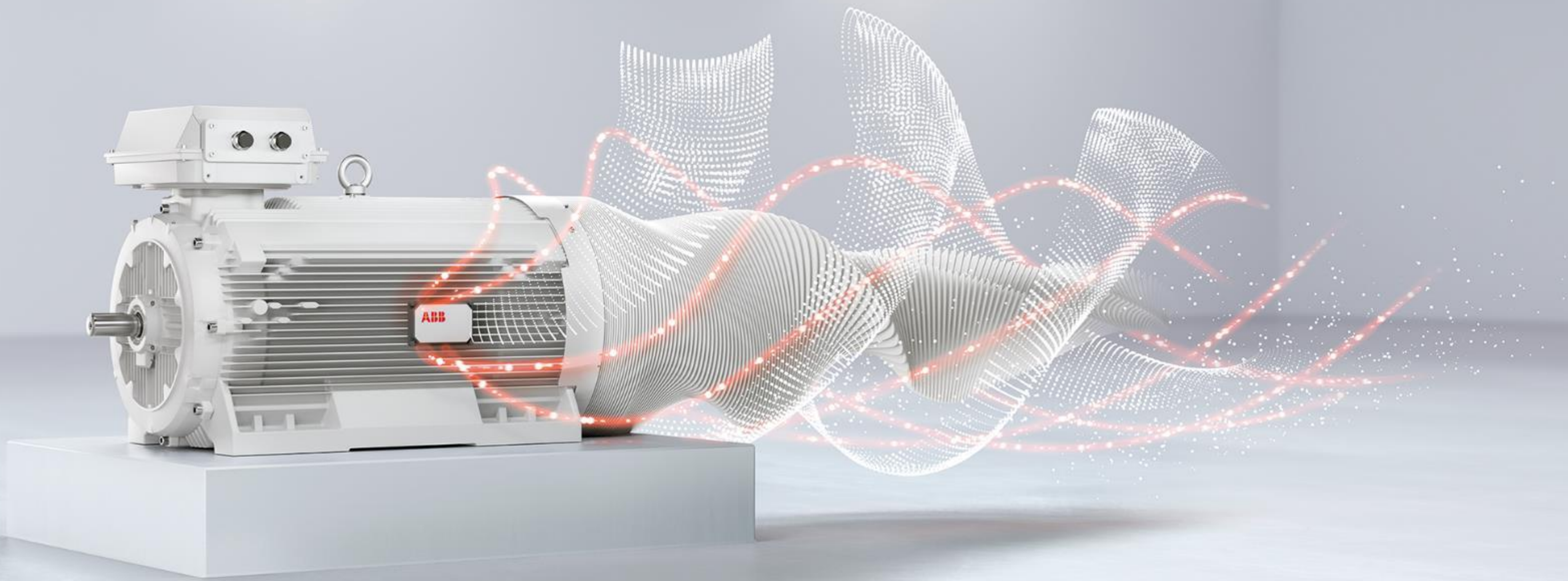


MAY 2021

Technical Information Exchange needs in simulation aided equipment dimensioning and energy efficient selection

Jouni Savolainen/Semantum and Antti Lukkari/ABB

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

Digital

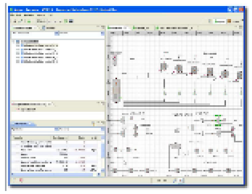
EIT Digital is supported by the EIT, a body of the European Union.

Why traditional way of working is not good enough?

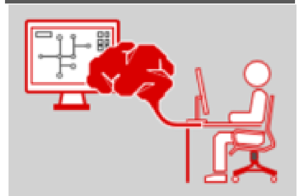
Total system design rigid and inefficient due to system silos and stacking of the risk margins

Process design / System design

Process



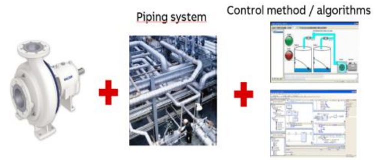
Engineering



System design:
Selection of main concepts, process equipment , overall control principles etc.

Sub system design / component selection / dimensioning

Sub system 1



Component selection

Supplier a | Supplier b | Supplier c

Sub system 2

Sub system n#

Detailed design
Design of subsystems
Selection of components

Manufacturing components / Building the system

Running the systems

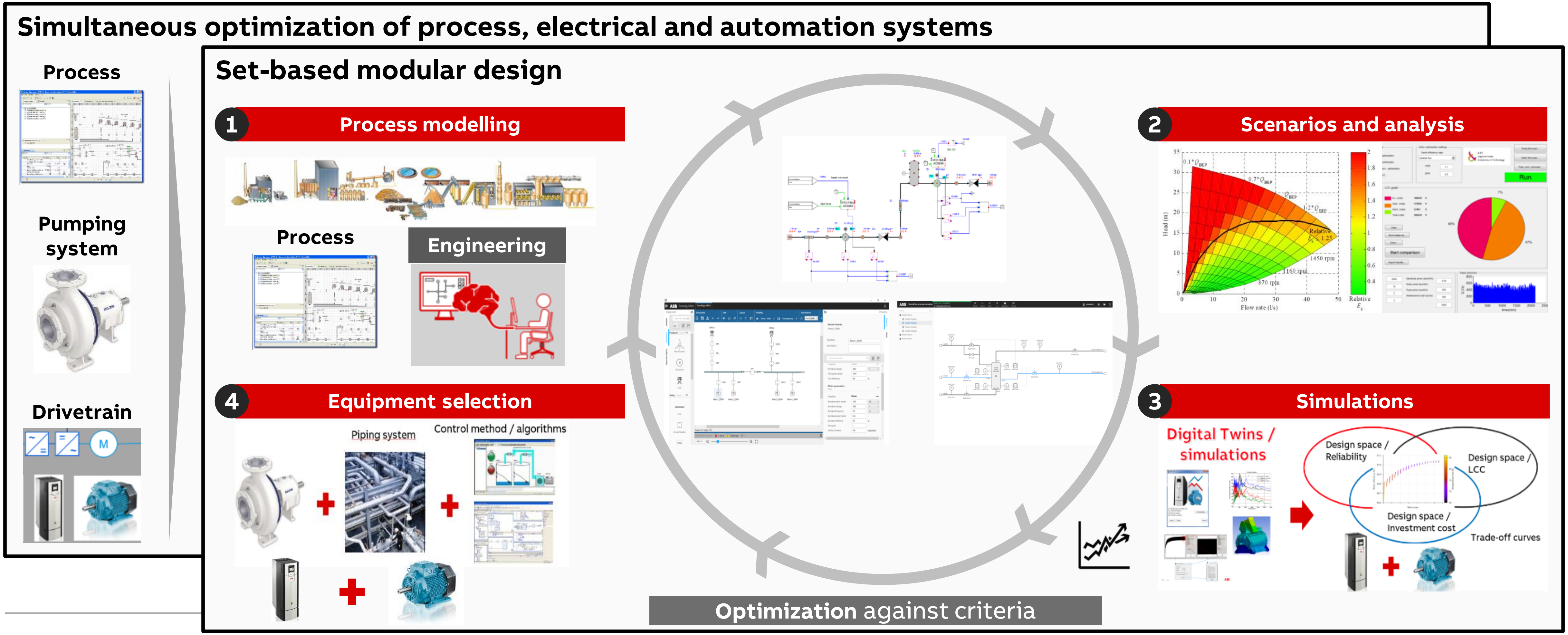
Poor efficiency

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.

New way of working: Collaborative Digital Twin (CDT)

Digital Twins enable simulation for optimal system and component design



This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.

eit Digital

Semantum

ABB

Benefits for the end customers

Why collaborate in system design and dimensioning?

Overdimensioning and too high risk margins can be easily avoided with collaborative dynamic simulation and system-level optimization.

→ **Improved energy efficiency and lower operating costs of the system**

Actual measurement data from the process is used to confirm the equipment performance and compatibility in the real operating environment and not just in a single operating point. This reduces the risk of unforeseen process runnability problems.

Simulation-proven and highly optimized processes and identification of new ways of running the process.

Fully digital, easy and effortless collaborative model for designing and dimensioning systems.

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.

Example: CDT–based pump and drivetrain selection

Overview

- Goal: find a pump and drivetrain combination that
  - satisfies customer requirements
  - is the most energy efficient over various typical operating points of the process

- How to do it?
  - Simulate multiple pump + motor + drive combinations
  - Calculate meaningful metrics
    - Specific energy consumption, kWh/ton
    - OPEX

- From CDT point-of-view this requires co-simulation of the process and the drivetrain
  - Process model   Apros®
  - Drivetrain model   Virtual Drive
- Co-simulation using Functional Mockup Interface (FMI)

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.

Example: CDT–based pump and drivetrain selection

Technical Information Exchange needs

- System-level simulation requires technical data from several sources
  - Pump manufacturer:
    - pump datasheet, containing pump curves and dimensions
  - Motor and drive manufacturer:
    - a simulation model with several parameters
  - Process owner/operator:
    - P&I Diagrams
    - Pipeline lengths, diameters, bends, elevations
    - Screenshots from control system (DCS)
    - Historical measurement data
    - Equipment data sheets and dimensions: towers, tanks, valves
    - Mass and energy balances
    - Functional descriptions of stabilizing level control loops
    - Control application logic diagrams
    - Relevant operational guidelines
    - 3D model
  - We know that getting all this is time consuming, even impossible. That is why the list is prioritized.

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.

Example: CDT–based pump and drivetrain selection

Technical Information Exchange needs

- Based on the above information
  - the models are parametrized
  - a simulation sequence is determined

- Next, simulations are run

- Currently, the information comes in various formats and channels
  - PDFs, Excel files, vendor-specific 3D-files, jpeg/png-screenshots, Word documents, etc.
  - E-mails, file sharing systems (e.g. Teams, OneDrive,…), telcos
  - Going through all these and extracting the useful pieces of information is laborous

- Thus, to make the collaboration easy and effortless,
  - all this information must be exchanged in pre-defined formats preferable via different interfaces and APIs (this ties CDT to TIE-project)
  - simulation models must use ready-made templates to minimize manual model configuration

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.

Example: CDT–based pump and drivetrain selection

Example case

- Process model
  - Between two constant pressure tanks
  - Piping and valves
  - The pump itself with details from manufacturer

- Drivetrain model
  - Electrical parameters from motor and drive
    - Supply voltage, power, current, efficiency, etc.
  - Virtual Drive uses the same software than the real drives

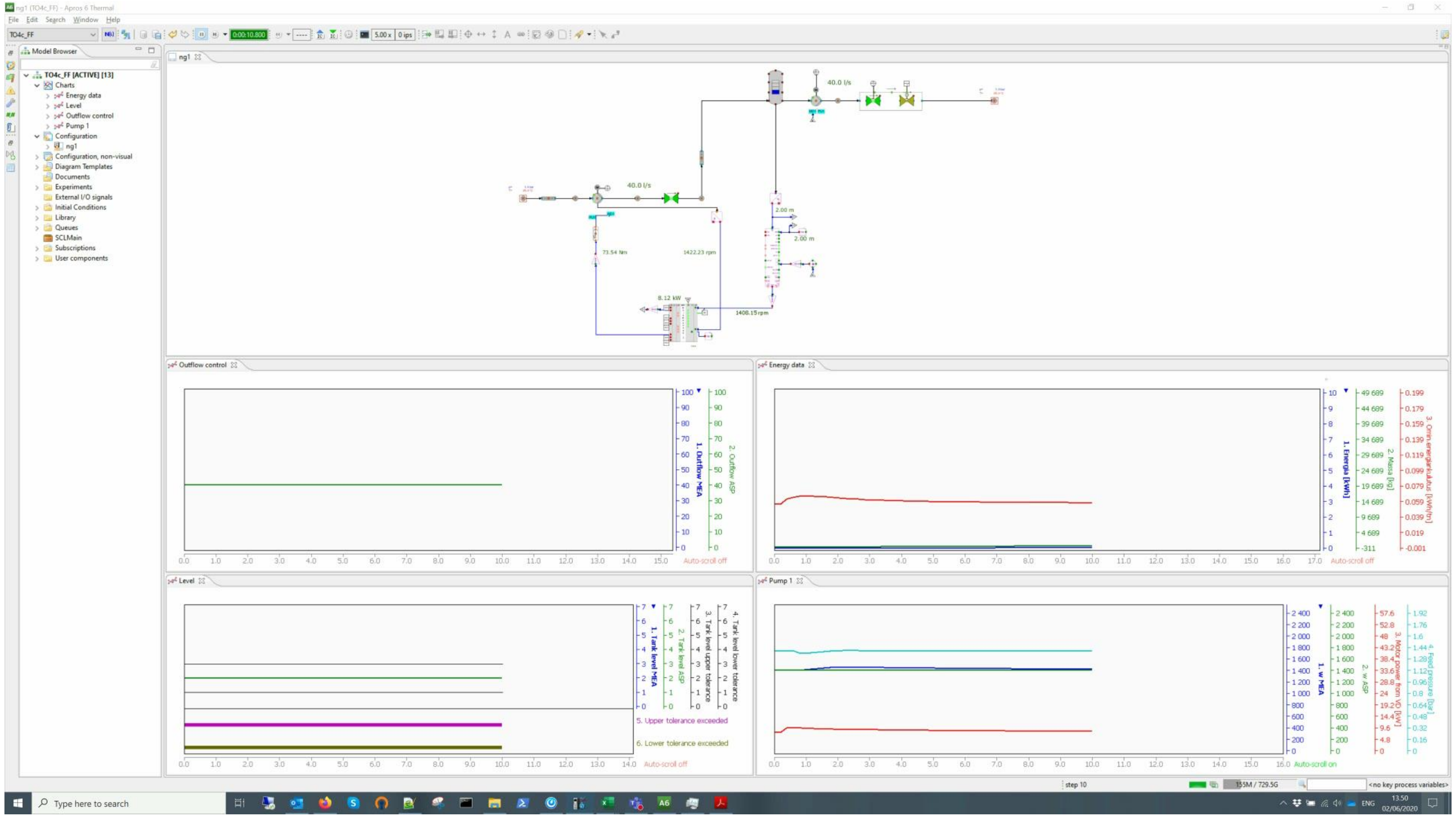
- Simulation sequence
  - A sequence of desired flow rates to receiving tank
  - Based on real measurement data from case process
    - Flow duration curve

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.

Example: CDT–based pump and drivetrain selection

Apros® dynamic process simulator and ABB Virtual Drive powertrain simulator



This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

eit Digital

EIT Digital is supported by the EIT, a body of the European Union.

Semantum

Example: CDT–based pump and drivetrain selection

Example results

Specific energy consumption[1]

OPEX[2]:	204 180 EUR/year	127 590 EUR/year	127 430 EUR/year	151 140 EUR/year

[1] Corresponds to the whole year real operating environment.
[2] Calculation based on the actual annual amount of water pumped and constant energy price estimation of 40 EUR/MWh.

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.

Any questions?

This activity has received funding from the European Institute of Innovation and Technology (EIT). This body of the European Union receives support from the European Union's Horizon 2020 research and innovation programme.

EIT Digital is supported by the EIT, a body of the European Union.