

Advanced Control in Powder Processing (Through Modelling and Continuous Processing) to Deliver Novel Formulations

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**We help companies to
develop, prove, scale-up
and commercialise new
products and processes**

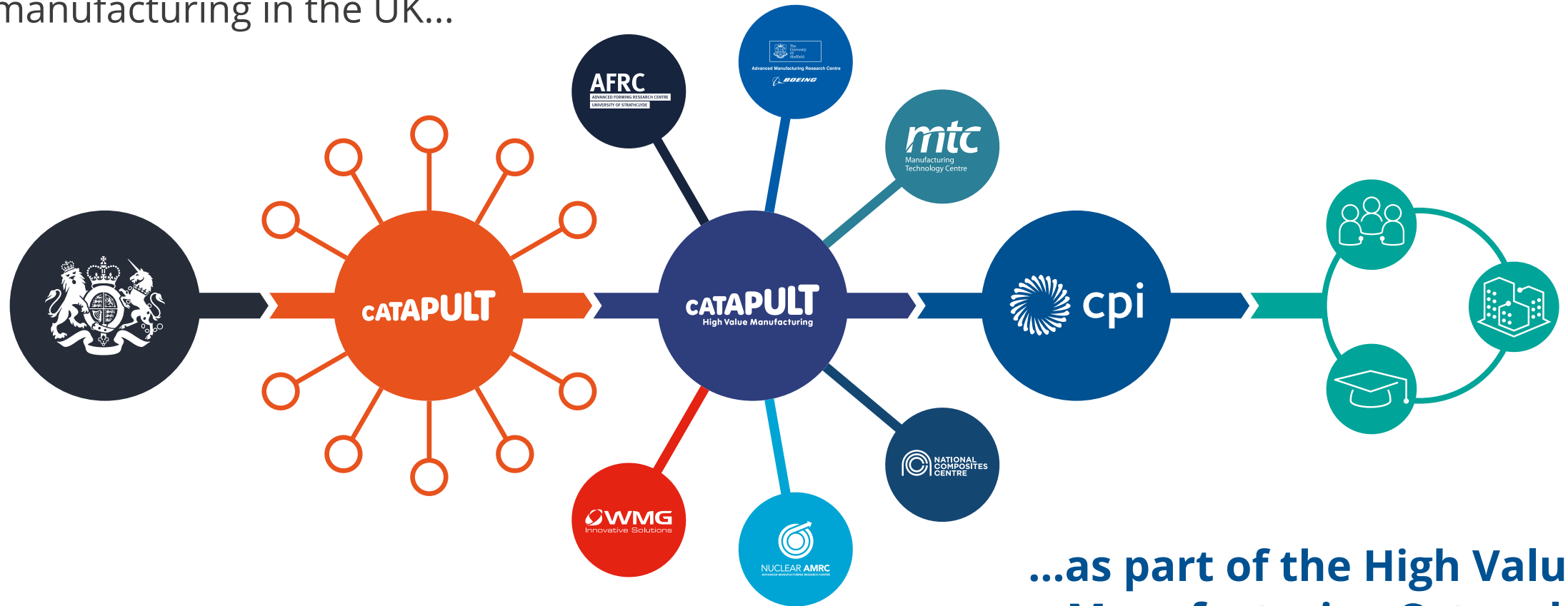


Creating a **healthier** society,
cleaner environment and a
vibrant UK economy...



...by ensuring **every** great
invention gets the **best**
opportunity to become a
successfully marketed product.

Supporting the growth and development of advanced manufacturing in the UK...



...as part of the High Value Manufacturing Catapult

...at our state-of-the-art facilities across the United Kingdom





Proof of concept and scale-up

to prove the feasibility of your new ideas before approaching investors, stakeholders, or funding programmes



Reduce risk

by helping prove and refine your novel technologies before investing further in new facilities and equipment



Decreasing time to market

by providing access to proven demonstration assets and industry expertise

Key ideologies that underpin my thinking for the next slides

'All models are wrong, some models are useful'

George Box (statistician)

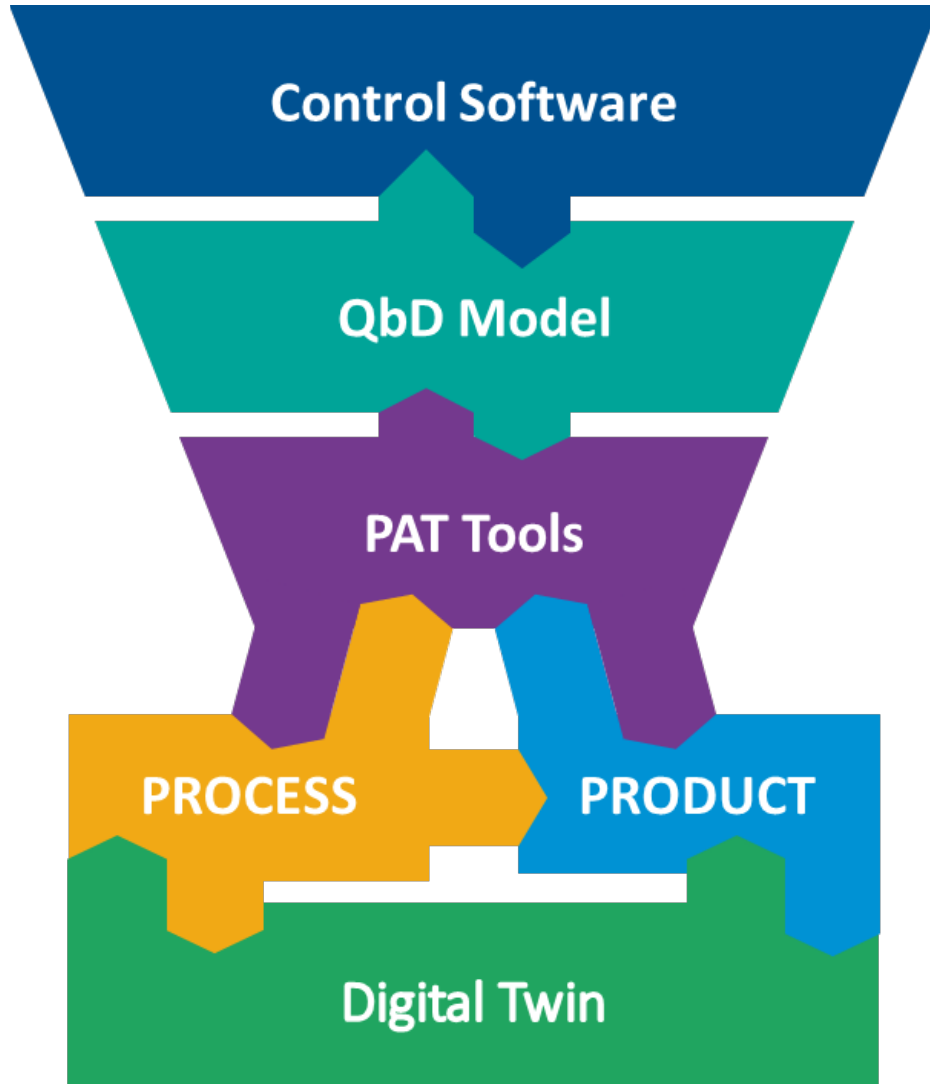
'The future is already here- it's just not very evenly distributed'

William Gibson (writer)

Continuous manufacturing

- Enables real time alteration of processing parameters (for better quality control)
- Agility
- Readily scalable

Building blocks of the Complex Particles offer



Real time alteration of physical asset parameters to ensure good quality product

Understanding of the quality of data, and its interaction with the products quality

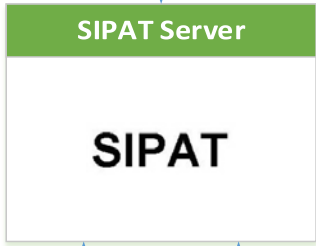
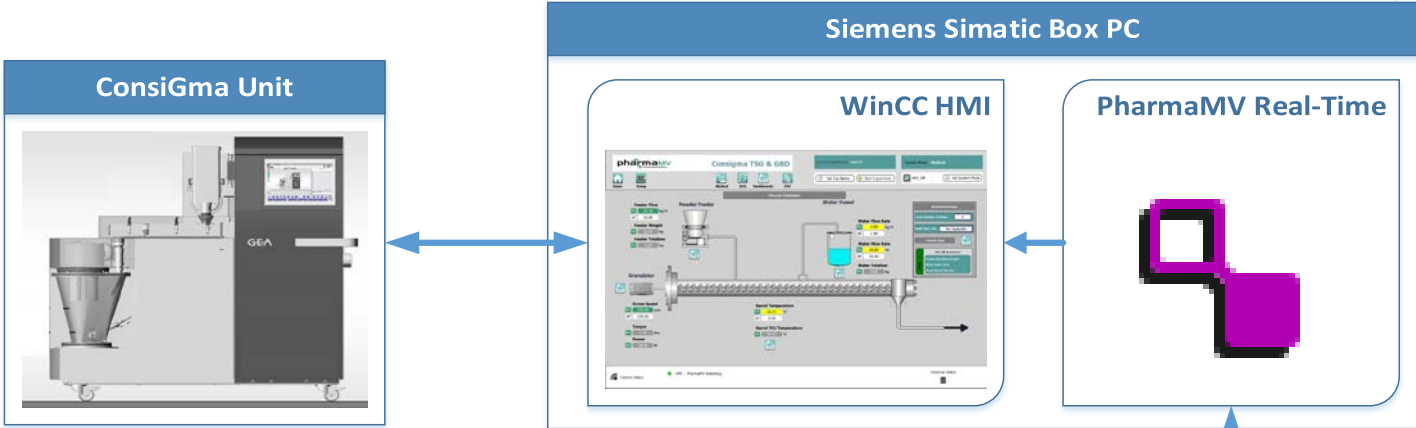
Means of chemical and physical interrogation of the product, sensors need to be appropriate and well integrated

Physical asset, where you produce a formulation

Model that helps you understand where to begin

Advanced Process Control Infrastructure

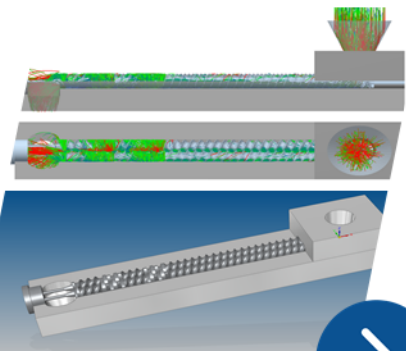
Requires containment
Need to be sure that feedback incorporates safety cut offs



No use if the information is not timely (doesn't always mean fastest)
No use if the information is not accurate (interface design checks)

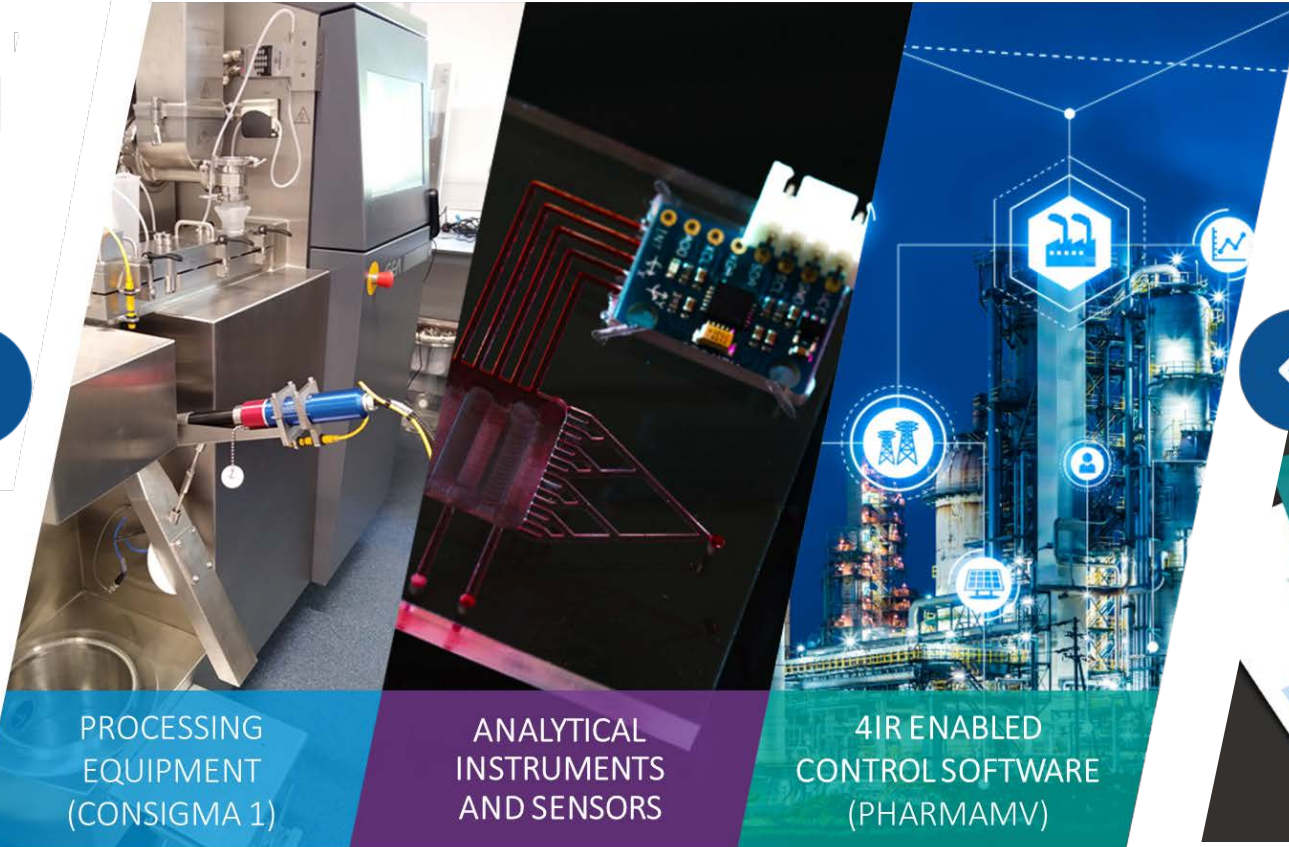
Prospect CP (complex Particles)

Proving of real-world, scalable, predictive tools and technologies for particulate formulations



Modelling the dynamics of material and process

Enabling predictive scale up



PROCESSING EQUIPMENT (CONSIGMA 1)

ANALYTICAL INSTRUMENTS AND SENSORS

4IR ENABLED CONTROL SOFTWARE (PHARMAMV)



Validate new sensor technologies

Develop process analytical techniques



Project now closed

Two year project (6 months in)

Practical Considerations- Isolating actives



Physical PAT sensor integration for the Consigma



Prospect CP

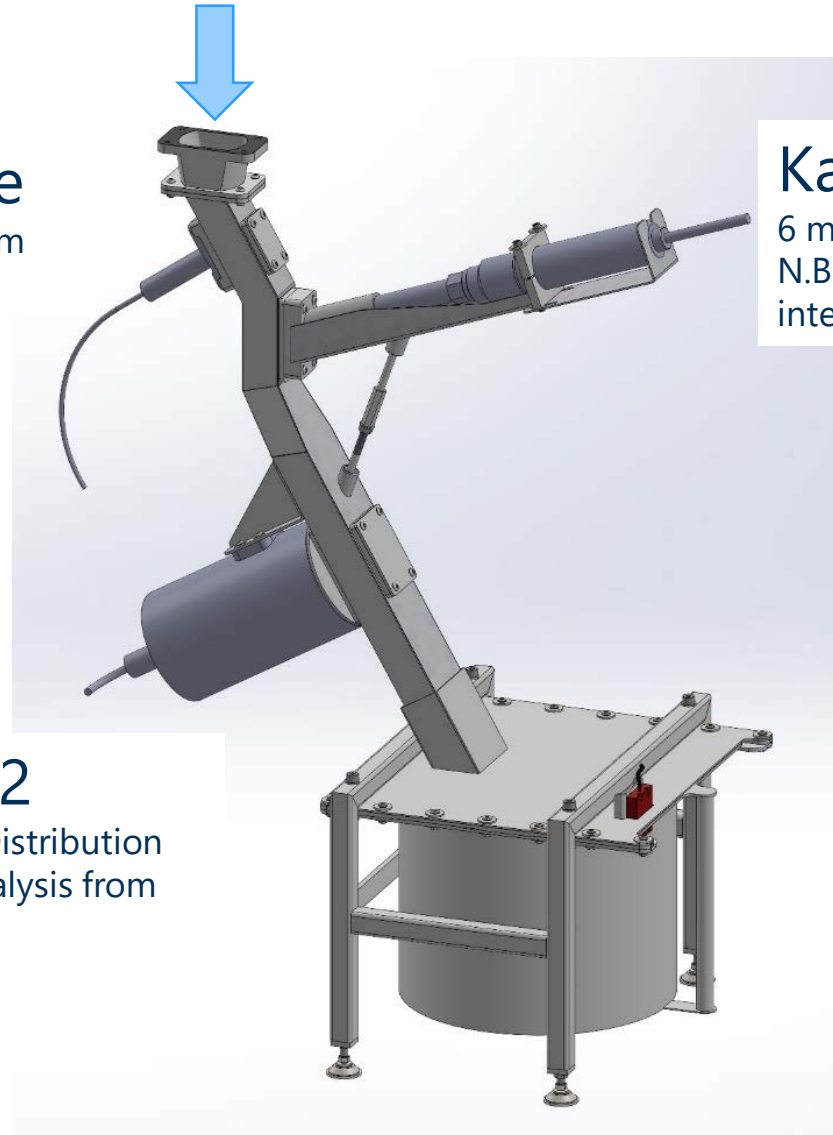
Connection to ConsiGma (replacing fluid bed drier)



Multieye
NIR probe from
Innopharma



Eyecon 2
Particle Size Distribution
and shape analysis from
Innopharma

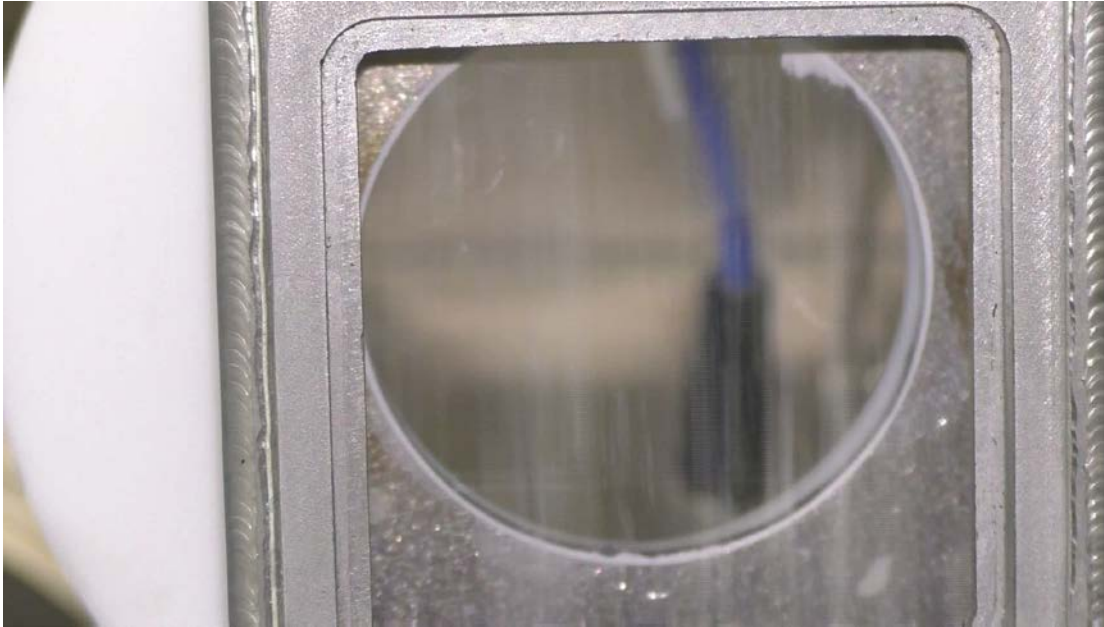


Kaiser Phat Raman probe

6 mm spot size and 785 nm laser
N.B. The attachment has been fully specified with
interlocks/locking screws for laser safety

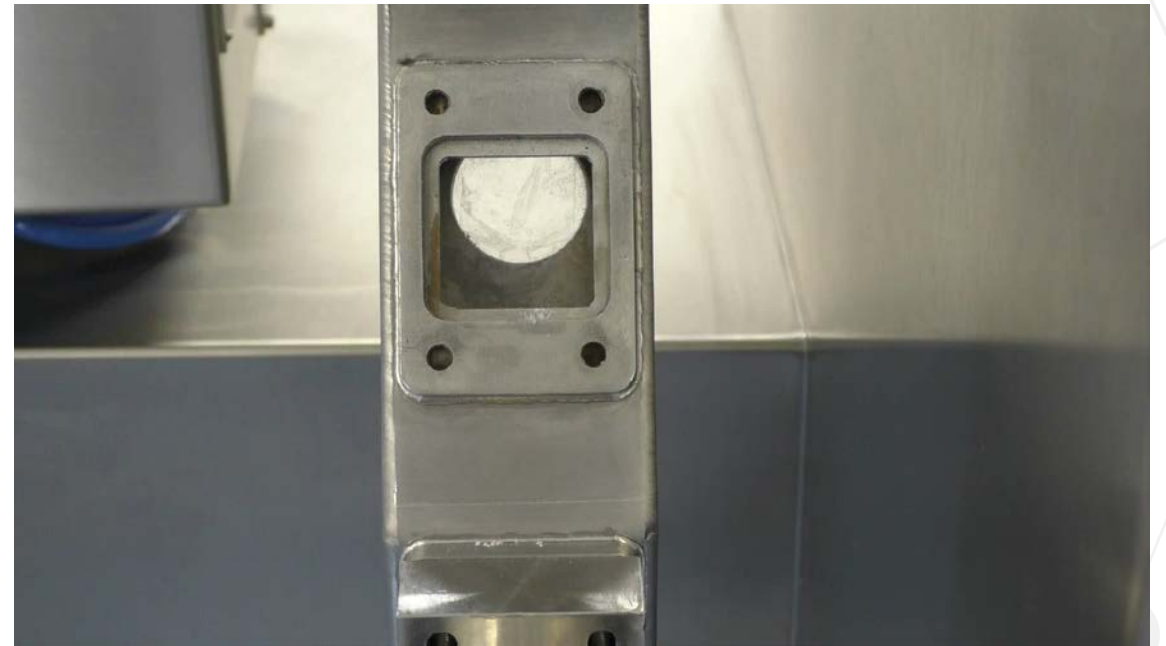


e.g. PAT interface

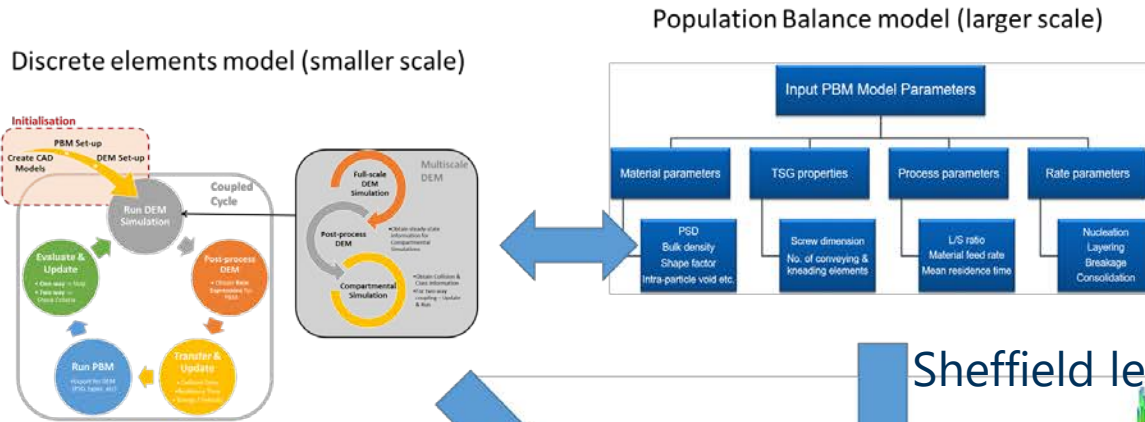


Particle size and shape window = right design

IR window = may be the right design



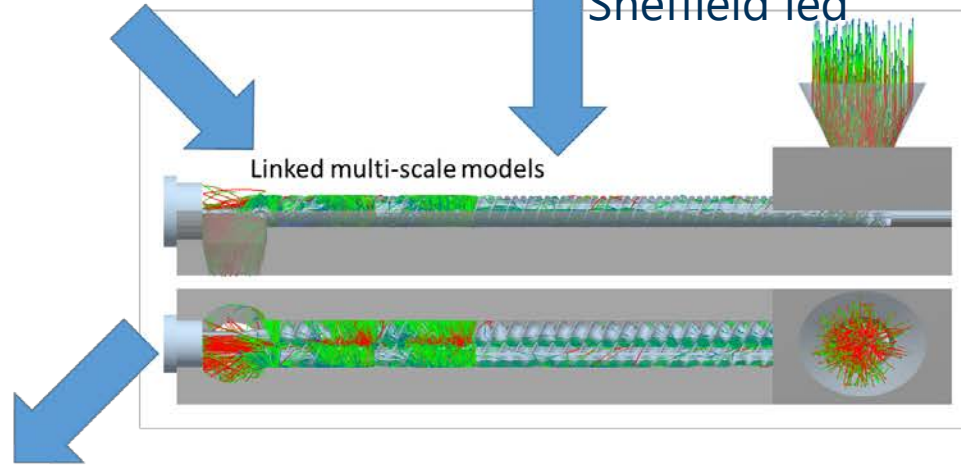
Digital Twin of Twin Screw Wet Granulation Process



Edinburgh led

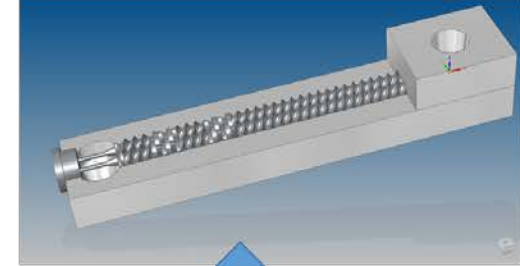
Sheffield led

Linked multi-scale models



Output= Prediction of product parameters and more agile determination of high quality products in the real world with less materials waste

CAD model of processing parts

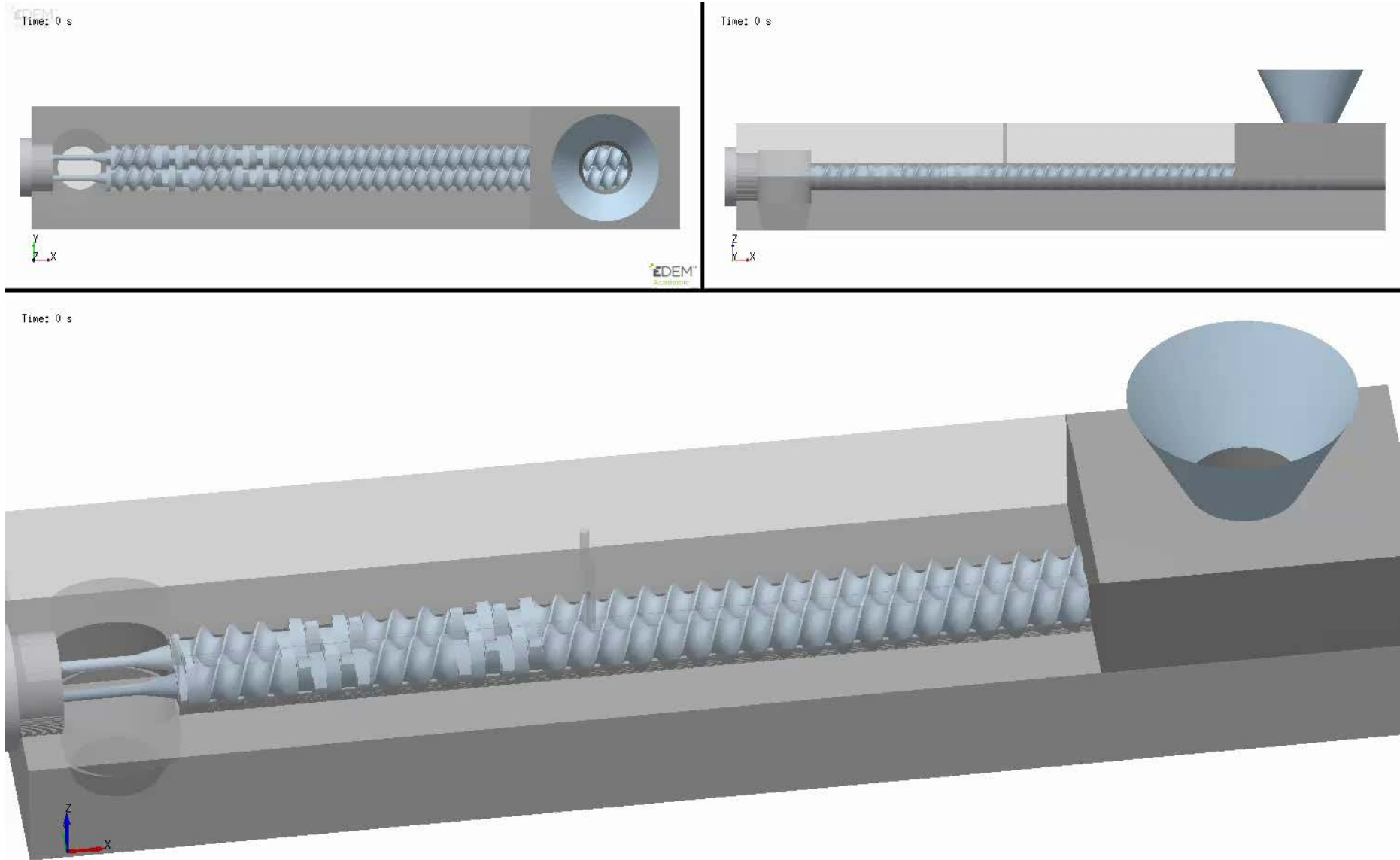


Equipment- GEA Consigma 1 Twin Screw Granulator

ConsiGma 1 model is a side effect of the broader project to utilise academic models in industry

Models for Particulate Processing (MPP)

DEM model from University of Edinburgh



Models for Particulate Processing project

Generated a framework for linking multi-scale models

This has already, and will, enable integration of multi-scale models

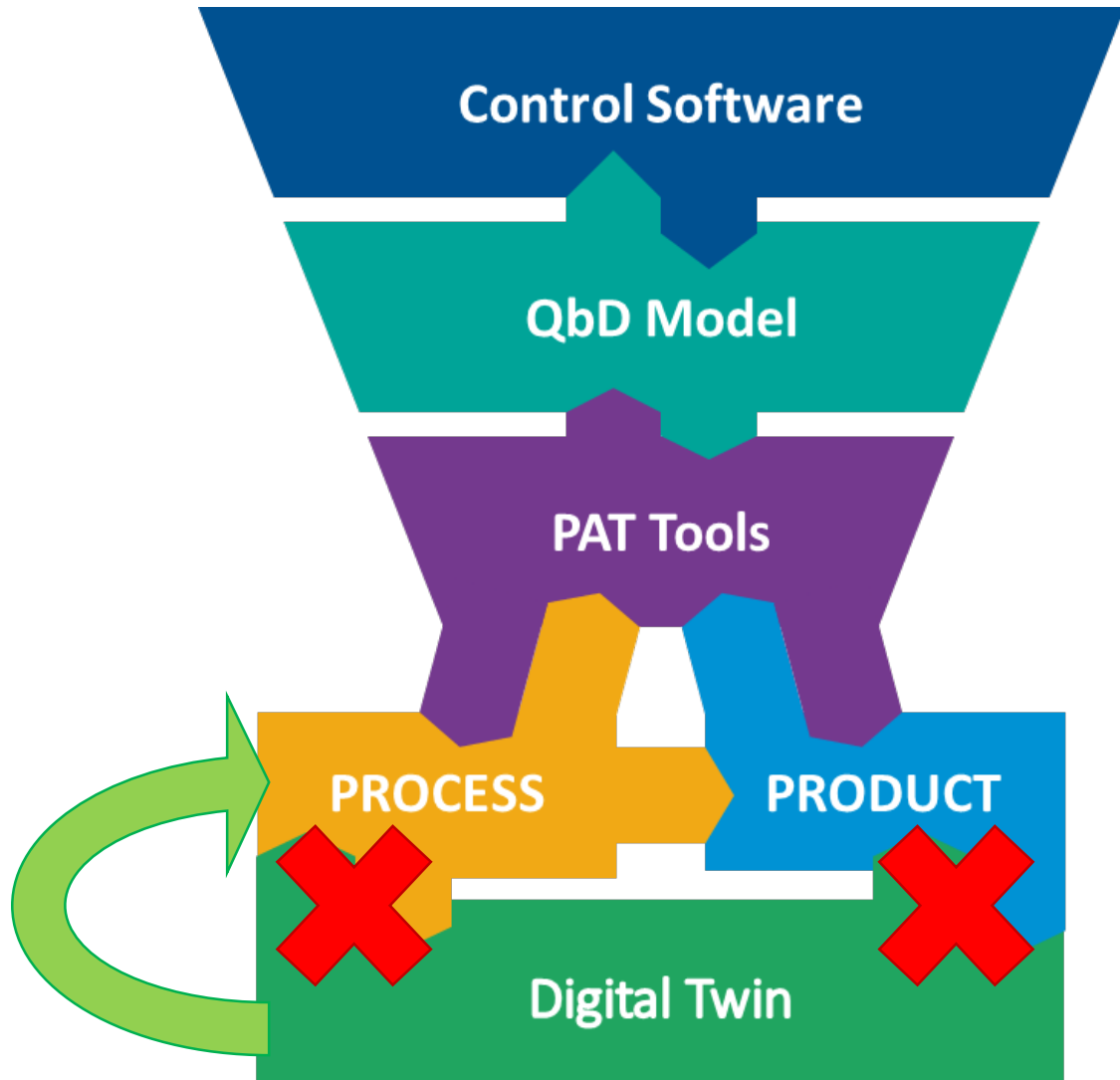
The information is not linked in real time to our process models



Made possible by our partners:



Building blocks - what we can't do (yet)



'The future is already here- it's just not very evenly distributed'
William Gibson (writer)

Our models aren't linked in real time

Model that helps you understand where to begin

Is still useful, even if it's not linked in real time

We have demonstrated other peoples models that are

What it doesn't enable us to do

We do not have control models for all of our powder capabilities

- Control of associated software can be hard and expensive to integrate
- Some of our processing assets don't have control software

We have not yet integrated cloud technology for knowledge sharing

Summary

Through a 'digital twin' and models predictive control project we have enabled predictive design of manufacturability within a powders laboratory

- Enables faster definition of manufacturing routes for novel formulations

You do not have to fully integrate every asset to improve product quality and the efficiency of a facility

- For those that you do the significant benefit is scalable agile processes with tight quality specifications

It is possible to create a flexible infrastructure, but it won't enable all assets to operate in the same way

- Do you need them to?

Thank you

For more information visit www.uk-cpi.com



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