new web-based QbDD user interface, the **QbDD Navigator**, is also under development, making the workflow more intuitive and reducing administrative overhead.

Industry collaboration is deepening too, with the launch of the Industry Exchange Programme, focussing on co-design and co-delivery of the MediForge programme.

Progress to date · 04

Demonstrating

cross-site integration.

L **Leeds**
SYNTHESIS · SDF

PARACETAMOL · FAIR DATA

S **Strathclyde**
SCALE-UP · CSDF · TDF · DDF

For the first time, MediForge researchers at Leeds and Strathclyde have shown:

01

Replicable flow synthesis and analytics for paracetamol across both sites.

02

Transferability between reactors, scales and analytical tools.

03

Secure and fully **FAIR data sharing**.

04

Early integration between crystallisation, tableting and dissolution within the QbDD workflow.



CRITICAL GROUNDWORK

This lays **critical groundwork** for future fully integrated end-to-end CMC workflows.

Looking ahead

Towards milestone two

and beyond.

MILESTONE 1

Apr 2026

CMC Objective I delivered, integrated workflow proven.

MILESTONE 2

Jan 2027

Sustainability targets, broader API portfolio, full digital twin progression.

Next steps include:

01

Integrating crystallisation across scales using the **Scale-Up CMC DataFactory® (SUDF)** and Drug Substance MicroFactory capability.

02

Expanding digital and modelling capability across the entire CPRI, supported by expertise from Imperial, Sheffield and the SolvIT project.

03

Progressing a **portfolio of APIs** through the full QbDD workflow.

04

Continuing to innovate **human-centric digital tools**, workflows and training.



MediForge is making **strong progress** across sustainability, digital infrastructure, agile research and CMC integration, positioning it well for its long-term vision.

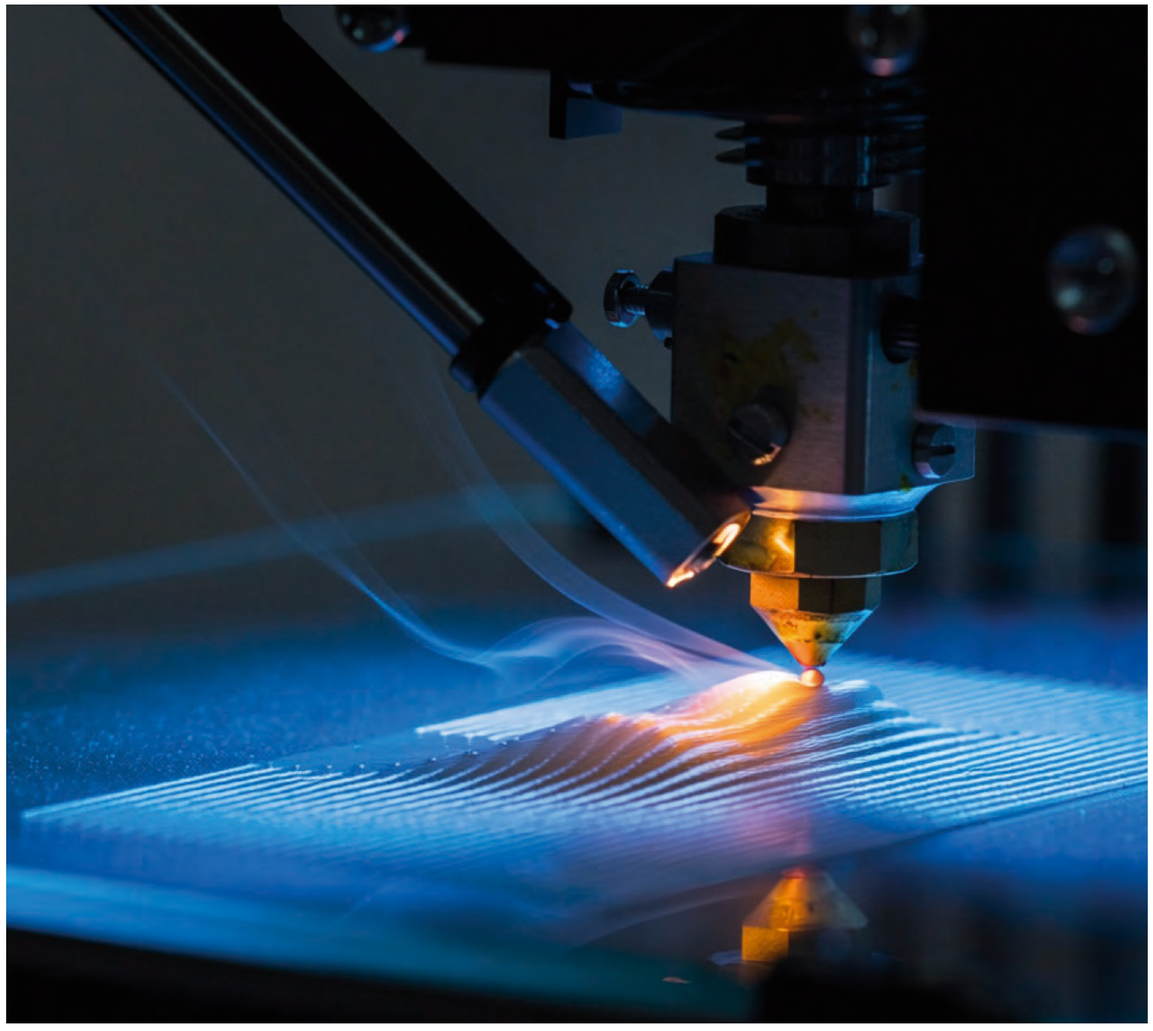
As it moves toward Milestone 2, the programme will advance integrated manufacturing, digital twins and human-centric tools, helping shape a **sustainable, data-driven future** for medicines manufacturing.

RESEARCH EXCELLENCE

01 Dialling up Performance for On-Demand Manufacturing

Building the digital foundations

for on-demand manufacturing.



£5.8m

DURATION
5 years

FUNDER
UKRI Engineering and Physical Sciences Research Council

ACADEMIC PARTNERS
University of Cambridge, University of Nottingham, University of Strathclyde

THE WORK

As part of the UK-wide Dialling Up Performance for On-Demand Manufacturing project, which aims to help industry make better, more functional materials through advanced 3D printing, CMAC has been focusing on improving the digital tools that make this possible.

The wider programme, led by the University of Nottingham, brings together expertise in materials, design and manufacturing to help companies adopt new 3D-printing technologies more easily.

Making materials data easier to use

This year, Dr Weiling Wang and the CMAC team have been building and refining a digital system designed to handle large amounts of materials data. This includes:

- A simpler, more reliable database structure.
- Easy-to-use dashboards shaped by partner feedback.
- Behind-the-scenes improvements that keep the whole system running smoothly.

These upgrades make it easier for researchers and industry partners to find, understand and use the data they need, an important step in developing quicker, more predictable materials screening workflows.

Using AI to make chemistry more predictable

Alongside this digital development work, Dr Wang published new research showing how combining machine learning with physics-based COSMO-RS calculations, a computer method used to predict how well drug molecules dissolve in different liquids. The study has demonstrated not just accurate predictions, but also why certain chemicals behave the way they do, making the results more trustworthy and easier to apply in real-world product development.

This approach supports one of the programmes goals: using smart, transparent digital tools to help speed up decisions in areas like pharmaceuticals and advanced manufacturing.

Bringing digital tools and real-world applications together

Overall, this year's progress brings CMAC's digital infrastructure and modelling work closer together. These advances help ensure that the data, tools and insights behind new materials are connected and accessible, making it easier for partners to design better products, faster.

CMAC continues to play a key role in the national effort to make advanced manufacturing more efficient, data-driven and ready for the future.





RESEARCH EXCELLENCE

02 SolvIT

SolvIT.

Sustainable solvent design for a greener, cleaner route to API manufacture.



£3.5m

DURATION
3 years

FUNDER
UKRI Engineering and Physical Sciences Research Council

ACADEMIC PARTNERS
Imperial College London, University of Strathclyde

INDUSTRY PARTNERS
1

THE WORK

Bringing together the University of Strathclyde and Imperial College London with multinational pharmaceutical company Lilly, this project aimed to tackle the industry's biggest challenges: improving efficiency and waste reduction.

The project has been delivered through three programmes of work:



01

Identification and use of sustainable solvents

A combination of computer modelling and experiments to evaluate greener solvents for chemical reactions in medicine synthesis, enabling new and existing processes to reduce waste and lower costs.



02

Integrated solvent and process design

Combining computational modelling with process design, guided by key metrics, enables multiple production steps to be "telescoped," reducing waste and speeding up manufacturing. Proactive lifecycle analysis ensures both environmental and financial savings.



03

Stakeholder engagement

Working closely with pharmaceutical partners and industry regulators, we're understanding current challenges in solvent recycling and sharing emerging solutions from the project.

THE HEADLINE RATIO

100kg HAZARDOUS WASTE : **1kg** ISOLATED API

Today, manufacturing APIs can generate up to **100 kg of hazardous waste for every kilogram of isolated API**, with the majority of this waste coming from solvents.

RESEARCH EXCELLENCE

03 Digital Medicines Manufacturing Research Centre (DM² Accelerator)

Scaling digital CMC

for smarter, faster, greener medicines.



£1.4m

DURATION
1 year

FUNDER
UK Research and Innovation

ACADEMIC PARTNERS
Loughborough University, The Glasgow School of Art, University of Cambridge, University of Strathclyde

Call: Made Smarter Innovation Digital Medicines Manufacturing Research Centre (DM² Accelerator), Translating the Technology.

THE WORK

The DM² Accelerator builds on the success of the Digital Medicines Manufacturing Research Centre (DM²) Phase 1, advancing CMAC's cyber-physical research infrastructure (CPRI) to accelerate industrial translation and upskill the sector. By integrating advanced informatics, automation and human-centric design across our CMC DataFactories®, the programme is enabling faster, more robust and sustainable medicines development.

01
Advance integrated, autonomous and model-driven research environments.

02
Accelerate industrial translation through user-led design, trials and technology transfer.

03
Build digital skills in pharmaceutical manufacturing.

04
Enable more sustainable, responsive manufacturing aligned with UK priorities.

Key achievements in 2025

Significant progress has been made in strengthening CMAC's digital capabilities:

- Deployment of a Knowledge Graph architecture, enabling FAIR, interoperable and semantically searchable data.
- Upgrades to the Tableting CMC DataFactory®, supporting higher Technology Readiness Levels, including improved containment and noise control.
- Expansion of CMAC CMC DataFactories® with new equipment and cross-platform integration.
- Standardisation of model architectures and automated DevOps pipelines to improve quality and scalability.
- Introduction of XR dashboards and natural-language interfaces to enhance usability and access to insights.
- Delivery of a multi-partner Dexamethasone case study, linking manufacturing, data and supply chain intelligence.

Industry collaboration and translation

The programme has strengthened engagement with industry and accelerated pathways to adoption:

- Six demonstration trials delivered with partners including AstraZeneca, Shionogi and Lonza.
- Development of technology transfer packages to support uptake by industry and SMEs.
- Progression of commercialisation routes through OpenCMC™, supporting real-world deployment.

Overcoming challenges

Two key challenges were addressed during delivery:

- Funding delays, mitigated through proactive engagement with EPSRC and close coordination with finance teams.
- System complexity across multiple platforms, addressed through standardised architectures, modular orchestration and Knowledge Graph integration to ensure scalability and interoperability.

Impact

The DM² Accelerator has significantly strengthened CMAC's research excellence and global position in digital CMC. It has:

- Enhanced industry partnerships and unlocked co-investment.
- Demonstrated scalable, digital-first manufacturing approaches.
- Raised CMAC's international profile through high-impact demonstrators.

Building on Phase 1 results showing 50-80% waste reduction in tablet development, the programme has expanded opportunities for sustainability through digital workflows. Importantly, it has delivered practical assets, workflows, design packages and user requirements, that reduce barriers to industrial adoption.

Collaborative strengths and insights

Co-creation with industry has been central to success. Early user engagement ensured solutions were both technically advanced and practically deployable. Standardisation across CMC DataFactories® improved scalability, while multidisciplinary collaboration enabled complex system integration. The introduction of Knowledge Graphs has shown particular promise in unlocking value across connected workflows.

Looking ahead

Future work will focus on fully integrated, closed-loop systems, where data and processes continuously inform one another. This includes:

- Exploring **agentic AI for autonomous optimisation**.
- Embedding Sustainability by Design principles.
- Expanding digital twin and predictive analytics capabilities.

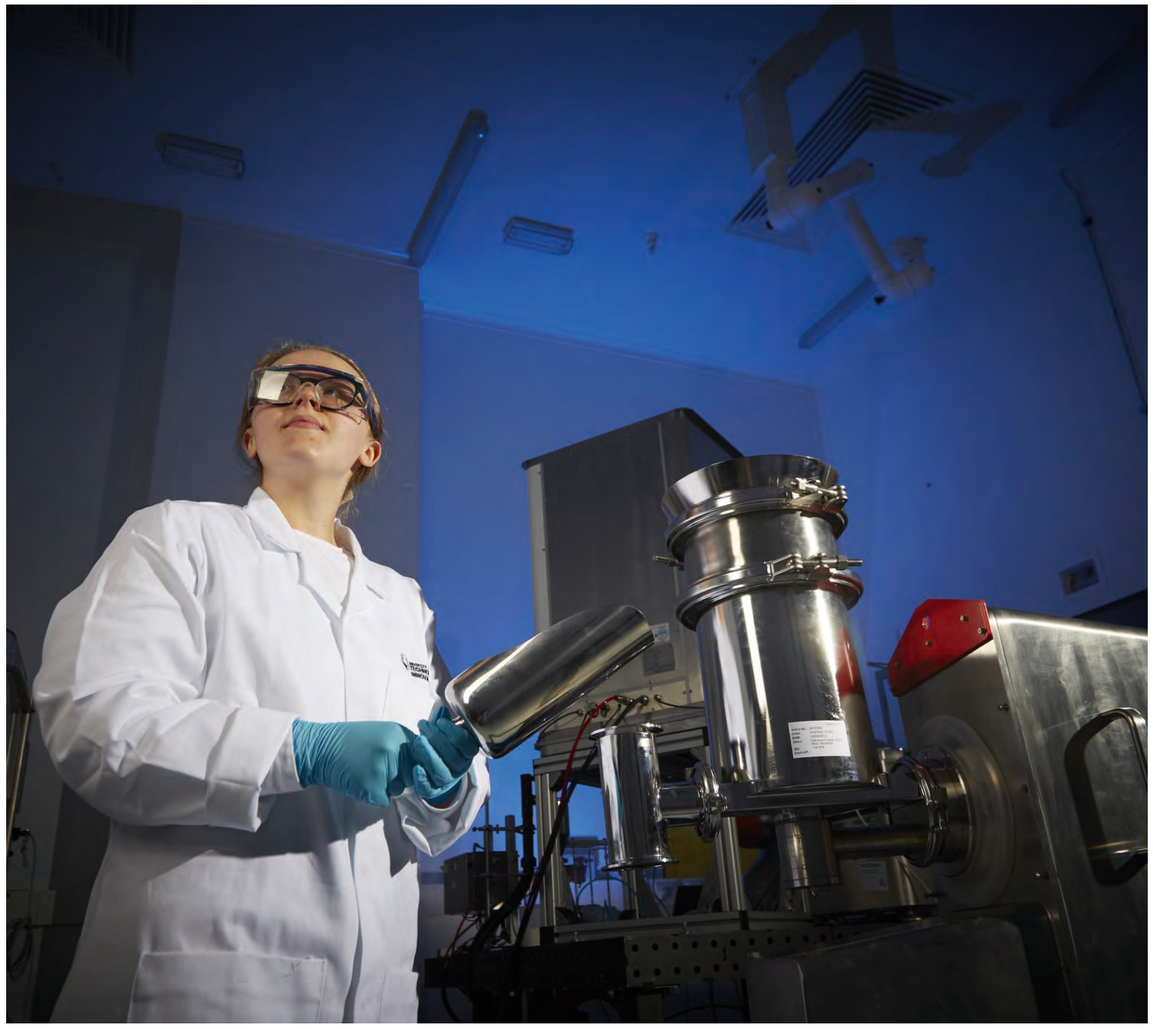
These advances will support wider industrial deployment and international commercialisation through OpenCMC™, positioning CMAC at the forefront of digital medicines manufacturing.

RESEARCH EXCELLENCE

04 Digital Design and Manufacture of Amorphous Pharmaceuticals (DDMAP)

Driving innovation

in amorphous drug development.



£1.2m

DURATION
4 years

FUNDER
UKRI Engineering and Physical Sciences Research Council

ACADEMIC PARTNERS
Ghent University, University of Copenhagen, University of Strathclyde

INDUSTRY PARTNERS
3

THE WORK

Ending in April 2026, the DDMAP project united CMAC with academic and industry partners to transform the science and manufacturing of amorphous pharmaceuticals. This international centre-to-centre collaboration with CPHarma (University of Copenhagen) and CESPE (Ghent University), supported by industry leaders including AstraZeneca, CCDC, and Takeda, set out to tackle one of the sector's most pressing challenges: the selection, production and application of amorphous molecular solids.

Amorphous forms offer a powerful solution to improve solubility and bioavailability for poorly water-soluble drugs; a growing issue as more complex molecules enter development. However, these advantages come with significant hurdles: amorphous materials are inherently unstable and prone to crystallisation, making consistent manufacturing and long-term storage difficult. Scaling production demands advanced techniques such as spray drying and hot-melt extrusion equipped with in-situ low frequency Raman, alongside robust formulation strategies to maintain stability and ensure quality throughout the product lifecycle.

The DDMAP project aimed to deliver a step change in understanding amorphous pharmaceuticals by creating new data resources, predictive tools and collaborative research frameworks to help enable more efficient and informed approaches to medicines manufacturing.

Key objectives

- Develop an Amorphous Pharmaceutical Database (APDb) and Amorphous Stability Index (ASI).
- Build predictive manufacturing and performance models.
- Strengthen international collaboration.

Methodology and approach

The project combined digital tools, including computational modelling and predictive analytics, with experimental validation in CMAC labs, and global collaboration to pool expertise, resources and perspectives, accelerating progress in amorphous pharmaceutical development.

Automated workflows and the APDb enabled predictive modelling for stability and performance. Stability screening platforms and hot melt extrusion case studies validated manufacturing processes. Advanced imaging with Optical Coherence Tomography (OCT) and molecular dynamics simulations delivered mechanistic insights. Strong partnerships with University of Copenhagen, Ghent University, and industry leaders ensured our research outcomes could make a real-world impact.

This integrated approach accelerates process understanding, reduces risk and supports data-driven decision-making in medicines manufacturing.

Outputs and deliverables

Over the course of the project, teams addressed industrial challenges such as:

- **Automated Screening Workflows:** Developed for amorphous and multi-component systems, generating data-rich results for inclusion in the APDb. These workflows streamline process development, reduce risk, and save time and resources.
- **Stability Screening Platform:** Monitors amorphous stability over time, providing predictive insights into manufacturability and performance. Verified through hot melt extrusion case studies, this tool supports informed decision-making during processing.
- **Mechanistic Insights:** Integration of OCT with dissolution experiments has delivered insight into structural changes during drug release from amorphous dosage forms.
- **Data-Driven Models:** APDb V1 launched with search, visualisation, and export capabilities; predictive models trained for API stability and polymer selection.

DDMAP has also been a catalyst for international collaboration and researcher mobility, with 5 incoming researcher exchange visits to CMAC.

Partnerships with the University of Copenhagen enabled molecular dynamics simulations of ball milling and joint OCT dissolution studies.

The University of Parma contributed expertise through cryo-milling and hot-melt extrusion studies on complex amorphous solid dispersions. Additionally, a PhD researcher undertook an industrial placement at AstraZeneca, developing machine learning models for ASD stability and automated mixing workflows.

These collaborations have ensured knowledge exchange, advanced our technical capabilities and delivered outputs with direct industrial relevance.

Impact

The outputs of the DDMAP project have generated strong interest across industry partners in adopting our CMC DataFactory® framework, applying its methods to novel APIs, and streamlining CMC development processes. The project demonstrates an integrated, automated workflow, alongside advanced predictive tools that inform industry practice and enable academic researchers to train and validate new models.

Beyond technical achievements, the project is supported by >10 aligned PhD projects and has expanded our collaborative expertise through partnerships with leading international institutions, driving knowledge exchange, advancing skills, and accelerating innovation.

RESEARCH EXCELLENCE

05 Digital CMC Centre of Excellence for Regulatory Science and Innovation

Driving digital transformation

of CMC.



£1m	DURATION	FUNDER	ACADEMIC PARTNERS	INDUSTRY PARTNERS
	1 year	UKRI Innovate UK	CCDC, De Montfort University, University of Strathclyde	5

FUNDER Innovate UK, in partnership with the Medicines and Healthcare products Regulatory Agency (MHRA), Office for Life Sciences and the Medical Research Council (MRC).

CALL UK RS&IN Implementation Phase: Human Health (CERSIs).

THE WORK

The Digital CMC Centre of Excellence for Regulatory Science and Innovation (CERSI) was established as one of seven UK national initiatives to accelerate the adoption of digital tools in chemistry, manufacturing and controls (CMC). Led by CMAC with partners De Montfort University, the Cambridge Crystallographic Data Centre (CCDC) and the Medicines and Healthcare Products Regulatory Agency (MHRA), the programme supports the UK Government's Pro-Innovation Regulation agenda by addressing barriers such as fragmented guidance, evolving AI systems and data integrity challenges.

01 / ENGAGEMENT

51
Industrialists engaged
From 13 organisations.

02 / CAPABILITY

120+
Professionals trained
In regulatory science and the CDR2 framework.

03 / GLOBAL REACH

5
International regulators
MHRA, FDA, EMA, ANVISA, PMDA.

04 / PUBLICATION

3
Scientific papers
In preparation.

Collaboration and approach

The project brought together regulatory experts, digital modellers and global partners, including MHRA, AstraZeneca, Pfizer, Roche, Takeda, Siemens, the National Manufacturing Institute Scotland (NMIS) and standards bodies such as ASME. Engagement with international regulators, including the FDA, EMA, ANVISA and PMDA, ensured alignment with global expectations. AI-driven systems, hybrid models and secure digital platforms were deployed throughout.

Engagement and delivery

The team delivered substantial outreach and capability building:

- 51 industrialists engaged from 13 organisations.
- Regulatory collaboration with MHRA, FDA, EMA, ANVISA and PMDA.
- Presentations to networks such as ISPE, EFPIA, the Crystal Form Consortium and the APS Regulatory Focus Group.
- 120+ professionals trained in regulatory science and the CDR2 framework.
- Contributions to major conferences including APS MCS+, TOPRA Annual Conference and FDA/CRCG AI workshops.
- Media features in TOPRA Regulatory Rapporteur, with three scientific papers in preparation.

Outputs and deliverables

The project has delivered solutions to advance regulatory innovation and digital adoption.

Impact

The CERSI has strengthened industry-regulator collaboration, built confidence in digital tools and expanded CMAC's role in shaping future regulatory approaches. It has supported best practice in model credibility, enhanced internal capability, and created clear pathways for further innovation. Workshops with MHRA and academic partners generated six priority project concepts and over 60 ideas for future research, laying the foundations for Phase II.

CDR2 Framework
For digital model maturity.

VERA
AI-powered assistant trained on 300+ regulatory documents.

Digital CMC Sandbox
Secure platform for model testing and evaluation.

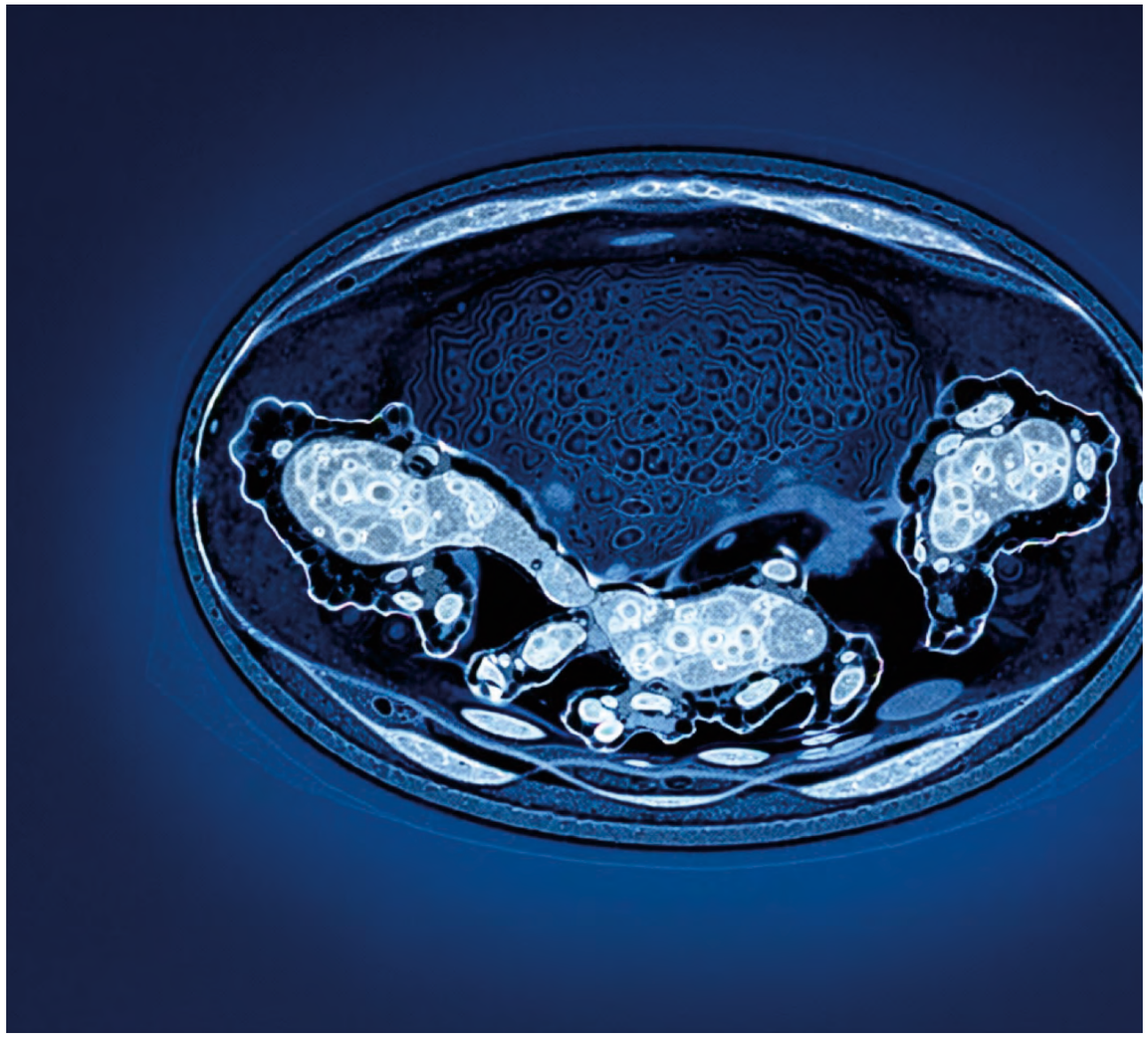
Modular Training
Digital CMC training for consistent capability building.

RESEARCH EXCELLENCE

06 Community for Analytical Measurement Science (CAMS)

Advancing understanding

of physical stability.



£300k

ACADEMIC PARTNERS

University of Strathclyde

INDUSTRY PARTNERS

3

THE WORK

In collaboration with AstraZeneca, Pfizer, and Takeda, CMAC has been redefining the way the pharmaceutical industry predicts long-term stability of medicines. This physical stability project focused on the relationship between material attributes, structural evolution at nano and micro-scale and their impact on drug release performance after extended storage.

The challenge

Ensuring the physical stability of pharmaceutical tablets over time is critical for patient safety, product efficacy and regulatory compliance. Traditionally, predicting these storage-induced changes has been complex and time-consuming. This project aimed to transform that process through advanced characterisation and predictive modelling.

The innovation

Leveraging CMAC's state-of-the-art technologies, including X-ray computed nano-tomography, and high-fidelity modelling expertise, the team visualised, quantified and modelled structural changes across scales from nanometres to millimetres. These insights have enabled a greater understanding of how raw material properties influence product stability.

Key achievements

- **Single-Particle Swelling Model:** Developed using dynamic vapor sorption (DVS) data, this model predicts moisture uptake and swelling behaviour of powders. Validation against experimental particle size data confirms its reliability.
- **Advanced Imaging Workflow:** Established a high-throughput X-ray CT analysis for tablets under accelerated storage conditions, enabling quantification of microstructural changes.
- **Algorithm for Microstructure Mapping:** Created a novel algorithm to reconstruct particle-level information from CT-derived microstructures, forming the basis for macro-scale mechanistic modelling.

Overcoming challenges

The project overcame technical challenges to achieve these developments. Custom tablet holders were designed for overnight batch scanning, enabling high-throughput CT workflows. A novel deconvolution algorithm was developed to distinguish individual particles within compressed tablets and machine learning-based segmentation using DigiM I2S software delivered substantial improvements in accuracy and efficiency compared to traditional methods.

These innovations have led to important discoveries. A validated single-particle swelling model was created using dynamic vapor sorption data, providing a robust tool for predicting moisture-driven swelling dynamics. Microstructural evolution patterns were uncovered, revealing spatially heterogeneous porosity changes that influence liquid penetration and drug release. CT-to-particle reconstruction methods now enable particle-level analysis within compressed structures and using machine learning, we have opened new avenues for predictive modelling.

Impact

The impact of this work is significant. For CMAC, it demonstrates leadership in integrating advanced characterisation with predictive modelling, delivering workflows that accelerate medicines development and support sustainability through reduced resource use. For industry, these predictive tools offer a step-change in stability assessment, enabling smarter, cost-effective experimental planning and reducing reliance on lengthy real-time studies.

Looking ahead

Next steps focus on extending the algorithm to accommodate multi-component tablets and complex formulations, ensuring a realistic representation of industrial products. This advancement will integrate particle-level swelling physics into a tablet-scale stability model, creating a powerful framework for predicting structural evolution during storage and linking these changes directly to performance metrics such as dissolution and drug release.

2 PUBLICATIONS

2 JOURNAL PAPERS IN PROGRESS

2 CONFERENCE PRESENTATIONS

3 INDUSTRY PARTNERS

Outstanding Skills Development:

Building the workforce of the future.



CMAC is investing in people and capability to power the future of pharmaceutical manufacturing. Through pathways such as the University of Strathclyde's MSc programme, our EPSRC Centre for Doctoral Training (CDT) and industry demand-led PhD initiatives and professional upskilling via the SkillsFactory, we are cultivating practice-ready talent, fostering research leadership, and building scalable industry skills.

The result: **a confident, connected workforce** equipped to deliver agile, digital, and sustainability-focused manufacturing.

> "We don't just teach skills, we build **capabilities** that accelerate innovation and improve patient outcomes."
>
> CMAC PERSPECTIVE



01 MSc

Advanced Pharmaceutical Manufacturing at the University of Strathclyde.

02 CDT / PhD

Centre for Doctoral Training and industry demand-led PhDs.

03 SkillsFactory

Professional upskilling for industry partners and community.

PATHWAY 01

Driving excellence through education:

The MSc in Advanced Manufacturing.

Industry-ready graduates for a fast-evolving sector.



The MSc in Advanced Pharmaceutical Manufacturing at the University of Strathclyde is delivered by the Strathclyde Institute of Pharmaceutical and Biomedical Sciences, in collaboration with CMAC. It provides expertise in pharmaceutical sciences and engineering, spanning across drug substance and drug product manufacturing.

Combining theory with hands-on training, students learn about continuous processes, crystallisation, PAT, QbD, data analytics, and professional skills, culminating in a 10-week research project at CMAC. Graduates are equipped to innovate in pharmaceutical development, production and compliance for careers in pharma and high-value manufacturing.

FROM CLASSROOM TO INDUSTRY

01 **Modules**

02 **Practical labs**

03 **Research project**

04 **Career**

PATHWAY 02

Shaping the future of research:

EPSRC Centre for Doctoral Training in cyber-physical systems for medicine development and manufacturing.

Future-focused research powering innovation.

CMAC's PhD programme develops research leaders who combine scientific excellence with translational impact. Doctoral researchers tackle complex challenges across materials design, crystallisation, formulation, process control and data-centric manufacturing, in collaboration with industry.

CEDAR, our EPSRC Centre for Doctoral Training (CDT), adds structured skills training in leadership, entrepreneurship, data science and responsible research. This ensures candidates are as skilled in communication and collaboration as they are in technical depth.

A unique approach to learning

While students pursue individual research projects tailored to their expertise and interests, CMAC has introduced a distinctive feature: Research Challenge Teams (RCTs). This innovative model represents a step change from the traditional PhD format. Each cohort is grouped into collaborative, multi-disciplinary teams to tackle a shared research challenge aligned to an overarching theme.

Working under these themes encourages creativity, fosters innovation and strengthens problem-solving skills. Supported by tailored training and guided by academic and industry mentors, the RCTs create a rich environment for knowledge exchange, bridging disciplines and finding solutions to real-world challenges.

Cohort-based learning fosters peer support and cross-disciplinary problem-solving, while placements and partner projects accelerate real-world impact. Our researchers step into roles across academia, industry and regulatory bodies, driving innovation in continuous processing, advanced analytics and digital quality systems to transform how medicines are developed and made.

Impact

- Multidisciplinary projects with strong industrial engagement.
- CEDAR CDT: leadership, data and innovation skills embedded.
- Access to state-of-the-art facilities and translational platforms.
- Alumni delivering impact across pharma R&D, manufacturing and policy.

Research Challenge Teams work under three overarching themes:

Nanomedicines

Drug substance

Drug product to patient

Engineering and Physical Sciences Research Council

A STRUCTURED PATHWAY

01 **Join the CDT**

02 **Build skills**

03 **Define research**

04 **Create & innovate**

05 **Transition & impact**

SPOTLIGHT · LIVING LABS

Living Labs:
Turning ideas into action.



As part of CEDAR's collaborative learning model, Living Lab group projects challenge PhD students to design and implement a cyber-physical system for medicine development within three months.

Working in cross-university teams, students receive a dedicated platform, a consumables budget and support for in-person collaboration on Strathclyde's campus. Each project culminates in a short film, a presentation at CMAC's Summer School and a reflective essay.

By taking on defined technical and management roles, students gain hands-on experience in automation, data management, and communication, building confidence in digital tools, leadership, and teamwork. The showcase celebrates innovation and fosters knowledge exchange.

> "Our doctoral training is designed for real-world impact, rigorous science coupled with the **capability to deliver change**."
>
> ACADEMIC SUPERVISOR

PATHWAY 03

Upskilling the workforce:
CMAC SkillsFactory.

Continuous learning for a competitive edge.

The CMAC SkillsFactory is our professional learning engine providing flexible, modular training programmes that range from short courses to tailored in-house training. The platform addresses capability gaps in small molecule medicines manufacturing and digital chemistry, manufacturing and controls (CMC).

We've developed tailored content for our research community and, through close consultation with industry partners, are expanding our offering to meet evolving sector needs. In collaboration with the National Manufacturing Institute Scotland (NMIS), we've also integrated their courses into our network, sharing expertise and strengthening knowledge exchange.

Currently, courses are available exclusively to the CMAC community and industry partners. However, we're actively developing new programmes to **open access to a wider audience**, ensuring more organisations can benefit from world-class training in advanced manufacturing.

Our impact

CMAC's skills ecosystem delivers measurable outcomes: more capable teams, faster adoption of advanced manufacturing and a stronger talent pipeline.

Across our programmes, we're seeing sustained demand, diverse participation and high placement rates. Our community is shaping continuous processing, digitisation and quality strategies across the sector, advancing productivity and resilience.

Modular short courses
Flexible training, from short to in-house.

NMIS integration
Shared courses, broader sector reach.

Widening access
Future programmes for a wider audience.

2025 IMPACT METRICS

People trained. Capabilities enhanced. Impact delivered.

MSC	PHD	SKILLSFACTORY
19	**71**	**45**
Cohort 2024-2025	**Active researchers 2025**	**Courses**
	5 industrial placements	27 for CMAC, 18 for partners

World-Class Facilities:

Building a national asset for advanced pharmaceutical development.



CMAC's National Facility continues to deliver the cutting-edge, scalable, and compliant environments that enable our partners to **de-risk development**, validate innovative manufacturing routes, and translate pioneering research into robust industrial practice.

Our infrastructure is central to supporting researchers, industry collaborators, and emerging technologies across the full development pipeline. Spanning five integrated capability areas, the facility provides a multidisciplinary space to address industrial challenges and build new manufacturing solutions.

This year, our teams also advanced a significant spherical agglomeration scale-up study, demonstrating our ability to translate novel processes into industrially relevant operations. In 2025, CMAC's facilities supported more than 100 staff and researchers, delivering high-impact projects, training, and translational activity across academia and industry.

UKRPIF

£11m

UK Research Partnership Investment Fund, final stage.

UNIVERSITY CAPEX

£2.5m

Strathclyde capital programme, completed in 2025.

RESEARCHERS SUPPORTED

100+

Staff and researchers using CMAC facilities in 2025.

FIVE INTEGRATED CAPABILITY AREAS

- **Crystallisation & Particle Engineering**
- **Drug Product & Powder Processing**
- **Advanced Materials Characterisation**
- **Next-Generation Solid State**
- **Nanomedicines**

HIGHLIGHT

A significant **spherical agglomeration scale-up** study was advanced, translating a novel process into industrially relevant operations.

Investment in advanced capability

Investment
in advanced capability.

This year marked the final stages of the **£11.1M UKRPIF** and University CapEx **£2.5M** investment programmes, major initiatives that have strengthened CMAC's position as a leading centre for advanced manufacturing research. New equipment and infrastructure added through these programmes include:

01 **Resodyn Acoustic Mixer**
Enabling enhanced powder blending and material handling.

02 **Omron and Boston Dynamics Mobile Robots**
Supporting automated material transport and improved workflow integration.

03 **Autichem Duty/Standby Filtration System**
Boosting reliability and operational flexibility for continuous processes.

04 **Anton Paar Dynamic Mechanical Analyser**
Expanding capability in solid-state mechanical characterisation.

05 **Vapourtec Synthesis Platform**
Strengthening our continuous synthesis and flow chemistry offering.

06 **Nvidia DGX B200**
AI supercomputing system for digital CMC development.

07 **Plvs Ultra Knowledge Graph**
Enabling FAIR data principles for data-driven research and semantic tools.

08 **Autichem Dynamically Mixed Annular Reactor / Taylor–Couette Reactor (DART)**
Advanced continuous flow reactor system.

National Facility Engagements

A national hub
for innovation and collaboration.

Beyond the research itself, CMAC plays a national convening role, hosting visitors and events, welcoming government and earning recognition at home and abroad.

NATIONAL HUB

Visitors and events hosted in 2025, as CMAC continues to act as a **national hub for innovation and collaboration**.

50+



NOTABLE GOVERNMENT VISIT

James Murray MP

Chief Secretary to the Treasury, highlighting CMAC's role in UK science and advanced manufacturing.

INTERNATIONAL RECOGNITION

CPHI Frankfurt

Shortlisted for the **API Development and Innovation** Award, showcasing global recognition.

SUSTAINABILITY RECOGNITION · LEAF AWARDS 2025

SILVER X-Ray Laboratory

SILVER Drug Substance Laboratory

BRONZE Cyber-Physical R&D Laboratory

CMAC Data Lab.

A digital medicines manufacturing research accelerator.

The CMAC Data Lab has been a landmark investment in the future of medicines manufacturing in the UK, building the cyber-physical research infrastructure (CPRI) needed to drive the next generation of digital medicines manufacturing.

At its core, the Data Lab establishes a **Data Fabric**, a unified digital architecture that captures data across all research activities to generate unique data assets, predictive models and autonomous workflow solutions. This infrastructure is designed to deliver on the goals of Industry 5.0: sustainability, resilience and human-centricity.

£11M
Capital Award (UK-RPIF Round 7)

£33M
Total partnership value

£2.1M
Savings through procurement efficiencies

£16.5M
Co-investment delivered by partners

Enabling a pipeline of research activities

- EPSRC MediForge Hub
- EPSRC CEDAR Centre for Doctoral Training
- Innovate UK DM² Accelerator

Capabilities include

- **Data architecture and digital infrastructure:** Building a cyber-physical foundation for digital CMC.
- **CMC DataFactories®:** Enabling technologies for automated self-driving research platforms.
- **MicroFactories:** Next generation modular manufacturing integrated test beds.
- **Advanced measurement and characterisation suite:** Generating rich, high-quality data across molecules, materials and formulated systems.



FUNDED BY UK Research and Innovation · Scottish Funding Council Comhairle Maoineachaidh na h-Alba

Net Zero initiatives.

Sustainability in action.

Running from 2022 to 2027, this **£2.5M** capital investment from UKRI and the Scottish Funding Council underpins CMAC's sustainability strategy and its commitment to developing the greener processes and technologies that medicines manufacturing will require in the decades ahead. The programme spans eight interconnected workstreams, from smart experimentation and automation through to cultural change and workforce development.

£2.5M
Net Zero Manufacturing Research Pilot

15.5
tCO_2e saved per annum

250+
Assets on real-time energy monitoring

24kg
Nitrile gloves diverted from waste

Eight workstreams

- **Smart Experimentation:** self-driving tableting CMC DataFactory®, 65% material savings, 60% faster development, 3× production speed.
- **Energy Monitoring:** real-time data across 250+ assets.
- **Automation:** lab robotics cutting error and CO_2e while improving data quality.
- **Replacement Instrumentation:** new instruments up to 80% more efficient, ~10 tCO_2e saved per annum.
- **Infrastructure Upgrades:** efficient fume hoods, water purification and centralised compressed air, 5.5 tCO_2e saved per annum.
- **Digital Technologies:** immersive, real-time collaboration reducing travel and resource use.
- **Cultural Change:** waste-awareness, lab-coat steaming, glove and coat recycling.
- **Future Workforce:** embedding Net Zero best practice in training and skills.



Recognition: Winner of Scottish Life Sciences 2026 Sustainability Award, and three CMAC labs awarded Laboratory Efficiency Assessment Framework (LEAF) Awards.

FUNDED BY UK Research and Innovation · Scottish Funding Council Comhairle Maoineachaidh na h-Alba

Translation
to industry.



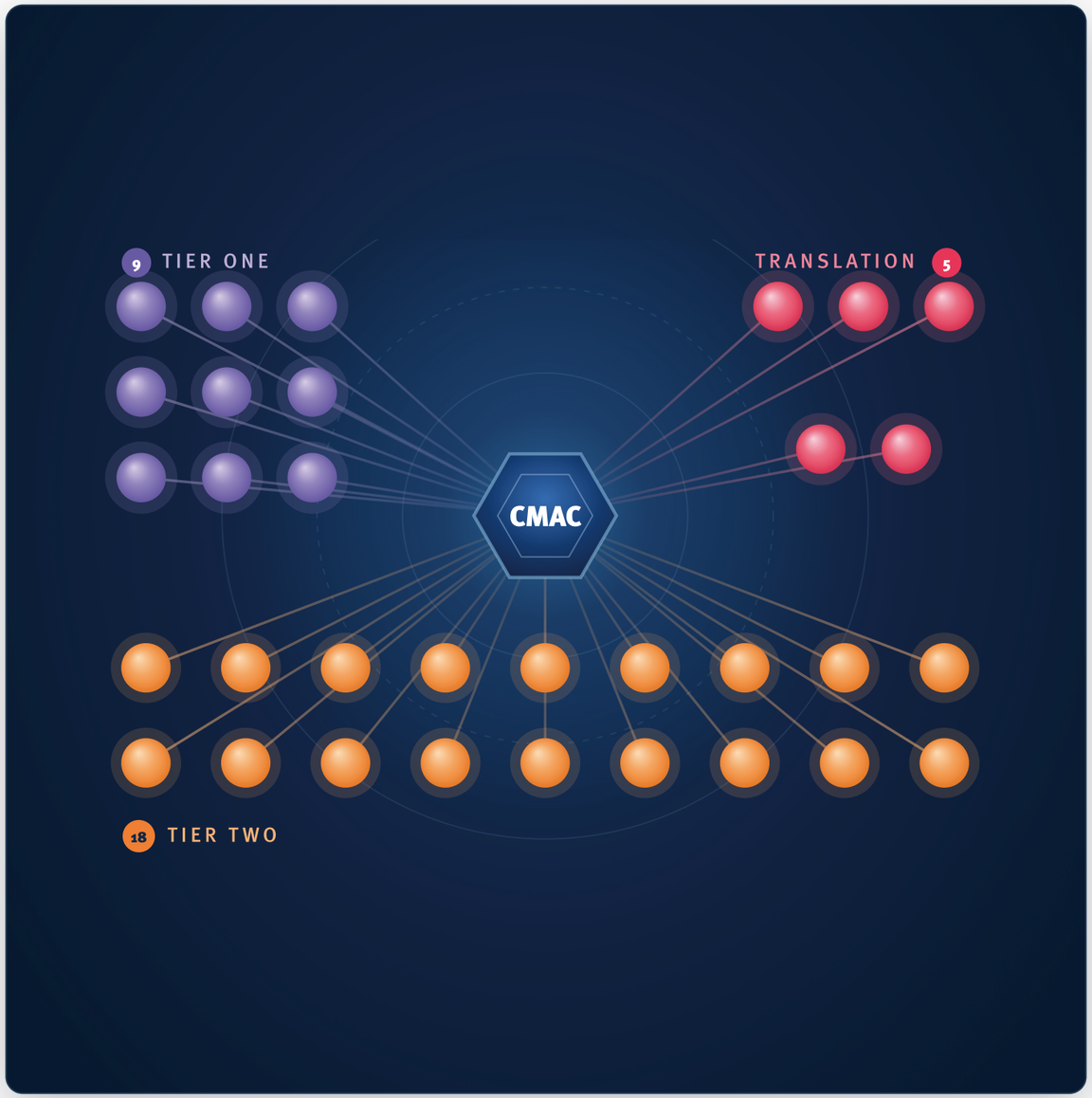
OVERVIEW OF ACTIVITIES · INDUSTRY ENGAGEMENT & PARTNERSHIPS

A portfolio of partners, across three tiers.

32

INDUSTRY PARTNERS · 2025

A connected ecosystem spanning strategic alliances, translation-focused collaborations and affiliate partnerships.



TECH TRANSFER & COMMERCIALISATION

OpenCMC™

Accelerating commercial adoption of CMAC technologies through an asset-centric, venture-client model.



AN ASSET-CENTRIC VENTURE-CLIENT MODEL

01
Validate IP
Screened for commercial readiness.

02
License
Dedicated mechanism for licensing.

03
Spin-out
OpenCMC™ as a Strathclyde spin-out.

04
Deploy
CMC DataFactory® in industry.

FOUNDED

2025

University of Strathclyde spin-out.

MODEL

Asset-centric venture-client

Direct industrial engagement with CMAC-developed technologies.

THE STORY

CMAC strengthened its technology transfer and commercialisation capability through the launch of **OpenCMC™**, a University of Strathclyde spin-out established to accelerate the industrial adoption of advanced chemistry, manufacturing and control (CMC) and digital medicines manufacturing technologies.



Technology Transfer & Commercialisation

OpenCMC™ has been created as an **innovation gateway** to unlock the commercial potential of CMAC's growing portfolio of validated CMC assets, reinforcing CMAC's position as a globally recognised centre of excellence in advanced medicines manufacturing.

IP, Licensing and Commercial Pathways

The company provides a dedicated commercial mechanism to **validate, license and deploy intellectual property** generated through CMAC research programmes. OpenCMC™ leads the execution and delivery of technologies licensed from CMAC, supporting their transition from research-validated assets into scalable, investable industrial platforms.

This structured approach strengthens CMAC's IP pipeline and enables coordinated industry engagement with emerging technologies at earlier stages of development, reducing adoption barriers and accelerating time to impact.

Spin-out Formation and Innovation Model

OpenCMC™ operates an innovative **asset-centric, venture-client model**, enabling industrial partners to engage directly with CMAC-developed technologies through collaborative pilots and early deployment. This model creates new commercial routes beyond traditional licensing, while maintaining strong links to CMAC's research base and industrial network.

Deployment of CMAC Technologies in Industry

A core focus of OpenCMC™ is the industrial deployment of CMAC-developed digital and self-learning manufacturing platforms, including next-generation **CMC DataFactories®**. These technologies aim to accelerate process development, enhance process understanding and enable more efficient, robust and sustainable pharmaceutical manufacturing.

By supporting coordinated industry adoption, OpenCMC™ strengthens CMAC's role in enabling the digital transformation of chemistry manufacturing and control across the pharmaceutical development lifecycle.

Impact

The establishment of OpenCMC™ marks a significant milestone in CMAC's industrialisation strategy, providing a sustained pathway for commercial adoption of its technology portfolio. It strengthens the centre's long-term sustainability, enhances international engagement and supports the delivery of **advanced medicines manufacturing solutions that can help bring new therapies to patients faster and more efficiently**.

CASE STUDIES

Industrialisation of Spherical Agglomeration:

Pilot-Plant Case Study with AstraZeneca.

HEADLINE RESULT

3 × 40kg

Successfully produced at the **1000 L scale** at AstraZeneca's Macclesfield site, using standard crystallisation, wet-milling and isolation infrastructure.

TIER ONE PARTNERS · CORE-FUNDED COLLABORATION

AstraZeneca · Chiesi · Lilly · Pfizer · Roche · Sanofi · Shionogi · Takeda · UCB

THE WORK

CMAC has successfully demonstrated the industrial translation of spherical agglomeration, advancing this particle engineering technology from laboratory to pilot-plant scale through a CORE-funded collaboration with Tier One partners. The programme addresses a key pharmaceutical manufacturing challenge: **enabling robust, scalable production of APIs** suitable for efficient solid-dosage manufacture.



Spherical agglomeration offers the potential to improve particle flowability, bulk density and compressibility at source, supporting downstream processing and enabling simplified manufacturing routes such as direct compression. However, until now, uncertainty has remained around its scalability and operational robustness under industrial conditions.

AstraZeneca hosted pilot-plant trials at its Macclesfield site, where CMAC applied a structured, modelling-led scale-up framework to de-risk industrial implementation. Three 40 kg batches were successfully produced at the 1000 L scale using standard crystallisation, wet-milling and isolation infrastructure. Target agglomerate sizes were achieved, filtration performance was excellent, and process behaviour aligned with expectations from laboratory studies.

The study provides CMAC partners with increased confidence that spherical agglomeration is a viable, industrially relevant particle engineering option. It also reinforces CMAC's capability to translate scientifically rigorous processes into real-world manufacturing environments, strengthening its role as a trusted partner in pharmaceutical process innovation.

9
TIER ONE PARTNERS

1000L
PILOT-PLANT SCALE

3
BATCHES SUCCESSFULLY PRODUCED

RESEARCHER PERSPECTIVE

Where Research

Meets Industry.



> “My placement gave me the opportunity to contribute my PhD research skills to real industry challenges, while gaining a clearer understanding of what it takes to **translate lab-based research into practical solutions** that can support manufacturing partners.”

Mitchelle Mandaza

PHD PLACEMENT AT ASTRAZENECA, MACCLESFIELD UK

UK

REGION

UK

On-site & hybrid placements

EU

REGION

Europe

Cross-border industry placements

US

REGION

USA

Remote & hybrid models

SKILLS & WORKFORCE DEVELOPMENT

CMAC’s translation to industry is driven as much by **people as by technologies**. Through industry-embedded PhD placements, CMAC equips researchers with industry-ready skills while ensuring advanced manufacturing research is shaped, tested and validated in real industrial environments.



Industrial Placements

Industrial PhD placements are a core element of CMAC’s engagement model, enabling early-stage research to be aligned with industrial priorities and accelerating the development of a highly skilled workforce for advanced medicines manufacturing.

Industry-Embedded PhD Research

During 2024-2025, CMAC PhD researchers completed placements with leading global pharmaceutical companies including **AstraZeneca, Chiesi, Lilly, Takeda and UCB**. Researchers worked directly within industrial teams, gaining access to real manufacturing challenges, data and facilities across CMC, process engineering and digital manufacturing.

Projects were co-designed with partners to combine scientific depth with immediate industrial relevance, supporting the translation of CMAC research into deployable knowledge, methods and tools.

Global Engagement

Placements were delivered through **on-site, remote and hybrid models** across the UK, Europe and the USA, reflecting both the global footprint of CMAC’s partners and the centre’s flexible approach to industrial collaboration.

Impact

For CMAC partners, placements provide early access to emerging capability, new modelling and digital approaches, and research embedded within industrial constraints. Researchers deliver critical experience in regulated environments and strengthen pathways into industrial careers.

Together, this reciprocal model ensures CMAC research remains grounded in industrial reality while building the skilled workforce needed to support the adoption of advanced manufacturing and digital CMC across the sector.

2024-2025 PLACEMENT PARTNERS

AstraZeneca · Chiesi · Lilly · Takeda · UCB

CMAC’s industry-embedded PhD programme **transforms research excellence into industrial capability**.

SECTION 06 / GOVERNANCE

Governance.

Map of current governance and committees.

STRATEGIC OVERSIGHT

- University Executive Board
- Industry Membership Board
- Independent Advisory Board
- Leadership Team

PORTFOLIO GOVERNANCE AND OPERATIONAL MANAGEMENT

- Technical Committee
- Translation to Industry Committee
- Equality, Diversity and Inclusivity Committee
- Skills Committee
- Management and Support Group
- Research Committee
- Sustainability and Net Zero Committee

COMMITTEE SPOTLIGHT

CEDIC.

The CMAC Equality, Diversity and Inclusion Committee.

The CMAC Equality, Diversity and Inclusion Committee (CEDIC) was established to support and promote Equality, Diversity and Inclusion (ED&I) activity across CMAC, working towards continuous improvement in creating an inclusive and equitable environment for all.

It held its first meeting in November 2025. The Committee meets every three months and brings together representatives from across CMAC's student and job families, as well as members of the Executive Group and programmes with an ED&I component, to discuss and act on ED&I matters relevant to CMAC: identifying challenges and barriers, addressing concerns, providing guidance and raising awareness of best practice, supporting inclusive practices and events, and monitoring progress across the centre.

In its first year, CEDIC has worked towards:

- Updating the CMAC ED&I Policy.
- Establishing dedicated ED&I communication channels open to all CMAC members.
- Embedding ED&I in staff inductions.
- Running a CMAC-wide ED&I survey.
- Supporting accessibility at the 2026 Open Days.
- Providing input on CMAC guidance and output (e.g., Working from Home guidance, Conference Attendance guidance, considerations in the design of AI agents).
- Providing input on ED&I initiatives (e.g., the Carer Support fund in CEDAR).
- Supporting programme reports (e.g., Data Lab annual report).
- Establishing links with external ED&I initiatives (e.g., EDI Hub+).



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35
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CITATIONS 01 TO 18 OF 35

CONTINUED ON P. 62

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Publications 2025, continued.

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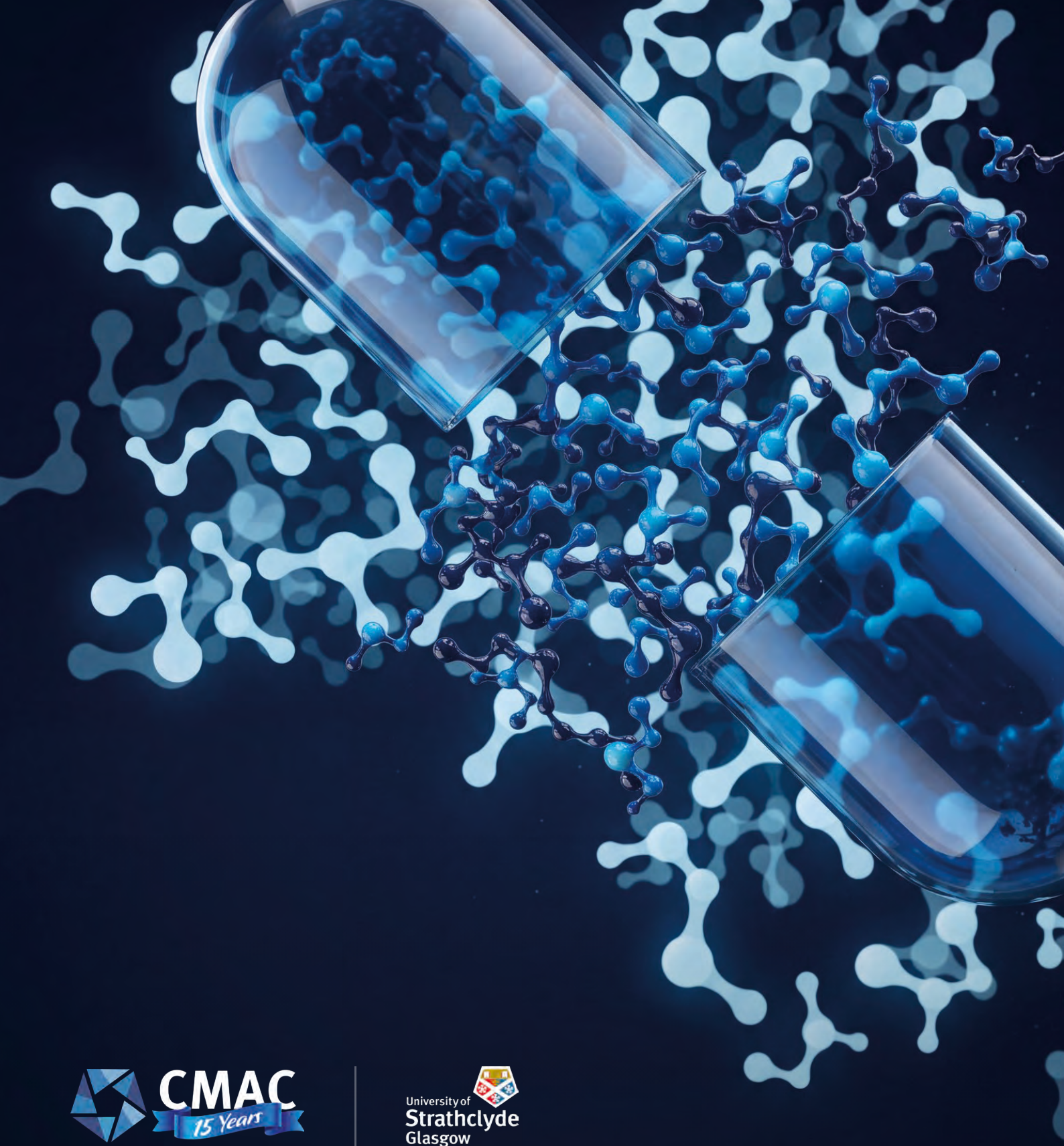
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