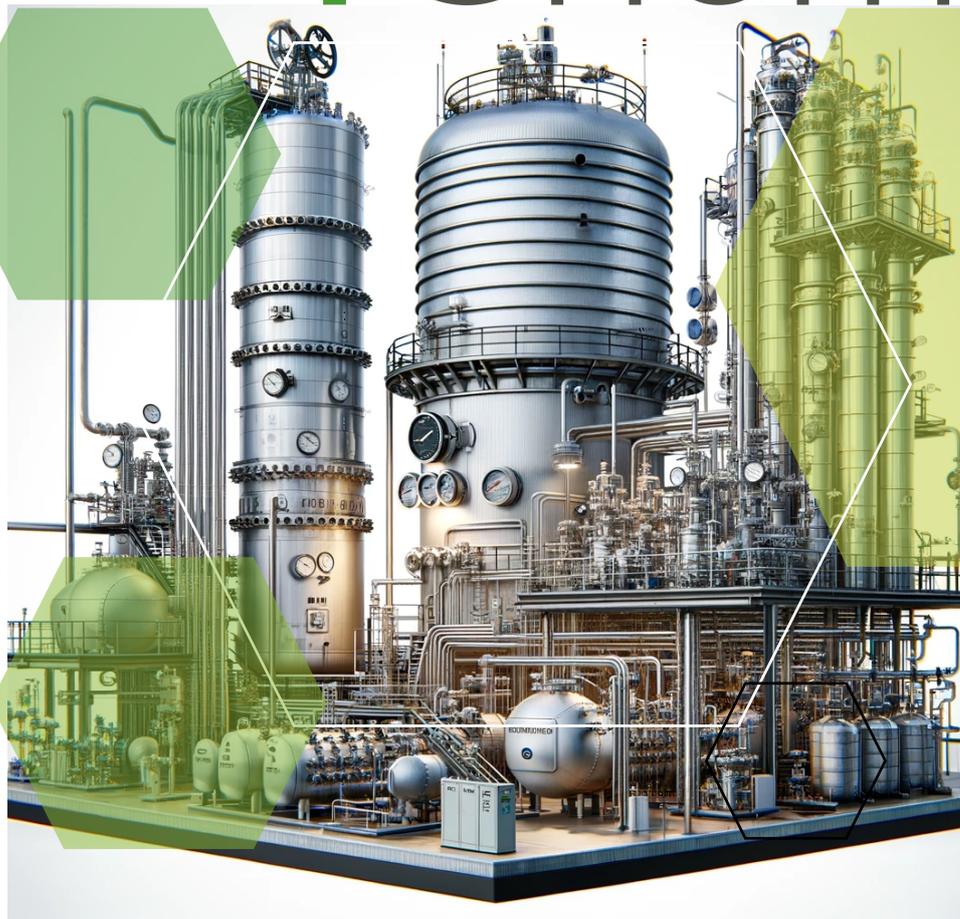


IChemE CAPE SIG Newsletter

COMPUTER
AIDED
PROCESS
ENGINEERING

IChemE



Q1 2026, ISSUE 006

INSIDE THIS ISSUE

WELCOME FROM THE CHAIR

HOT OFF THE PRESS

FEATURE: PROCESS
CONTROL -EVOLVING
FOUNDATIONS IN
CHEMICAL
ENGINEERING

GLOBAL ICHEME
NEWS

UPCOMING
WEBINARS

NEWS FROM OUR
MALAYSIA CHAPTER

NERD-OUT
CROSSWORD

Welcome to this special edition of the IChemE Computer-Aided Process Engineering Special Interest Group (CAPE SIG) newsletter, dedicated to the academic community and the students who represent the future of our profession.

As Chair of the SIG, I'm delighted to introduce a newsletter that puts the spotlight on the people, ideas, and energy that drive innovation in academia. Whether you're a student beginning your journey in process systems engineering or an academic shaping the next wave of research, this issue is for you. This edition brings a strong focus on Advanced Process Control (APC) and Process Control, areas that continue to underpin modern industrial performance, digital transformation, and the evolution of intelligent manufacturing systems.

In this edition, we feature an article on understanding the evolving foundations of process control, with insights especially relevant to the APC and control communities. We also share updates from our Malaysia Chapter as well as Global IChemE News, targeting key issues at the heart of Chemical Engineering. And because learning should be engaging as well as rigorous, we've included a fun crossword at the end of the newsletter, designed to test your knowledge and maybe even teach you something new along the way. As always, we welcome your thoughts, feedback, and contributions. Whether you're interested in sharing your research, highlighting student achievements, or suggesting new ways we can support the academic community, we'd love to hear from you.

Thank you for being part of this vibrant and growing network. Let's continue to learn from one another, support each other, and push the boundaries of what we can achieve together.

Sol Brown
Chair, IChemE CAPE SIG
University of Sheffield

HOT OFF THE PRESS:

A LOOK AT THE LATEST DEVELOPMENTS IN PROCESS CONTROL

Written By Bhavik
Mehta



DIGITAL TWIN TECHNOLOGY FOR PROCESS CONTROL STATIONS

This publication discusses how digital twin technology enhances modern process control stations by integrating Industry 4.0 concepts to improve interconnectivity, real-time monitoring, and automation. It explains the role of digitalization in enabling mass customization, higher productivity, and the synchronization of multi-system environments. The work highlights how digital twins support advanced control schemes by providing virtual replicas for system analysis, fault detection, and predictive optimization, ultimately improving the robustness and responsiveness of process control operations. [Click here to read the full article.](#)

DIGITAL TWIN ENABLED PROCESS DEVELOPMENT, OPTIMIZATION AND CONTROL IN LYOPHILIZATION

This open-access article presents a validated digital twin framework for freeze-drying processes in biopharmaceutical manufacturing. It illustrates how combining digital twins with Process Analytical Technology (PAT), Advanced Process Control (APC), and physicochemical modelling significantly improves the efficiency, flexibility, and sustainability of lyophilization. The authors show that the system enables adaptable operating conditions, accurate prediction of product temperature and drying endpoints, and substantial improvements such as productivity increases up to 300% and major reductions in cost and environmental impact.

[Click here to read the full article.](#)

DESIGN AND MODELING OF PROCESS MANUFACTURING-ORIENTED DIGITAL TWIN SYSTEM

This peer-reviewed article proposes a comprehensive digital twin system architecture for process manufacturing, addressing longstanding challenges like limited transparency, delayed response to anomalies, and insufficient real-time data interaction. The paper establishes a five-dimensional digital twin model and translates it into a practical system with capabilities including remote monitoring, data analysis, process tracing, VR interaction, and remote control. Its results show improved responsiveness and oversight in continuous industrial processes, offering a structured blueprint for digitalizing traditional process control environments. [Click here to read the full article.](#)

THE USE OF A DIGITAL TWIN IN DEVELOPING AN OPTIMAL CONTROL STRATEGY WITH ADVANCED PROCESS CONTROL

This publication focuses on the application of digital twins to optimize comminution circuits in the mining industry using Advanced Process Control (APC). It describes how model predictive control (MPC) can be evaluated and refined within a realistic virtual plant environment built on first-principles simulation and integrated with real-time control system logic. The digital twin enables non-intrusive experimentation, faster testing of extreme operating conditions, and assessment of alternative circuit configurations, ultimately supporting the development of robust APC strategies for grinding and milling processes. [Click here to read the full article.](#)

REINFORCEMENT LEARNING IN PROCESS INDUSTRIES: REVIEW AND PERSPECTIVE

This survey paper reviews how reinforcement learning (RL) contributes to digitalization in process industries, with direct relevance to advanced and autonomous process control. It covers fundamental RL methods and their links to classical control theory, then discusses real industrial applications such as soft sensing, distributed control, fault-tolerant control, optimization, and scheduling. The authors emphasize that growing digitalization demands

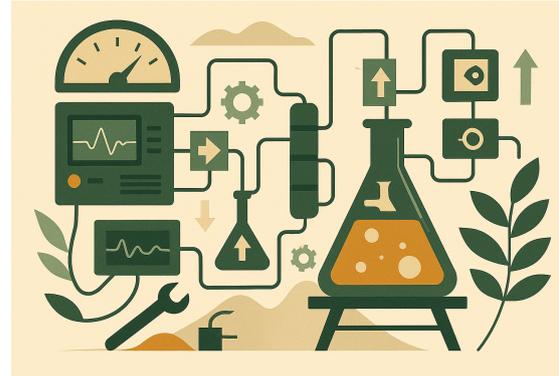
holistic, data-centric control strategies, and that RL offers powerful tools for improving decision-making and automation across all levels of the process control hierarchy. [Click here to read the full article.](#)

INTELLIGENCE FOR INDUSTRIAL PROCESS CONTROL: DEVELOPMENT AND PROSPECTS

This publication examines the evolution of industrial process control toward intelligent, fully autonomous systems enabled by next-generation information technologies. It details the limitations of classical control systems, the need for integration with industrial AI and industrial internet technologies, and emerging methods such as anti-latency control and intelligent adaptive control architectures. The paper outlines future research directions for autonomous, optimized, and digitally integrated process control systems across large-scale continuous industries. [Click here to read the full article.](#)

PROCESS CONTROL: EVOLVING FOUNDATIONS IN CHEMICAL ENGINEERING

Written By Manish
Aggarwal



Process control has long been central to chemical engineering, underpinning safe, efficient, and sustainable operations. Traditionally, this discipline relied on detailed mathematical models to predict system behaviour and design controllers. While practical, such approaches often become impractical for modern processes, where complexity and scale make accurate modelling challenging. Recent research has addressed this limitation. **Van Waarde et al. (2025)** introduced a data-informativity framework that enables engineers to assess key properties, such as controllability and stability, directly from input-output data. This approach reduces dependence on explicit models, offering a practical solution for systems where modelling is infeasible. Alongside these developments, Model Predictive Control (MPC) has established itself as a cornerstone of advanced process control. As reviewed by **Qin and Badgwell (2003)**, MPC's ability to manage multivariable interactions and constraints has driven its widespread industrial adoption. Building on this foundation, **Bemporad and Morari (1999)** advanced robust MPC strategies to address uncertainty, improving reliability and safety in critical applications.

The field continues to evolve as machine learning (ML) is integrated. **Wu et al. (2025)** demonstrated how ML-enhanced MPC can adapt to changing conditions by learning from real-time data. This hybrid approach combines predictive modelling with adaptive intelligence, enabling controllers to respond dynamically to variability, a significant step toward more resilient and efficient operations. These advances mark a shift from rigid, model-centric methods to flexible, data-driven strategies. The implications are clear: shorter design cycles, improved adaptability, and enhanced robustness. Industries can now operate closer to optimal performance while meeting stringent safety and sustainability targets.

Looking ahead, process control is moving toward autonomous, intelligent systems. Key areas of development include:

- **Self-tuning controllers** that continuously learn and optimise.
- **Integration with digital twins** for predictive maintenance and real-time decision-making.
- **Cybersecurity measures** to protect increasingly connected control architectures.
- **Sustainability-focused control** to minimise energy use and emissions.

As chemical engineering embraces Industry 4.0, process control will remain a foundational discipline, evolving from a reactive safeguard to a proactive, adaptive system that supports innovation and resilience.

Feature

REFERENCES

- [1] van Waarde, H. J., Camlibel, M. K., & Trentelman, H. L. (2025). *Data-based Linear Systems and Control Theory*. Kindle Direct Publishing.
- [2] Qin, S. J., & Badgwell, T. A. (2003). A survey of industrial model predictive control technology. *Control Engineering Practice*, 11(7), 733-764.
- [3] Bemporad, A., Morari, M. (1999). Robust model predictive control: A survey. In: Garulli, A., Tesi, A. (eds) *Robustness in identification and control. Lecture Notes in Control and Information Sciences*, vol 245. Springer, London
- [4] Wu, Z., Christofides, P., Wu, W., Wang, Y., Abdullah, F., Alnajdi, A. & Kadakia, Y. (2025). A tutorial review of machine learning-based model predictive control methods. *Reviews in Chemical Engineering*, 41(4), 359-400.

COMMITTEE OVERVIEW

Sol Brown (Chair)	Chua Choon Hong (Chair Malaysia chapter)
Maria Papathanasiou (Secretary)	Tan Yin Ling
Malcolm Woodman (Treasurer)	Vasileios Charitopoulos
Michael Fairweather	Bhavik Mehta (Newsletter)
Michael Francis Benjamin	Keeran Ward (Newsletter)
John Lewis	Irene Chew
Rafael Ventura (Webinar Coordinator)	Bishwjeet Binwal
Rahul Nabar	Sumit Gadwe
Shoaib Kiyani (Knowledge & Networks Officer)	Manish Aggarwal (Newsletter)
James Sweeney	Lazaros Papageorgiou
Alberto Saccardo	

IChemE GLOBAL ICHEME NEWS

Chemical Engineering at the Heart of Net Zero

IChemE hosted its second Energy Transition Debate in London on 20 January 2026, bringing together chemical engineers, industry leaders, academics, and policymakers to discuss the role of chemical engineering in delivering the UK's industrial strategy, net-zero targets, and sustainable growth. The event featured contributions from IChemE President Professor Raffaella Ocone and UK Minister for Industry Chris McDonald MP, alongside an expert panel spanning industry, finance, and academia. Discussions focused on the intersection of industrial policy, geopolitics, and sustainability, highlighting how chemical engineers are uniquely positioned to develop practical, scalable solutions for the low-carbon transition. The debate reinforced IChemE's commitment to fostering dialogue between government and the profession on critical energy transition challenges and opportunities. [For more information, click here.](#)

Opening New Pathways for Technicians

IChemE has become a supporter of the Technician Commitment and launched a new free membership category for work-based learners, including apprentices and vocational trainees. The initiative strengthens recognition of technicians and process operatives while providing a clear, accessible pathway into professional membership, tailored development resources, and progression towards Engineering Technician (EngTech) status. [For more information, click here.](#)

Engineering Comes Alive in Schools

IChemE has partnered with All About Futures to deliver DiscoverChemEngLIVE Challenge Days, bringing hands-on chemical, biochemical, and process engineering experiences to Year 8 students in state-funded schools across the UK. The programme uses interactive, team-based activities to showcase real-world engineering impact and inspire future careers, at no cost to schools. [For more information, click here.](#)

Decarbonising Industries

IChemE, in partnership with the Royal Society of Edinburgh, convened an expert roundtable to examine industrial decarbonisation in Scotland and its implications for skills, jobs, and economic development. The discussion highlighted Scotland's strengths in areas such as carbon storage, hydrogen, and renewables, while stressing the need for long-term policy clarity, workforce transition support, and strategic investment to enable a successful net-zero transition. [For more information, click here.](#)

UPCOMING WEBINARS

ARC-Enabled APC: A Simplified Design for Ammonia Reformer Optimisation

Speakers: Ms Normaya binti Shabudin, Mr Godwin Lim Kah Soon, IChemE CAPE SIG – Malaysian Chapter

Date: Friday, 27th March 2026

Description: Traditional APC deployment in ammonia plants often results in overly complex models that are difficult for operators to manage and may cause calculation issues. This presentation introduces a streamlined approach using Advanced Regulatory Control (ARC) to handle primary stabilisation tasks in the reforming section and manage fast-acting disturbances. By controlling critical loops, such as the steam-to-carbon ratio and the reformer outlet temperature, at the regulatory level, the overall APC design is simplified, and the computational burden is reduced. The approach reduces commissioning effort, improves energy efficiency, and enables safer operation at higher production limits. [For more information, click here.](#)

Process Systems Engineering for Gene Therapy Manufacturing

Speakers: Francesco Destro, BioCurie – AIChE Cast & IChemE CAPE SIG

Date: Tuesday, 12th May 2026

Description: Recent advancements in the fields of gene and cell therapies have led to the approval of treatments for diseases that were previously incurable, including certain types of genetic disorders and cancers. However, most advanced biotherapeutics are produced through manufacturing processes characterised by low efficiency and high costs, which are slowing down the translation into the clinic and patient access for breakthrough life-saving medicine. This talk will demonstrate how process systems engineering tools can address key challenges in the manufacturing of recombinant adeno-associated virus (rAAV), a primary viral vector for in vivo gene therapy. A novel framework integrating mechanistic modelling and machine learning is introduced and experimentally validated, demonstrating its potential to transform rAAV process performance across development and manufacturing scales. [For more information, click here.](#)

NEWS FROM OUR MALAYSIA CHAPTER

WHAT HAVE WE BEEN UP TO?

In 2025, the IChemE CAPESIG Malaysia Chapter actively organised and supported a range of academic and industrial knowledge-sharing activities, demonstrating a strong commitment to advancing digitalisation, sustainability, and engineering education.



NEWSLETTERS

The Malaysia Chapter published two CAPESIG newsletters in **May** and **November** 2025. These newsletters featured technical articles, industry perspectives, academic insights, and updates on CAPE-related activities, covering themes such as process simulation, digitalisation, sustainability, and industrial applications of CAPE tools.

WEBINARS

Throughout the year, CAPESIG organised a comprehensive series of technical webinars addressing emerging tools, methodologies, and industrial applications of computer-aided process engineering. The webinar programme commenced in January 2025 with “**Industrial Application of Machine Learning for Process Optimisation**”, delivered by Mr Sergio Sama Rubio, which explored how machine learning techniques enhance process efficiency, optimisation, and decision-making in complex industrial systems. In April 2025, the webinar “**Minimising Unknowns with Advanced Simulation**”, presented by Ir Rafil Elyas, focused on how advanced simulation tools reduce uncertainty, improve process safety, and enhance operational reliability. This was followed in June 2025 by “**Role of Computer-Aided Process Engineering Tools for Energy Sector Decarbonisation – The Past, Present and Future**”, delivered by Dr Viknesh Andiappan from Swinburne University of Technology, Sarawak. The session highlighted how process systems engineering tools support net-zero energy planning, carbon reduction strategies, and informed decision-making for sustainable energy systems. In September 2025, the webinar “**AVEVA Industrial Digital Twin Solution**”, conducted by Ms Maamira Mior, showcased the application of industrial digital twin technologies for asset performance optimisation, real-time monitoring, and sustainability improvements across industrial operations. The webinar series concluded in November 2025 with “**Computer-Aided Process Engineering: Usage of Computers in Process Modelling for the Oil and Gas Industry**”, presented by Mr Lionel Ling Chung Hui from Shell MDS. This session emphasised the importance of accurate process modelling for design, optimisation, performance monitoring, and troubleshooting in the oil and gas sector. Collectively, these webinars strengthened engagement between academia and industry while demonstrating the practical value of CAPE tools in addressing modern engineering challenges.



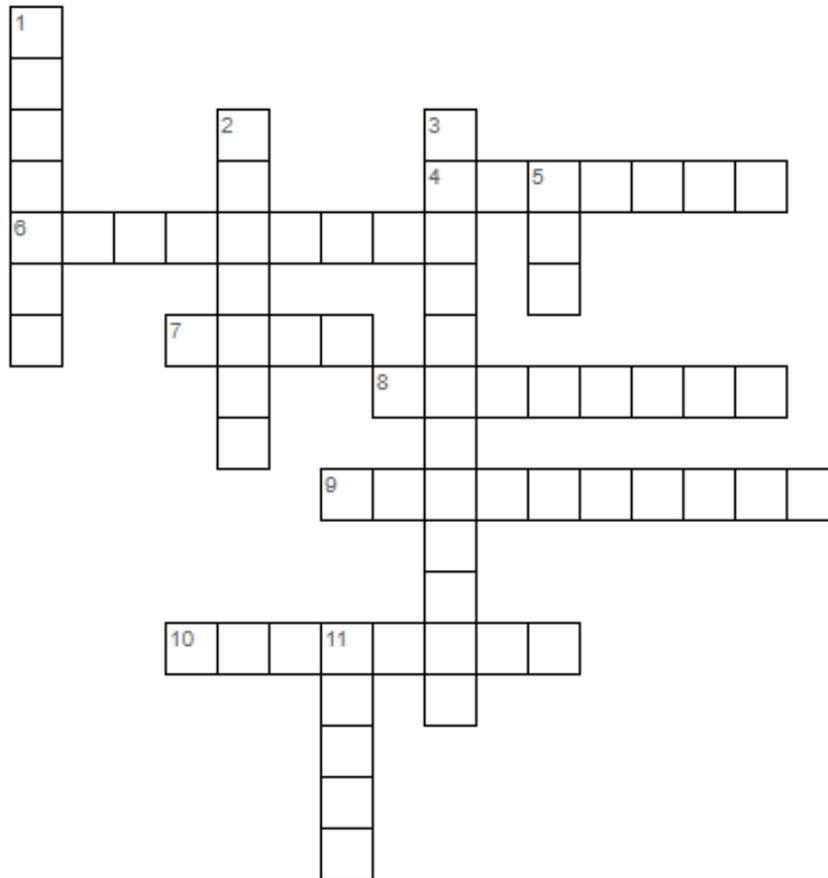
TECHNICAL WORKSHOPS

In addition to the webinar series, a major in-person training event was successfully conducted in October 2025. The Process Simulation Workshop (UNISIM Software) was held on 16 October 2025 at Curtin University Malaysia and jointly organised by the IChemE CAPESIG, IChemE Education SIG, and the Curtin Malaysia IChemE Student Chapter. Led by Prof Dominic Foo from the University of Nottingham Malaysia, the workshop provided hands-on training in building and running process simulation models, interpreting simulation results, linking theoretical process design with industrial-scale applications, and introducing digital twin concepts for optimisation and decision-making.

NERD-OUT CROSSWORD

THIS ISSUE'S CROSSWORD IS ALL ABOUT PROCESS CONTROL IN CHEMICAL ENGINEERING

Use the guide below to answer terms used when discussing Process Control in the context of Chemical Engineering.



ACROSS

- [4] Transform used to convert differential equations to algebraic form
- [6] Temporary deviation from setpoint after a change
- [7] Ratio of output change to input change
- [8] A process property that must be controlled, measured, or manipulated
- [9] Type of control that uses future predictions
- [10] The desired target value in a control loop

DOWN

- [1] Family of controller tuning method associated with Ziegler—____
- [2] Common control structure in DCS systems
- [3] Common tuning approach requiring closed-loop tests
- [5] Classical controller with proportional, integral, and derivative action
- [11] Simple controller with only proportional action

CROSSWORD ANSWERS KEY: 1- NICHOLS; 2-CASCADE; 3- ULTIMATE GAIN; 4-LAPLACE; 5-PID; 6-OVERSHOOT; 7-GAIN; 8-VARIABLE; 9- PREDICTIVE; 10- SETPOINT; 11- PONLY

