The CPACT Way

CPACT works to facilitate the creation of manufacturing excellence of the Process and Pharmaceutical Industries through leading edge R&D, technology translation and exploitation of Process Analysis, Chemometrics and Control Technologies.

Fact Sheet

Summer 2009

Web site: www.cpact.com

News: CPACT Short-listed for an EPSRC Innovative Manufacturing Research Centre (IMRC)

Centre for Process Analytics and Control Technologies

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CPACT BACKGROUND

- CPACT was formed in July 1997 through the Foresight Challenge with an EPSRC/DTI award of £1.34M plus industrial contributions of £690,000 in cash and £1,999,000 in-kind; involved 3 Universities and 15 companies.
- The EPSRC Review of CPACT rated the project as "tending to internationally leading" with particular mention of the "outstanding contributions to research output and staff output".
- CPACT Phase II 'KNOW-HOW' was launched in June 2001 with EPSRC support of £1.254M plus industrial funding of £915,000 in cash and £1,642,000 in-kind from its 18 member companies. EPSRC review rated the project as *'Outstanding'* with *'Internationally Leading'* assessments for *'Research Quality'* and *'Research Planning & Practice*'; '*Tending to Internationally Leading'* for '*Potential Scientific Impact*', and *'Outstanding'* for *'Quality & Training*', *'Communications of Outputs'* and '*Cost Effectiveness*'.
- CPACT has raised and delivered additional research grants of ~£5M.

CPACT ACTIVITIES & SERVICES

- Industrially shaped R and D
- Technology Translation & Knowledge Transfer Partnerships (KTPs)
- Training and CPD Courses
- Networking, Workshops & Conferences

CPACT OUTPUTS

- Established a unique confidentiality agreement and modus operandi between UK universities, collaborating companies and European Institutes which is designed so that new members can sign up "quickly and easily", and which includes a 'Proprietary Project' Annex.
- Delivered 48 research reports, 29 PhDs and 25 Post Doctoral Researchers, 6 Temporary Assistants and 14 Vacation studentships from the three universities in Phases I and II.
- Trained 150 Industrialists and academics in the CPACT technologies.
- Delivered 10 collaborative research programs to the satisfaction of the industrial sponsors and achieved RAE 5* ratings at Newcastle and 4 at Strathclyde and Hull in RAE 2001.
- Run 9 Annual APACT Conferences with over 600 delegates, the leading annual conference in PACT technologies in Europe.
- Established triennial EUROPACT conference with the German Chemical Society and DECHEMA (April 2008). EUROPACT 2011 - Glasgow.
- Established links with CPAC in the USA and CAPEC in Denmark.

MEMBERSHIP BENEFITS

- Participation in specific Research Council, TSB and EU projects of strategic company importance (either with individual companies or as part of consortia).
- Shared generic learning from CPACT projects.
- Access to a pool of academic expertise across seven Universities and industrial experience across member companies.
- Access to well-trained recruits at PhD and Post Doctoral levels.
- Access to CPACT Software Toolkits.
- Industrial and Academic Networking.
- A virtual PhD and Postdoctoral researcher 'Club' providing in-depth multidisciplinary support.
- A forum to raise the profile of process analytics and control technologies across process and pharma sectors.
- Reduced costs of attending the annual APACT conference series, tailored CPD training courses and other events.
- Advice and help on accessing Research and Development funding.
- Effective training of the workforce.
- Ensuring R&D and Networking funding sources are effectively leveraged.
- Access to a dedicated web site with open and members sections. Participation in CPACT Webinars.
- Assistance with technology implementation in Process Analysis and Control Technologies.

SOME BUSINESS BENEFITS FROM CPACT TECHNOLOGIES

- Savings in catalyst usage in a commercial scale fluidised bed reactor ~ £1M / annum (BASF).
- Detection and Diagnosis of a bio-intermediate impurity problem (GSK).
- Multi-site transfer of development and production models using generic modelling technologies (GSK).
- Neural network model based experimental design – 30% improvement in the throughput innovation & developments of a new protein innovation & development lab.
- Assured monitoring of chemical reactions ~ £800,000 per annum.
- Integrating spectral and process data for on-line real-time reaction monitoring.
- Early detection of faulty reactor dosing ~ £250K / annum.
- Modified recycling of fluidised bed catalytic reactors ~ £250K per Bed.
- Unexplained variability in fermentation production processes, expected benefits ~ £4.5M / annum (GSK).

PARTNER COMPANIES

3M Healthcare; AJM Consulting; Bioinnovel; BP Chemicals; Clairet Scientific; Centre for Process Innovation; Fibre Photonics; Fujifilm; Genzyme; GSK; Johnson Matthey; MKS Instruments; National Nuclear Lab; Perceptive Engineering; Syngenta; VTT Optical Instrumentation

ANNUAL MEMBERSHIP FEES

- End User company - £7,500 + VAT
- Non-SME Vendor - £4,400 + VAT
- SMEs - £1,000 + VAT if less that 20 employees, otherwise - £2,250 + VAT
- Research Institutes - £2,250 + VAT

CPACT CONSULTANTS

- Professor Roger Benson FREng
- Dr Frank Cottee (ex GSK)
  (CPACT Honorary Presidents)
- Professor Julian Morris FREng. CEng. FIChemE FInstMC
  (CPACT Technical Director)

PhD & POSTDOCTORAL RESEARCH

Strathclyde:

- Allyson McIntyre – Development and applications of new probes for in-line MIR and NIR spectral measurements.
- David Wilsdon - In-situ characterization polymer stabilized pigment dispersions using spectroscopic techniques.
- Melissa Black - On-line measurement of rheology in biotechnology processes
- Nicci Townshend - Development of photonics-based techniques and procedures for real-time process analysis (Raman, NIR and MIR spectrometries).
- Sergey Mozharov - Optical developments for Raman spectroscopy including intra-cavity laser systems.
- Peter Hamilton - Real-time particle characterisation during solvent removal in pharmaceutical dryers (using particle analysers, Raman and NIR spectrometries).

Newcastle:

- Jega Jewaratnam - Model-based Bio-process performance monitoring and batch-to-batch optimization.
- Jeong Jin Hong - Integration of spectroscopic and process data for enhanced process performance monitoring.
- Shallon Stubbs - Dynamic model based process performance monitoring.
- Javier Serradilla (Maths CASE Award) - Predictive Dynamic Modeling for Next Generation Processing.
- Mohd Yusri Mohd Yunus - Reliable fault detection and diagnosis techniques for nonlinear processes using multidimensional scaling (MDS) and nonlinear data reduction techniques.
- Dr Zeng-ping Chen – Advanced Chemometric modelling and calibration.

Hull:

- Micro reactor & continuous flow synthesis technology for efficient production of chemicals.

EUROPEAN FRAMEWORK PROJECTS

- BIOPRODUCTION – Integrated Project
- EOCARB – FP7 Coal and Steel Project
- MULTIMOD – Marie Curie ITN
- INTELLIGENT BIOPROCESSING - Accepted for 2nd round submission

KNOWLEDGE TRANSFER PARTNERSHIPS

- National Nuclear Lab and BNFG.
- Akzo Nobel Powder Coatings.
- Centre for Process Innovation (CPI)

INDUSTRIAL MANAGEMENT BOARD

- CPACT's member organisations each have a seat on the Industrial Management Board (IMB) which meets annually to review and set policy which is delegated to a Steering Committee which meets 3 times a year. The Steering Committee has responsibility for all scientific and financial matters relating to the operation of activities agreed by the IMB which meets quarterly with 5 elected industrial members. The IMB and Steering Committee Chair is Dr Colin Clarke from the National Nuclear Lab.

CPACT COURSES

- Multivariate Methods for Industrial Data Analysis and DoE (with ISRU)
- Multivariate Statistical Process Control
- Process Spectroscopy
- Process Control for Chemists
- Introduction to Chemometrics
- Process Analysis
- Acoustic Methods
- Neural Networks
- PAT and Lean Six Sigma (with ISRU)

PERSONNEL

Lead Academics:

- David Littlejohn, Lorraine Gibson & Dr Alison Nordon, University of Strathclyde, Department of Pure & Applied Chemistry; Dr Suresh Thennadil, Chemical Engineering.
- Julian Morris & Jie Zhang, Newcastle University, School of Chemical Engineering & Advanced Materials.
- Tony Walmsley & Paul Watts, University of Hull, Department of Physical Sciences.
- Senior staff from Imperial College, Leeds, Manchester & Heriot-Watt.

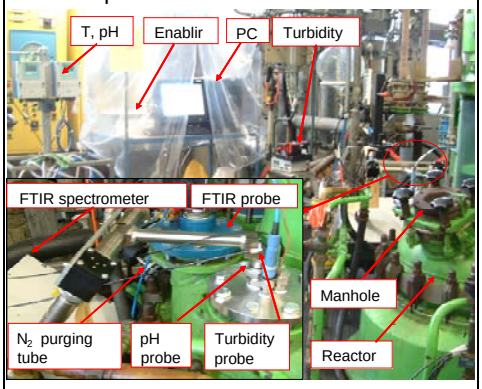
RESEARCH AND DEVELOPMENT OPPORTUNITIES

Process Analytics:

- Research and development of at-line, on-line, in-line and non-invasive process analytical technologies:
  - ⇒ NIR, MIR, UV-visible, Raman scattering, Fluorescence, NMR, Microwave, Acoustic, and Mass spectrometry techniques.
  - ⇒ Analyser / Sensor miniaturisation.

Process Analysis and Chemometrics:

- Data mining & visualisation and advanced multivariate data analysis:
  - ⇒ MS2 Data Mining & Visualisation (*AJM Consulting* & CPACT).
  - ⇒ Process Performance Monitoring.
  - ⇒ Robust modelling and calibration from small data sets; model / calibration transfer.
  - ⇒ Data Fusion – integrating disparate data form e.g. spectroscopic & process data.
  - ⇒ Generic multi-recipe, multi-formulation, multi-site modelling.
  - ⇒ building robust transferable calibrations from minimal data, correcting non-linear shifts and spectral band broadening caused by changing process conditions such as temperature, pH, etc.
  - ⇒ correcting for shifts or drifts in instrument responses: changing from a 'primary' instrument to a 'second' instrument; changing probes & probe locations; etc
  - ⇒ separating absorbance from multiplicative light scattering effects caused by the variations in optical path
  - ⇒ fast re-calibration using only a few experiments or data



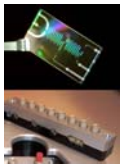
Process Modelling, Inferential Estimation, Control & Optimisation:

- Inferential estimation, advanced process control and optimisation.
- Neural Networks & Software Sensors.
- Hybrid (mechanistic plus empirical) modelling.

Process Intensification:

- High Through-put Technologies.
- Reaction Calorimetry
- Hi-Gee spinning disks, rotating packed bed reactors; oscillatory baffled reactors – EU Project Bioproduction.

Micro and Flow Reactors



- Micro reactor & continuous flow synthesis technology for efficient production of chemicals

CPACT SOFTWARE

- Data pre-screening.
- Multivariate data analysis and modelling
- Neural Network Modelling.
- Design of Experiments & Optimisation