A Workshop for improving the design, development and transfer of formulated products into manufacturing using the "Digital Twin" methodology

perceptive APC

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BENEFITS:

- Accelerated Product Development Cycle
- Optimisation of Experimental Design using Model Based DoE
- Early stage assessment of manufacturing robustness
- Increased process understanding
- Understand Product and Process Sensitivities, de-risking capital investments

DIGITALISATION OF PHARMACEUTICAL PRODUCT DEVELOPMENT

With the Industry 4.0 initiative driving digitalisation in many manufacturing sectors, there is significant progress in the development of optimised scale-up, and tech transfer tools to assist with efficiency improvements required in Pharmaceutical Product Development to lower the cost of early stage development.

THE NEXT STEP IN PHARMACEUTICAL MANUFACTURING

There are a number of obstacles to consistent and efficient product development and technical transfer to manufacturing in the pharmaceutical sector. Despite considerable research, and evidence that greatest benefits are achieved with 'model-based drug development', when models are fully integrated in the process, there remain some challenges to deploy models within manufacturing.

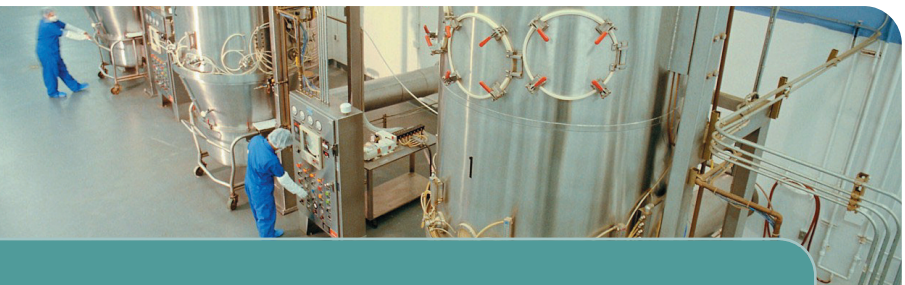
DIGITAL TWIN

Model-based engineering tools to identify an optimised route for pharmaceutical drug development are in regular use, but achieving technology transfer into the manufacturing environment has remained a challenge. Through a collaboration by PSE and Perceptive Engineering there is now an integrated platform for Product Development and Manufacturing. This overcomes the difficulties of transference of models and knowledge, enabling a complete control system to be generated from mechanistic process development models.

The Digital Twin workshop comprises a two-day hands on activity, introducing the tools and skills for development of mechanistic models, optimised DoE's, Model based control and multivariate monitoring techniques to deploy on a GxP ready platform. Using leading-edge software, delegates will learn the how the "Digital Twin" is constructed, explore, through sensitivity analysis, the impact of raw material variability and determine when and how a feedback/feedforward model predictive control system can improve product quality and optimise throughput.

THE WORKSHOP OBJECTIVES

Understand the Process & Product	Improve Process Robustness	Continuous Process Improvement
Speed up Process Development using Model Based Design, focussing effort on process and product sensitivities	Evaluate the impact of raw material variability in simulation. Design tolerant control system before process constructed.	Explore the Design Space to permit process optimisation for economic value without impact on any CQA.
Develop a rigorous Design Space providing opportunity for flexible control adjustment in commercial manufacturing	Detect and Highlight abnormal operation before it causes OOS product	Assess through simulation the optimisation opportunity possible through additional analytical measurement



PSE

PERCEPTIVE ENGINEERING LTD

Model based engineering tools to achieve an optimised route for Pharmaceutical Drug development.

The Perceptive/PSE "Digital Twin" Workshop

Introduction
- Workshop Objectives,
- Introduce the "Digital Twin"

Introduction to gPROMS Formulated Products
- gCRYSTAL modules
  - Overview of capabilities
  - Common applications
  - Batch & continuous processes

Mechanistic model – Simulation & Configuration
- **Case Study - Batch cooling crystallization**
- Plant crystallization process
  - Getting started
  - Simulating the plant process
- Model validation
  - Scale-down
  - Entering experimental data
  - Solubility verification
  - Setting up parameter estimation
  - Running a parameter estimation
  - Model verification and applicability
- Model deployment options
  - Scale-up – validation at plant scale
  - Optimisation of plant recipe
  - Simulating the optimal point

Additional platform capabilities
- Global System Analysis (GSA)
  - Parametric Studies
  - Uncertainty analyses
  - Sensitivity analyses
- **Application case - Batch cooling crystallization**

Data integration
- Data import tool – easier input of experimental data

Introduction to Advanced Process Control techniques
- Define Models for calibration, monitoring, control and Optimisation
- Inferential, ("Soft" sensor) applications
- White, Black and Grey Box modelling
- Model Predictive Control; what, why, when, where!

Introduction to APC for Crystallisation
- Solution overview
- Trajectory following Model Predictive Control for supersaturation control
- Particle size control using FBRM

Simulating gCRYSTAL within PerceptiveAPC
- Case Study – CSTR crystallization
- Overview of the integration of gCRYSTAL model and PerceptiveAPC

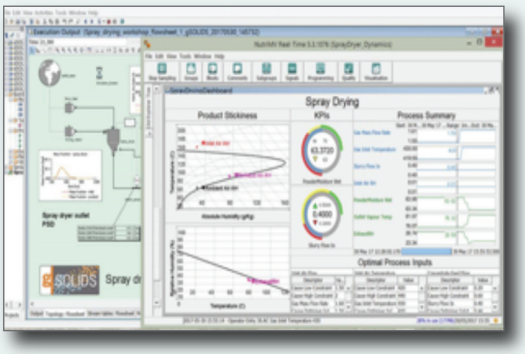
Process Response Tests
- Process response tests to build a MPC for CSTR temperature control
- Process response tests for Metastable zone generation
- Developing the Supersaturation model

MPC Configuration
- Configuration of the Trajectory following temperature controller
- Configuration of the MPC for Supersaturation control

Simulation using gCRYSTAL with PerceptiveAPC to assess Operational Performance
- Running the integrated solution to explore operational scenarios.

PERCEPTIVE ENGINEERING LTD

works with some of the most innovative companies, including Pfizer, Abbott, GSK, Merck, Takeda and many others as partners in designing, developing and deploying Advanced Process Control strategies. In collaboration with Process Systems Enterprise (PSE) we are able to provide a comprehensive "Development to Manufacturing" environment for formulated products.



As both companies are partners in the Advanced Digital Design of Pharmaceutical Therapeutics (ADDOPT™) we are at the forefront of developments in the digitalisation of the Pharmaceutical Industry. Through this workshop we aim to drive the Industry 4.0 concept of the "Digital Twin" to contribute toward the future of pharmaceutical manufacturing.

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