FrieslandCampina

nourishing by nature


# Creating value in FrieslandCampina with Advanced Process Modelling

Marc Jacobs

APM Forum
25 April 2017

# Royal FrieslandCampina
# A Dutch dairy co-operative

# We have a long history…

**1871** — Nine farmers take over a cheese factory in the Dutch Wieringerwaard

**1879** — Founding of Arnhemse Melk-inrichting

**1880** — Founding of the first dairy co-operatives

**1913** — Founding of CCF in Leeuwarden

**1919** — Friesche Vlag, Dutch Baby and Bonnet Rouge are registered for international markets

**1926** — Founding of the De Meijerij Veghel / De Melkindustrie Veghel

**1947** — Campina brand introduced

**1965** — Founding of Coberco in Zutphen

**1989** — Founding of Campina Melkunie

**1993** — Merger of Coberco, Friesland Dairy Foods, De Zuid-Oost-Hoek and Twee Provinciën

**1997** — Acquisition of Südmilch (Heilbronn)

**2001** — Acquisition of Nutricia Dairy & Drinks Group

**2001** — International launch of formation of international Campina brand and co-operative

**2004** — Friesland Foods receives Royal designation on its 125th anniversary

**2008** — FrieslandCampina nourishing by nature

**2012** — Acquisition of Alaska Milk Corporation Philippines

**2013** — Acquisition of IDB Belgium

**2013** — Acquisition of Zijerveld and Veldhuyzen and G. den Hollander Holding

**2014** — Acquisition of Olam Ivory Coast and DEK in Italy

**2015** — Acquisition of mozzarella producer Fabrelac in Belgium

**2015** — Acquisition of the activities of Anika Group in Russia

**2015** — Founding of joint venture Friesland Huishan Dairy

**2016** — Acquisition of 51% of the shares in Engro Foods in Pakistan

**2020** — route2020

FrieslandCampina
nourishing by nature

# nourishing by nature

## Better nutrition…

- Provide food for the growing population to 9.7 billion people in 2050
- Optimise nutritional value of dairy products
- Provide affordable nutrition in selected markets

## …a good living for our farmers…

- Be an attractive cooperative for member dairy farmers
- Support dairy farmers in Asia, Africa and Eastern Europe to improve their farm management and milk quality
- Enhance attractiveness for young farmers

## …now and for generations to come

- Invest in sustainable long-term growth and the financial health of the Company and the Cooperative
- Grow in a climate neutral way
- Reduce the usage of scarce natural resources

# FrieslandCampina at a glance

**11.0 billion**
euros revenue

**22,000**
employees

Facilities in
**33** countries

Export to over
**100** countries


**19,000**
Member dairy farmers
own the Company

Every day
**millions**
of consumers

FrieslandCampina
nourishing by nature

# You may know us from

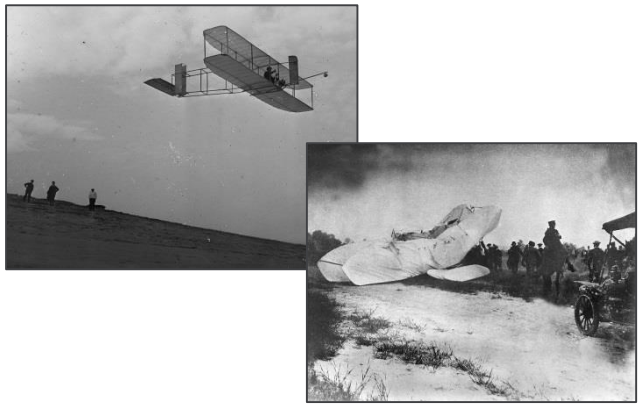

DOMO® DMV DFE pharma Nutrifeed kievit


# Process modelling in FrieslandCampina

# Why modelling?


- Modelling provides a solid quantitative basis for decisions through scenario analysis
- Reduced uncertainties, stronger decisions
- Single source of truth for our most important technologies → product-process interactions, carbon footprints etc.
- Building and securing scientific insights

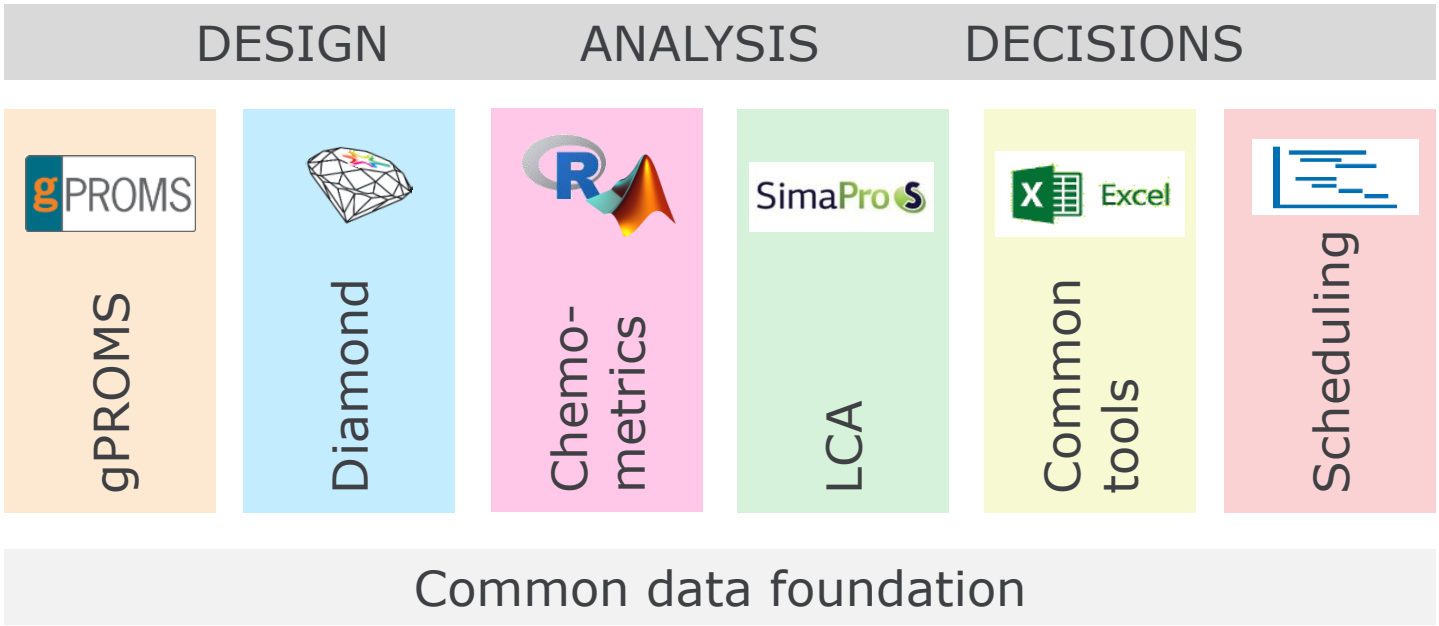
From brothers Wright…



to first time right!

©Boeing

# Modelling within RFC

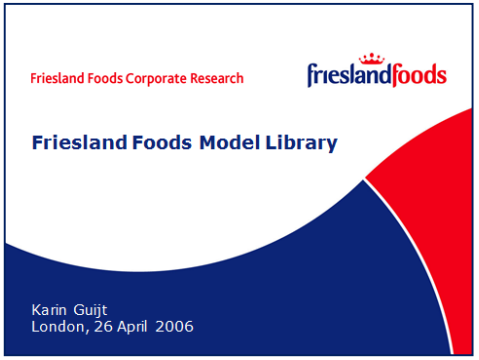


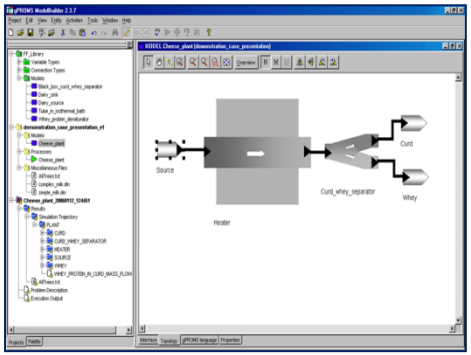

gPROMS: detailed flow sheeting incl. process-product interactions
Diamond: strategic modelling for milk valorisation
Chemometrics: statistical models of processes and products
LCA: carbon footprint calculations
Excel: many single use specialist calculation tools
Scheduling: (batch) process scheduling

# Start of the APM story at RFC

- Around 2003 gPROMS introduced at FrieslandFoods Research as an advanced calculation tool
  - Start model development in R&D projects

- 2006 start of library development
  - DairyFO for handling of dairy properties
    - component hierarchy & selection
    - physical properties
    - reactions kinetics
  - First flow sheet models based on libraries



- milk
  - water
  - fat
  - protein
    - casein
    - serum protein
  - lactose
  - salt

# Early APM in FrieslandCampina

## 2006-2012 start of valorising modelling

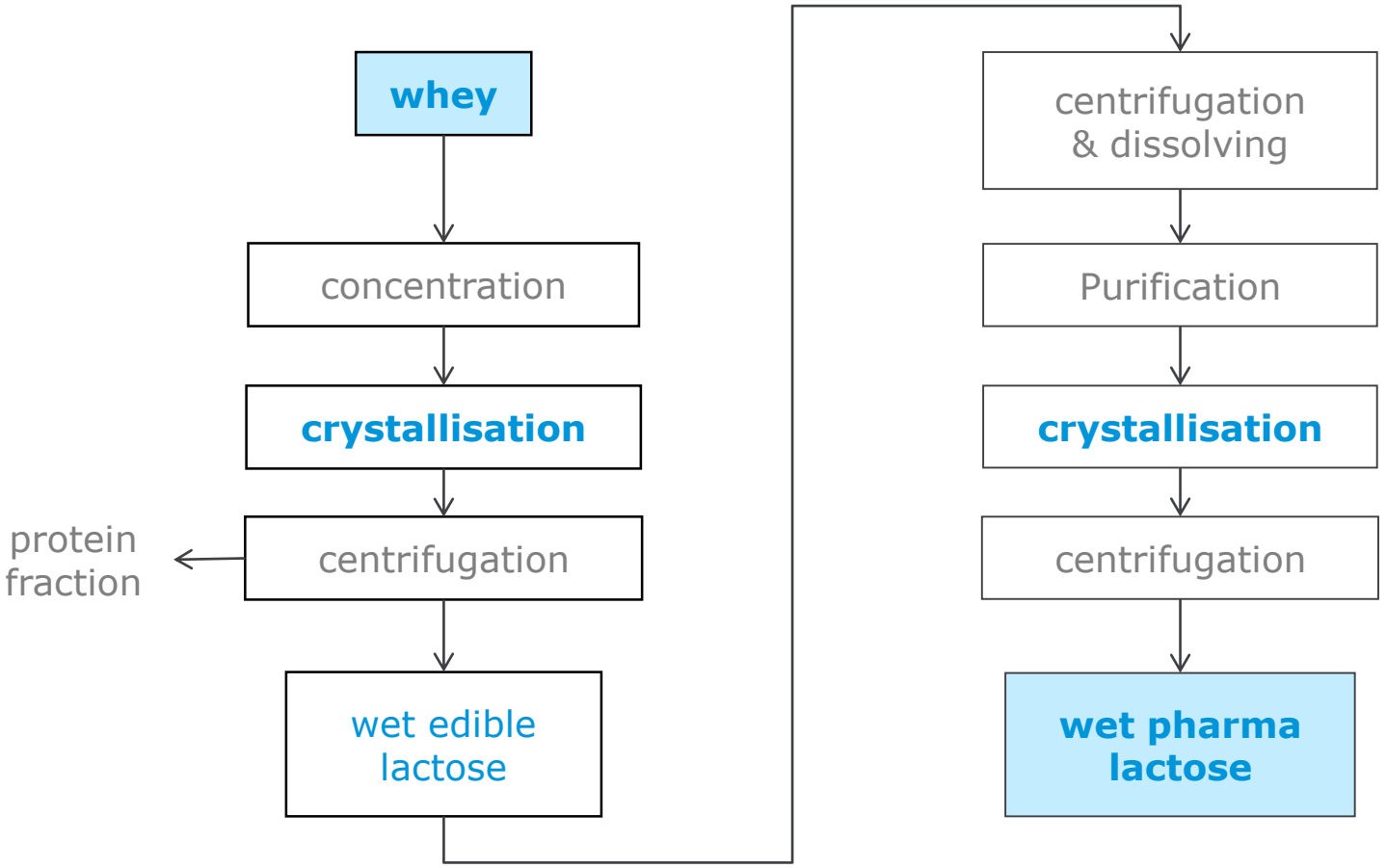
- Ad hoc project based development and use of models
  - heat exchange & preservation
  - membrane separation
  - chromatography
  - evaporation
  - lactose crystallisation

## Optimisation of Lactose crystallisation process in Domo Borculo with gPROMS model based on AML:SC

- process optimisation of batch cooling crystallisers
- control of particle size distribution

# Creating value with APM: Lactose

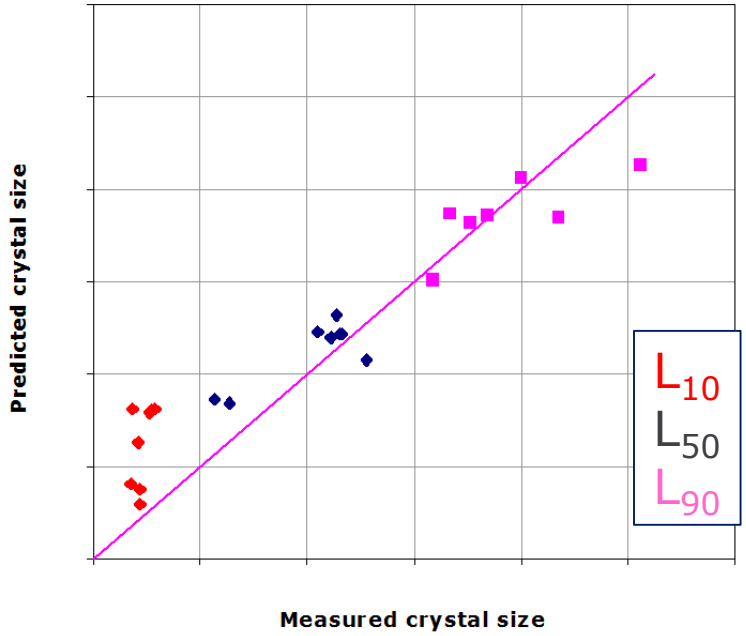
## DOMO Lactose production



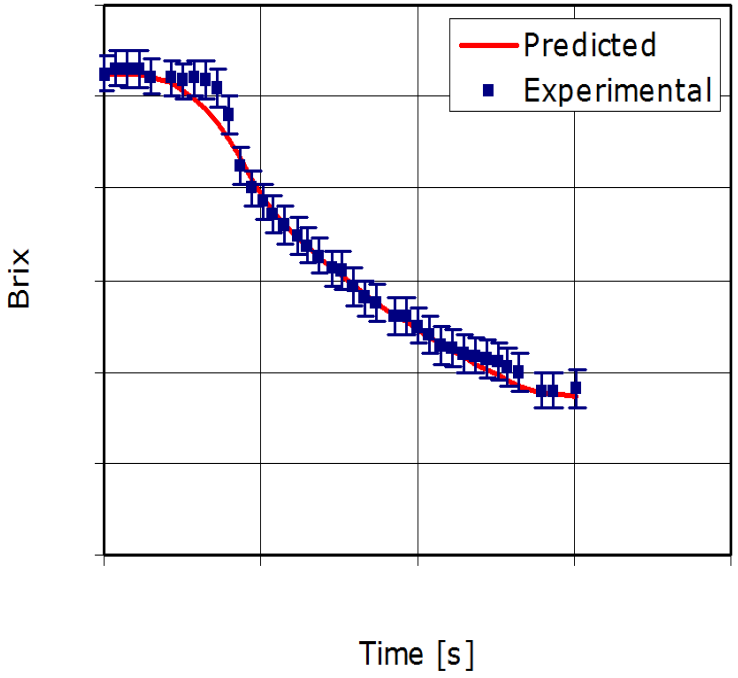
# Creating value with APM: Lactose

## Model predicts crystal size distribution and process dynamics

Simulated versus measured quantiles for plant product **crystal size distribution**

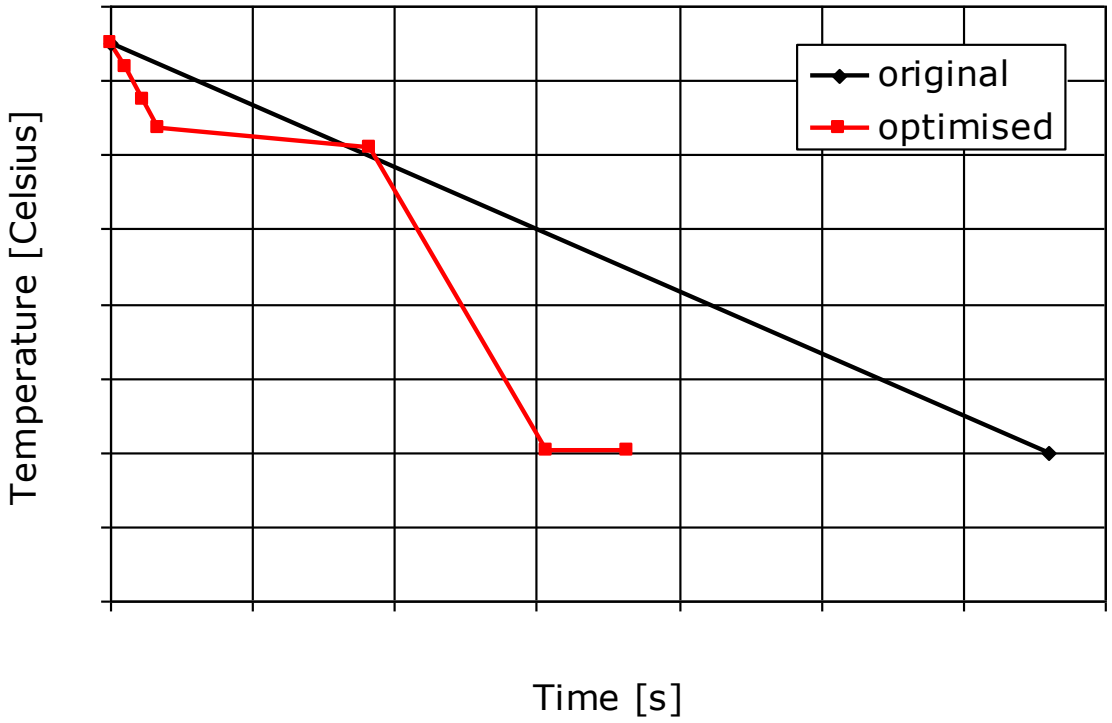



Simulated and measured **lactose concentration** in time



# Creating value with APM: Lactose

Objective: minimise batch time
Constraint: same median size




Reduction of batch time with 44% implemented

# Organising modelling

Successful use of models as personal tools by expert

However…

- Single user models
- Modelling knowledge only in R&D
- Knowledge not optimally (re)used in the company
- Lack of single source of truth
- Model maintenance not organised

2013-2014 Development of the FC model library (FCML)

- A *single* component tree and set of physical properties
- A basic set of compatible flowsheet models, centrally stored and controlled
- Technical model documentation

# Organising modelling

## 2015-2016 Organization

- Organisation of the technology chain
- Technology Expert Teams (TETs) setup: alignment of R&D and SC
- Steering group for modelling from R&D and SC
- Modelling part of most R&D PT projects

### development

- Speed up development with Open Innovation
- Library testing framework

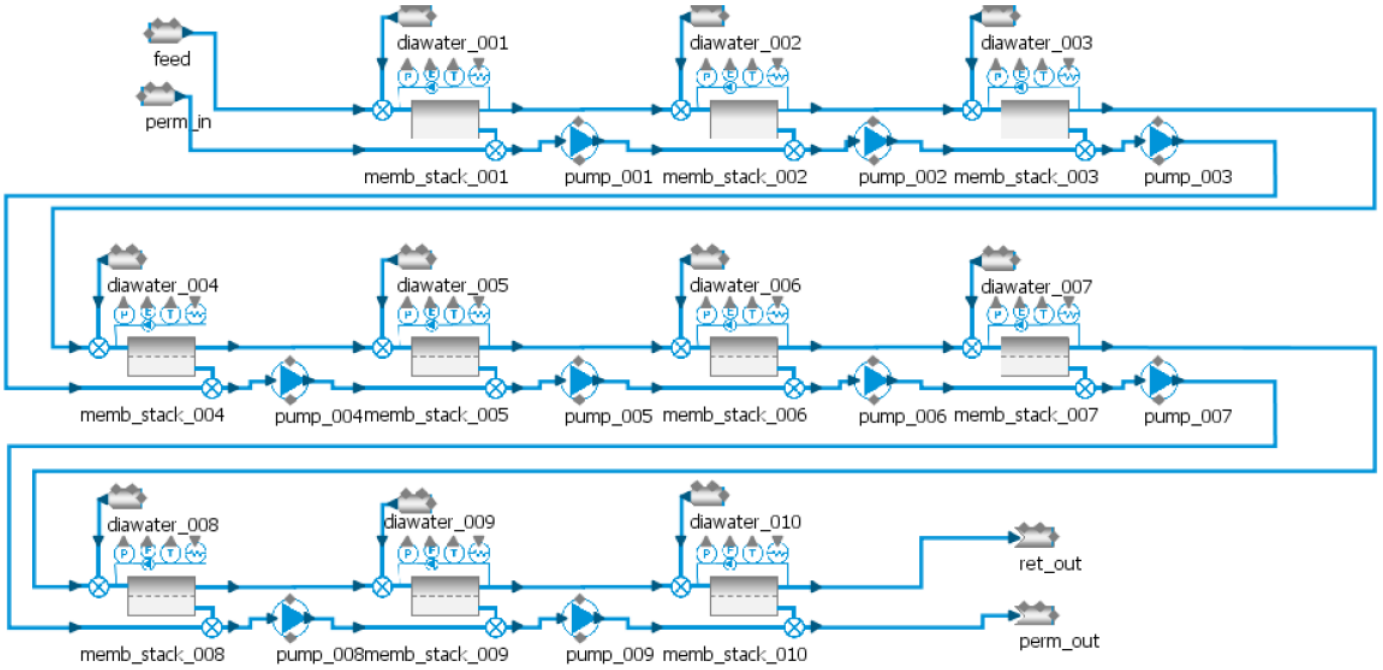
### deployment

- gPROMS training by PSE for R&D and SP
- Deployment with user interfaces

# Creating value with APM: WPC

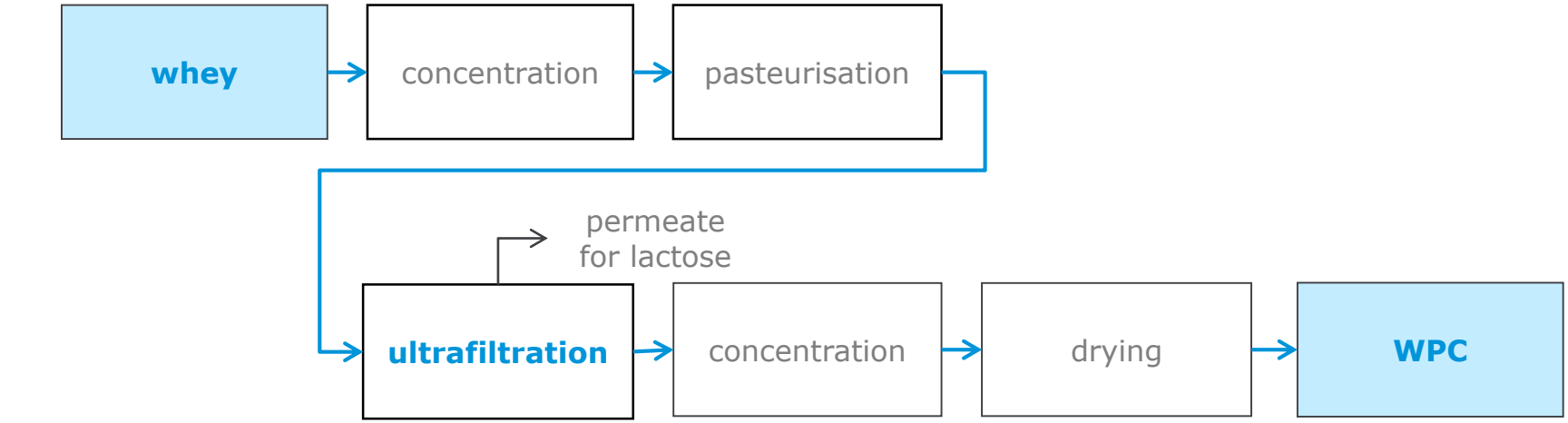
## Control optimisation of ultrafiltration in the whey protein concentrate process in Domo Workum with gPROMS

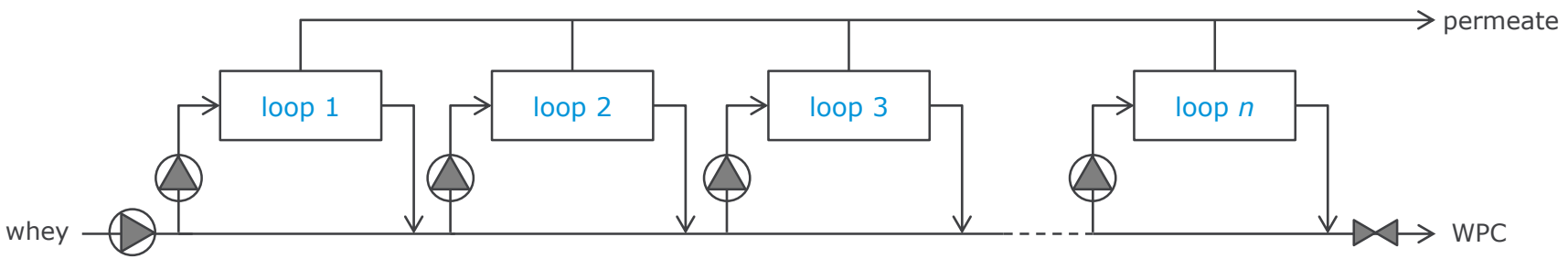
- process optimisation of ultrafiltration
  - fouling control & run time extension



# Creating value with APM: WPC

## Whey protein concentrate production

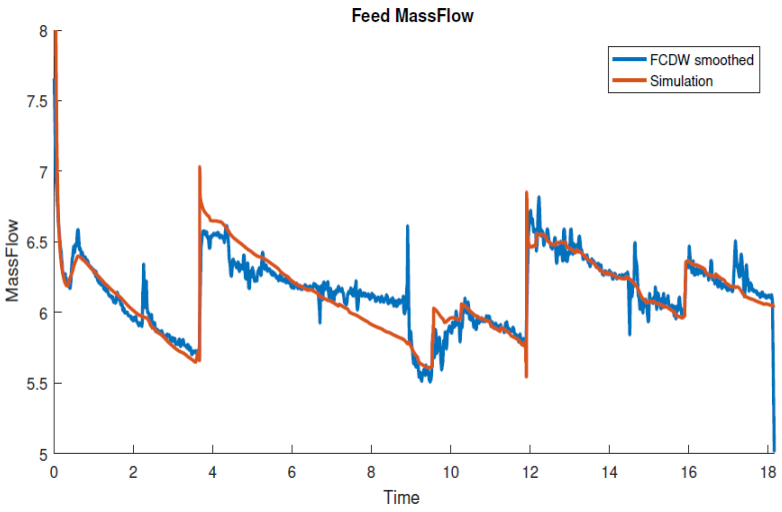


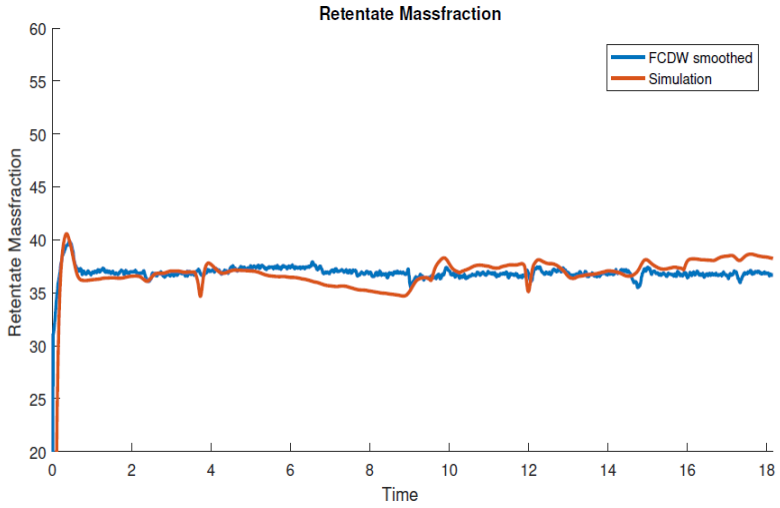
# Creating value with APM: WPC

## Model predicts process dynamics and membrane separation

Simulated and measured whey **feed flow** with controlled retentate flow

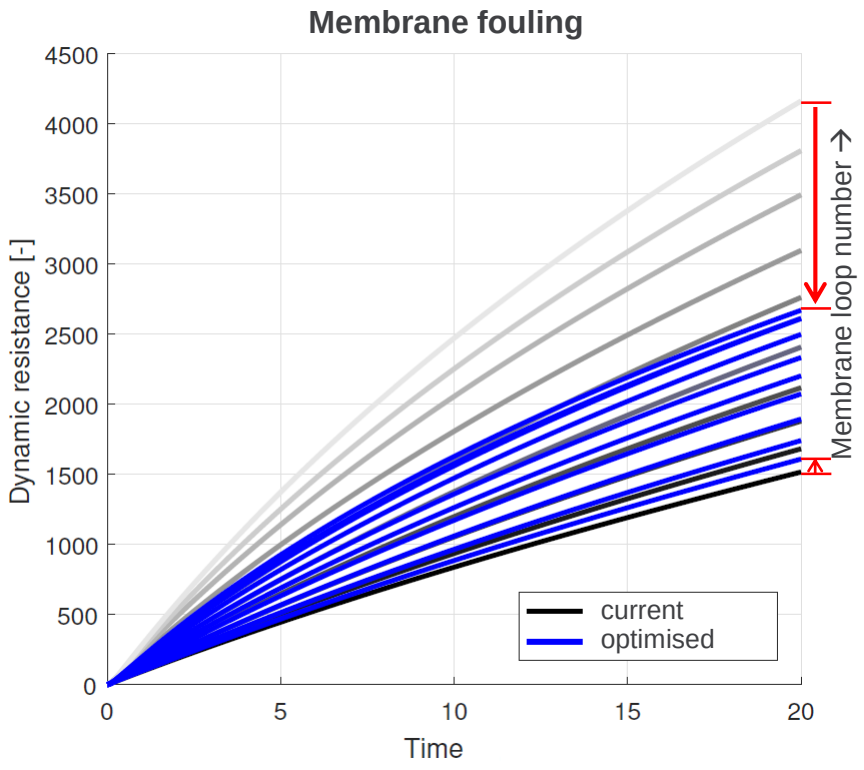



Simulated and measured **protein concentration** in time



# Creating value with APM: WPC

Objective: minimise fouling
Constraint: same capacity and product




System potential:
Increase runtime up to 10%

Knowledge transferred to
- Membrane expert team
- Process control expert team
- SC technologist
- Site technologists

→ Tests in current system
→ Included in new design

# Unlocking the APM potential

## Organization

- Organisation of the technology chain
- Managed team based development program
- Alignment to supply chain: timely demand driven development of models and libraries (KISS)
- Internal PR to/through senior management

## People

- Multi-tier modelling knowledge in the chain through training program → PSE can help here

## Tooling

- User friendly, complete, stable and documented modelling tools. Multi-tier user interfaces.

# APM in food processing brings value.

However, at a cost…

- In house library development is expensive and slow
  - Due to the complex products, the food industry cannot easily use many process modelling libraries
  - Accelerate by collaboration with initiatives like gFOOD

- Having APM used and embedded outside R&D is a challenge
  - Organisation – people – tooling
  - Accelerate by sharing approaches and experiences