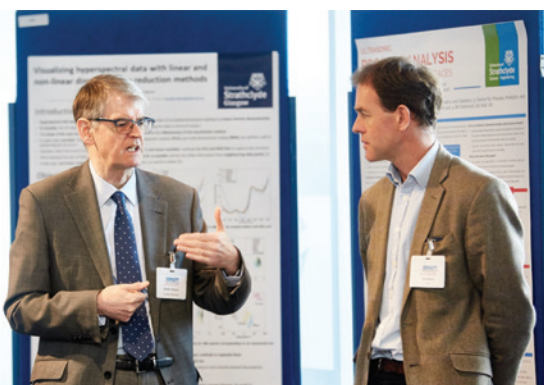


# CPACT CELEBRATES 20 YEARS AND LOOKS TO THE FUTURE

**In October this year the Centre for Process Analysis and Control Technology (CPACT) marked their 20th Anniversary with a 2-day Conference and celebratory dinner at their home base, Strathclyde University in Glasgow. Process analysis and control is a key technology area for the petroleum and petrochemical industries and CPACT are keen to develop further links with the industry as they continue to grow the scope of the technologies and expertise they can offer to member organisations. In this article we look at what CPACT has to offer the industry.**



One of the Founders of CPACT, Prof David Littlejohn (left) and Dan Wood CEO of member company Keit Spectrometers in deep discussion at the CPACT 20th Anniversary meeting in Strathclyde University. Photo courtesy of Natalie Kerr, CPACT

## Who are CPACT?

The concept of CPACT was developed during discussions in the mid 1990s between Prof David Littlejohn from Strathclyde University, who was interested in on-line process analysis, and Prof Julian Morris from Newcastle University, who was interested in process control technologies. These discussions were further

developed with other interested industrial and academic parties and led to the formation of CPACT in July 1997 with funding from the UK government through the Foresight Challenge of £1.34m plus industrial contributions of £669,000 in cash and circa £2m in-kind contributions.

Founding members included the Universities of Strathclyde, Newcastle and Hull together with 9 end-user and vendor companies who launched CPACT as a UK based, inter-disciplinary consortium to promote advanced process monitoring and control technologies. Through the last 20 years CPACT has grown and developed into a successful self-sustaining international organisation delivering process analysis and control technology collaborations between academia, vendors and end-user companies (Figure 1).

A major feature of the CPACT model is a unique confidentiality agreement and modus operandi between universities and collaborating companies, which is designed so that new members can sign up "quickly and easily", and which includes a 'Proprietary Project' Annex.

CPACT now includes 29 industrial members and 12 University and Research Centres and has a track record of delivering value added projects. The current members are listed by category in Table 1. Members estimate that CPACT have brought over £60m in benefits

through projects which have included petrochemical processes such as catalytic cracking, catalyst recycling (£0.25m per annum), fluidised bed optimisation (£1m per annum), reaction monitoring in both batch and continuous processes and unexplained variability in fermentation processes (£4.5m per annum).

## What Does CPACT Do?

The main mission of CPACT is to deliver research and technology transfer (Figure 2) in process analytics, process monitoring, process modelling, process control and chemometrics by providing a "one stop shop" for companies seeking advice and research on all aspects of process control. By combining leading universities with technology vendors working in conjunction with the end user companies, CPACT provides an excellent window on the world of process control and chemical analysis.

The research is focussed on industry led projects and provides routes to tangible scientific and technological benefits in process manufacturing. CPACT addresses the manufacturing challenges being faced by the chemical, biochemical, pharmaceutical, food and materials processing industries through the unique synergy of end-user process manufacturers, analytical vendor companies and control systems solution providers.

Key research areas and technologies which can be accessed by members of CPACT include: -

### Process Analytics:

The main process analytical research is based in Strathclyde University and focusses on the development of at-line, on-line, in-line and non-invasive process monitoring procedures for specific applications based on a wide range of techniques combined with chemometric data analysis and the development of miniaturised 'bespoke' process sensors.

Optical spectroscopy techniques are widely employed on-line in the petroleum industries and CPACT expertise in this area includes near and mid infra-red, ultra violet and raman spectroscopy which are often combined with chemometric and advanced statistical data processing techniques to provide "real time" chemical process analysis data. The academic expertise is also supplemented by several vendor members supplying leading edge hardware and software

Low Field Nuclear Magnetic Resonance (LFNMR) techniques are currently of interest in the petroleum industry and are being studied by CPACT for process analysis. In addition to deploying commercially available LFNMR bench top instrumentation CPACT has secured a recent research award to develop Very Low Field NMR which has the potential to deliver a paradigm shift for LFNMR spectroscopy for industrial process monitoring, control, and optimisation.

Acoustic spectroscopy, both in passive and active modes, is a powerful non-invasive tool for process analysis and CPACT has significant expertise and an active research programme in this area. Other areas include on-line mass spectrometry, data fusion, smart chemometrics and signal processing.

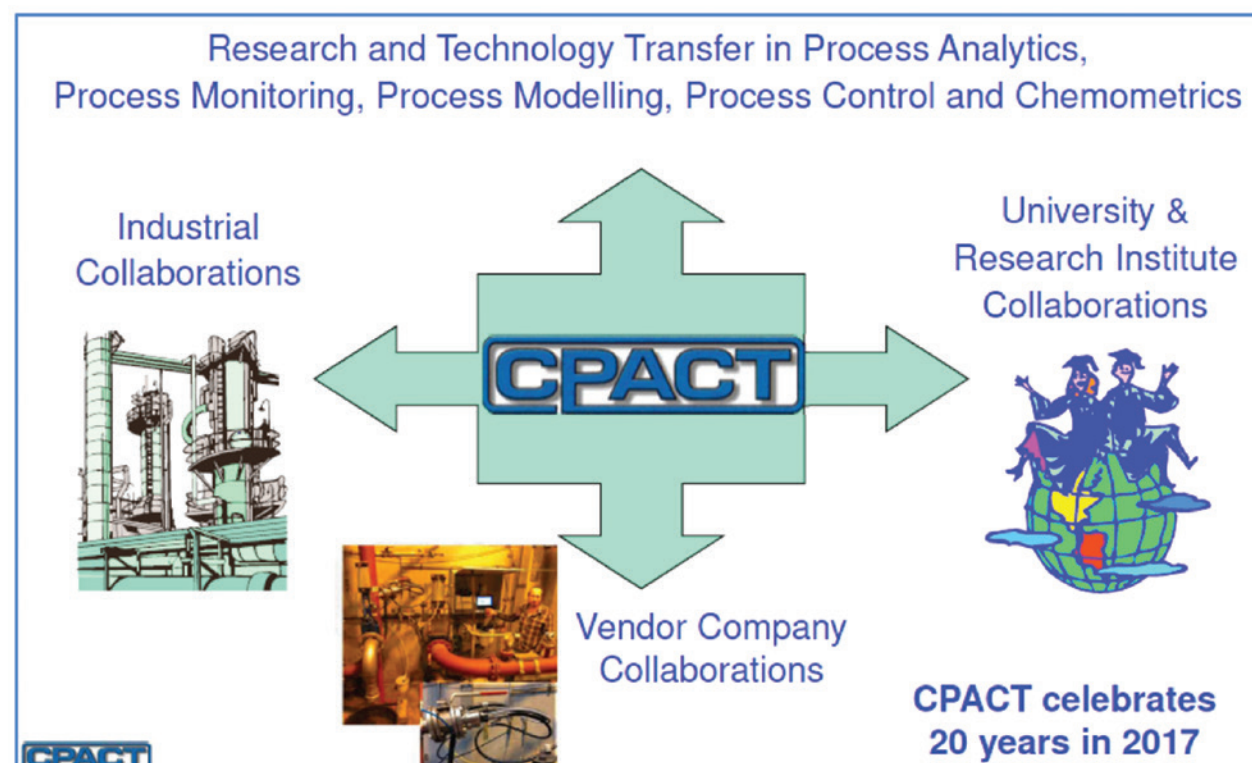


Figure 1: The CPACT technology collaboration model between academia, vendors and end-user companies. Courtesy CPACT



CPACT researchers have published over 46 papers on process analytical techniques which are listed on their website ([http://www.cpact.com/research/publications/process\\_analytical\\_techniques](http://www.cpact.com/research/publications/process_analytical_techniques))

**Predictive Modelling and Process Performance Monitoring**

This area of activity has been championed and progressed by Professor Julian Morris and Dr Alison Nordon and covers a wide range of activities including: - Multivariate statistical predictive modelling. Design of Experiments and Performance Monitoring. An EU Innovative Training Network "ModLife" at USTR is addressing two themes: Dynamic Multivariate Statistical Process Performance Monitoring and Data Fusion, and the Integration of Spectroscopic and Process Data

The scope of this area is illustrated by the fact that CPACT researchers have published over 120 papers in this area which are catalogued on their website <http://www.cpact.com/research/publications>

**Conferences, Training and Continuous Professional Development:**

CPACT provides an outstanding training environment for PhD students and postdoctoral researchers many of whom have gone on to gain careers and leading positions in industry and academia.

Members companies can also access a wide range of training opportunities for their employees including a series of popular training courses, webinars and six-monthly Research Days

CPACT initiated and run a conference series titled "Advances in Process Analytics and Control Technologies (APACT)", [www.apact.co.uk](http://www.apact.co.uk), which is an open forum for the presentation and discussion of recent advances in engineering and scientific topics relevant to process analytics and control technologies. Plenary and keynote speakers describe the formulation and implementation of PAC strategies, review the benefits that can be achieved, and report recent developments. An instrument exhibition and full social programme are also included.

CPACT also established the triennial EUROPACT conference, [www.euro-pact.org](http://www.euro-pact.org), with the German Chemical Society and DECHEMA which was first held in 2008 in Germany. Subsequent events were held in Glasgow in 2011, in Barcelona in May 2014 and in Berlin in May 2017.

**CPACT Software toolboxes:**

Over the years CPACT has developed a range of software toolboxes which are available at no extra cost to member companies and include: -

**Data PreScreen:** A Multivariate Statistical Data Pre-screening Toolbox has been designed and developed for use by the practising process engineer who wishes to pre-process and pre-screen process data prior to multivariate data analysis, process data modelling or building predictive and inferential models.

**MultidAT:** is a Multivariate Statistical Modelling & Statistical Process Control Toolbox designed and developed for use by the practising process engineer who wishes to analyse process data for plant data interpretation, feature detection and process modelling. The toolbox builds on top of the MATLAB programming environment, with powerful user interface procedures providing user friendly, mouse/menu driven software.

**BatchDAT:** is a Multivariate Batch Process Statistical Process Control Toolbox which was initially designed and developed for GSK but can be used by practising process engineer who wish to analyse the scale up from fed batch seed to production vessels.

**DoEMan:** is a software tool for the Design of Experiments for Calibration Modelling to simplify the use of experimental designs for choosing suitable pre-treatment methods for calibration problems. The immediate benefit of using experimental designs to select pre-treatment methods for calibration problems is that choosing the best pre-treatment method becomes a structured and objective activity.

**Spectral Shooter:** is a new CPACT MATLAB-based Toolbox that provides highly visual and easy-to-use state-of-art spectral data pre-processing methods, calibration transfer between different

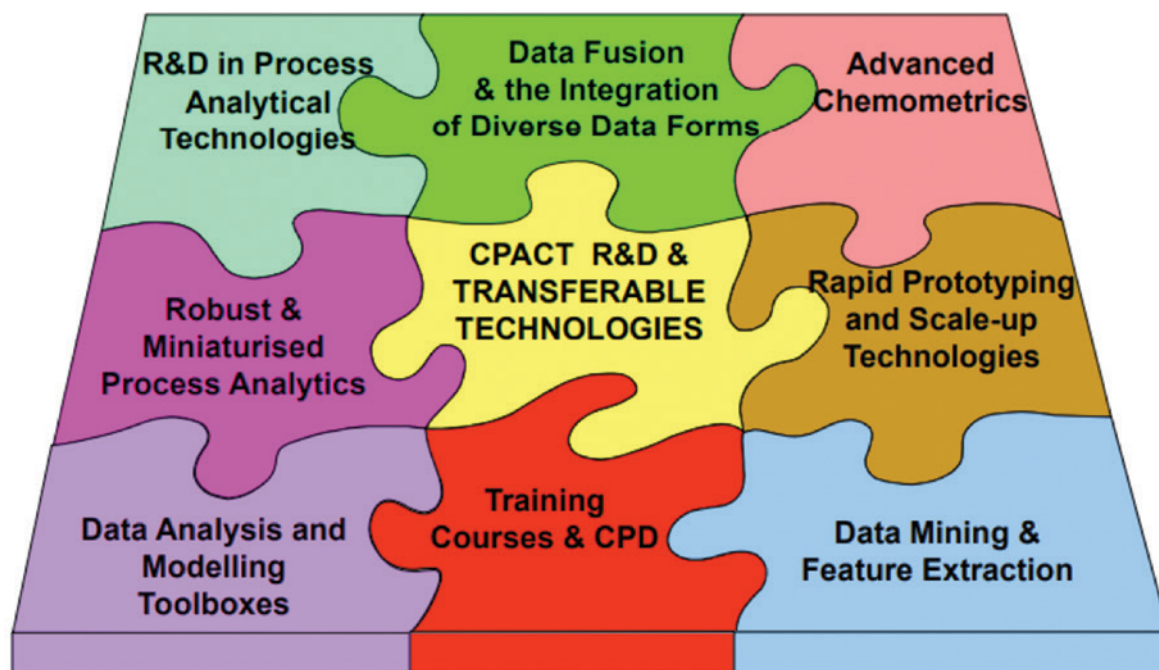


Figure 2: CPACT Key skills and expertise in combining transferable research and technology for world class process control. Courtesy CPACT

instruments and calibration maintenance. It is aimed at allowing users to try novel algorithms that are not available in conventional chemometrics packages. As part of the functionality standard spectral data pre-processing has been added to allow comparison of the new tools with currently available methods.

All the CPACT toolboxes, except for DoEMan, are compiled and do not need MATLAB to run.

**Feasibility Studies**

Feasibility studies are small scale investigational studies within the general areas of process analysis, process performance monitoring and chemometrics which are designed to help specify research routes to more detailed projects. They are designed to be capable of being completed within 12 months and cost no more than £2 to £3K. Individual companies suggest the type of brief study that might be of benefit to them and a study programme is developed. Recent studies have included: -

- The analysis of Raman and UV-visible spectra of mixtures to assess process analytical options.
- The comparison of different spectroscopic techniques for target compounds in a process.
- The evaluation of handheld/portable Raman spectrometers for different samples.
- The application of CPACT software to process and spectroscopic data.

**CPACT the Future?**

As CPACT looks forward after 20 years it will strive to maintain its position as the leading process analytics and control technologies network in Europe and beyond by Influencing the production of next generation analysers and data analysis software to deliver advances in manufacturing processes to help members drive improvements and thus increased profitability

It aspires to continue to extend training for both industrialists and academics and to produce high quality researchers and trained PAT scientists who can assist access to the latest research and enable technology transfer. CPACT can also help companies assess new technologies through short feasibility studies and then assist coordinate grant applications to leverage R&D funding from a range of sources.

CPACT are keen to explore further interactions with the petroleum and petrochemical industries and further information and contact details can be found on their website <http://www.cpact.com/>

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Centre for Process Analytics and Control Technology Partners		
Research/Innovation Institutes	Technology End Users	Technology Vendors
A*STAR, Singapore	AstraZeneca	Art photonics GmbH
Hunan University, China	Borealis	CAMO Software
Imperial College London, UK	BP	Clairat Scientific
IRTA, Spain	Bristol-Myers Squibb	Eigenvector Research Inc.
Newcastle University, UK	Domino	Hellma
Tel-Tek, Norway	Fujifilm Imaging Colorants	Indatech
University College London, UK	GlaxoSmithKline	KEIT Spectrometers
University of Bergen, Norway	Johnson Matthey Plc	Perceptive Engineering
University of Bremen, Germany	Centre for Process Innovation	Polytec
University of Manchester, UK	Merck Sharp & Dohme	Process Vision
University of Strathclyde, UK	Unilever R&D Vlaardingen B.V.	Sartorius-Stedim Data Analytics
University of York, UK	The National Nuclear Laboratory	tec5 AG
	DSM Resolve	
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	Syngenta	
	Sanofi	
	Thomas Swan	

Table 1: CPACT current members by category

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