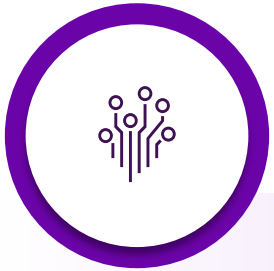
OCTOBER, 26 2023

Maximize your operational excellence with AVEVA™ Process Simulation & Scripting Automation

A digital twin story by ThyssenKrupp and AVEVA

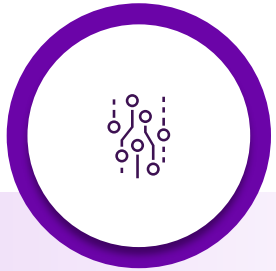
Stefan Millhoff, Ryan Muir

The challenge



Goals

- Development of a digital twin for the customer, to obtain better operational excellence, without having the expertise in simulation
- Cloud solution (on premise possible)
- Provide stable and fast user experience
- Unlock increased efficiency and sustainable operations



Challenges / Obstacles

- Interfaces for automation and scheduling of simulations difficult to use
- Slow interfaces for data processing (upload - KPI calculation - download)
- Slow and non-robust simulations
- Difficult setup of different cases, parametrizations & optimizations

thyssenkrupp

Scripting Automation to Guide Process Operations with AVEVA™ Process Simulation

AVEVA

What does thyssenkrupp do?

Our businesses in figures | Fiscal year 2021/22

Materials Services	Industrial Components	Automotive Technology	Steel Europe	Marine Systems	Multi Tracks*
€16.4 billion	€2.8 billion	€4.8 billion	€13.2 billion	€1.8 billion	€4.1 billion
Sales					
15,914	12,019	20,266	26,304	6,943	12,892
Employees					

thyssenkrupp Uhde

* Since beginning of October 2023 thyssenkrupp Uhde belongs to Decarbonization Technologies

Digital Products as part of thyssenkrupp Uhde

Data Analytics & Consulting

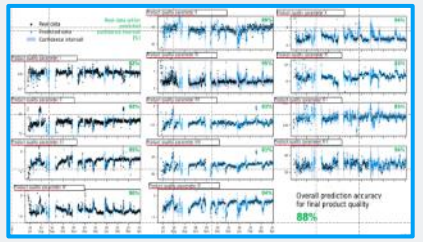
- Remote expert support
- Periodic/on demand reporting & consulting
- Online dashboards

Predictive Maintenance

- (Thermal) Drone inspections
- Plant Scan 3D
- Professional Spare Part Navigator (PSPN)
- Remaining lifetime prediction
- Digital service sticker
- Remote inspection
- Mobile device app
- Automated machine monitoring (turbomachinery and piston machines)

Predictive Operation

- Monitoring & control systems
  - Uhde Evaluator / Administrator
  - Coke O&M Optimizer
- Advanced process control
- Operator training simulator
- Plant rate control

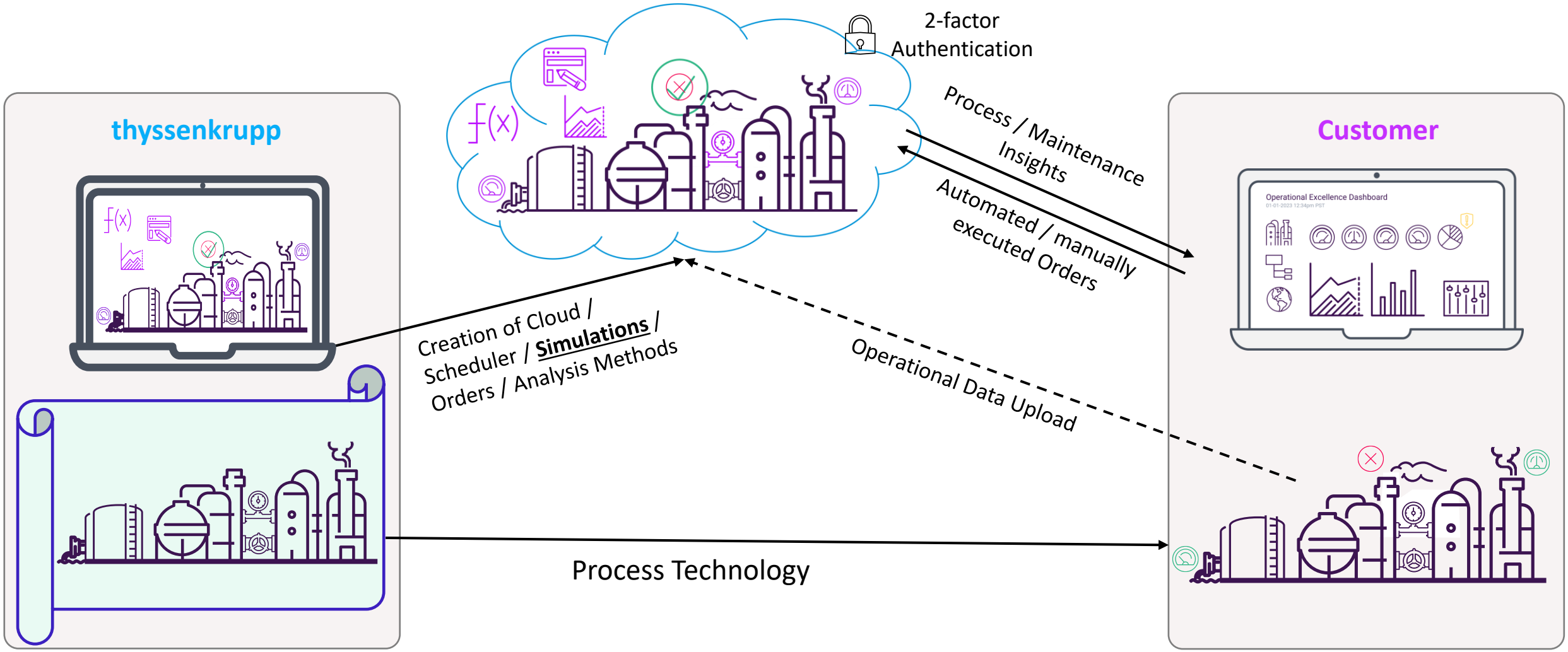


Performance Optimization

- Performance contracts
  - Energy consumption optimization
  - Raw materials reduction
  - Product quality enhancement
  - Emission reduction

DIGITAL TWIN

Concept of the thyssenkrupp Digital Twin



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AVEVA™ Process Simulation

AVEVA Process Simulation brings a platform approach to process simulation

Key Capability	Key Market	Key Goal
FLEXIBILITY	CHEMICAL INDUSTRY	SUSTAINABILITY

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AVEVA™ Process Simulation (APS)

Designed from the ground up, delivering the process digital twin, to the next generation of process engineers

SimSci Thermodynamics

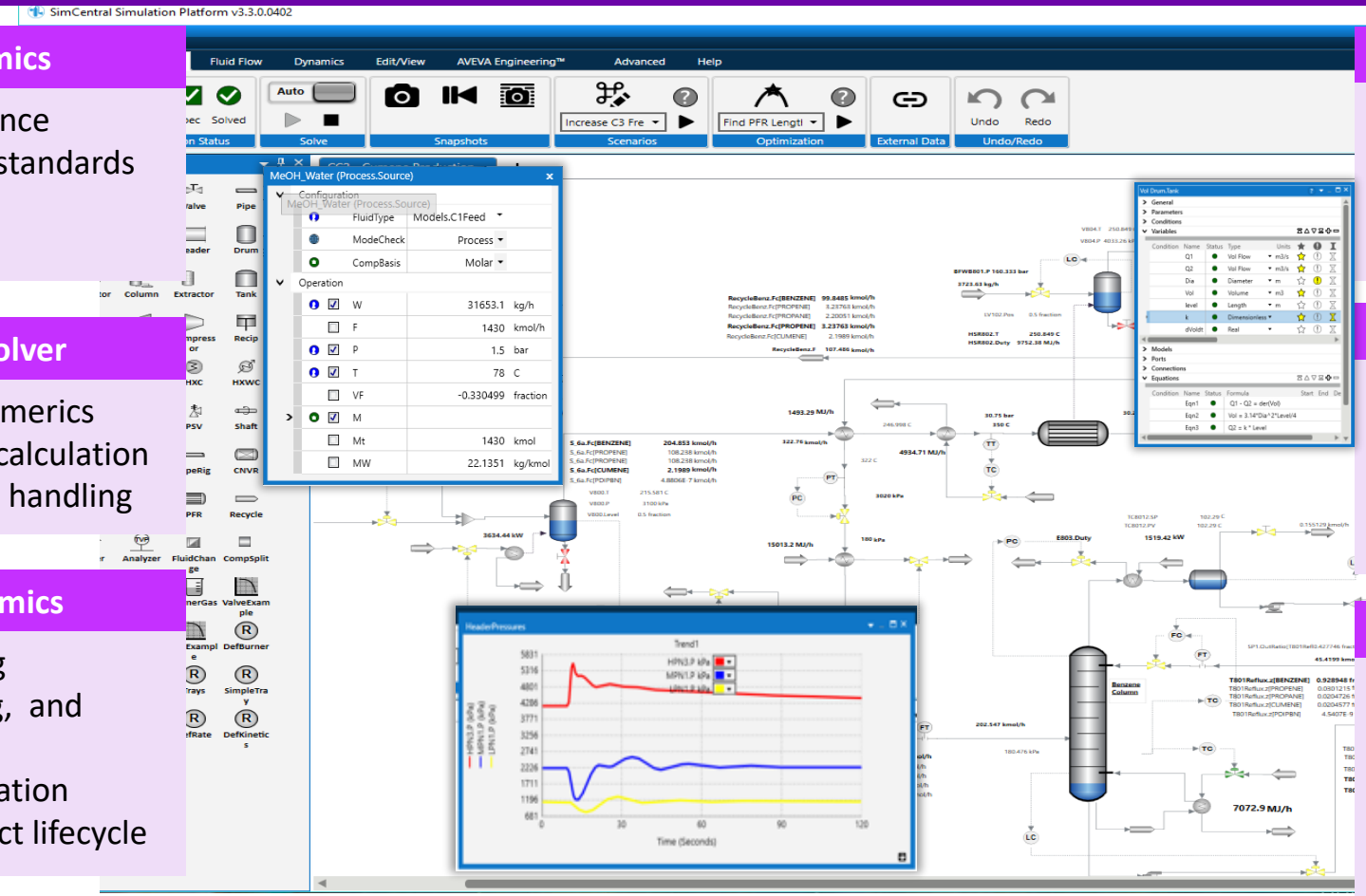
- Over 50 yr. experience
- based on industry standards
- high-speed
- accurate solutions

Equation-Oriented Solver

- State-of-the-art numerics
- Robust & Efficient calculation
- Enhanced Recycles handling

Steady-State & Dynamics

- Seamless switching
- steady state, rating, and dynamics
- Enhanced collaboration
- Reuse across project lifecycle



Ease of Use

- Continuously-solved
- Highly-interactive
- Focus on engineering task
- Fast adoption

Open Modeling

- Access to the math equations
- customize and add new equipment models without programming

New Applications

- open & extendable platform
- Python & C# Scripting
- AI Models
- Expansion into other industries (e.g., Power, Batch)

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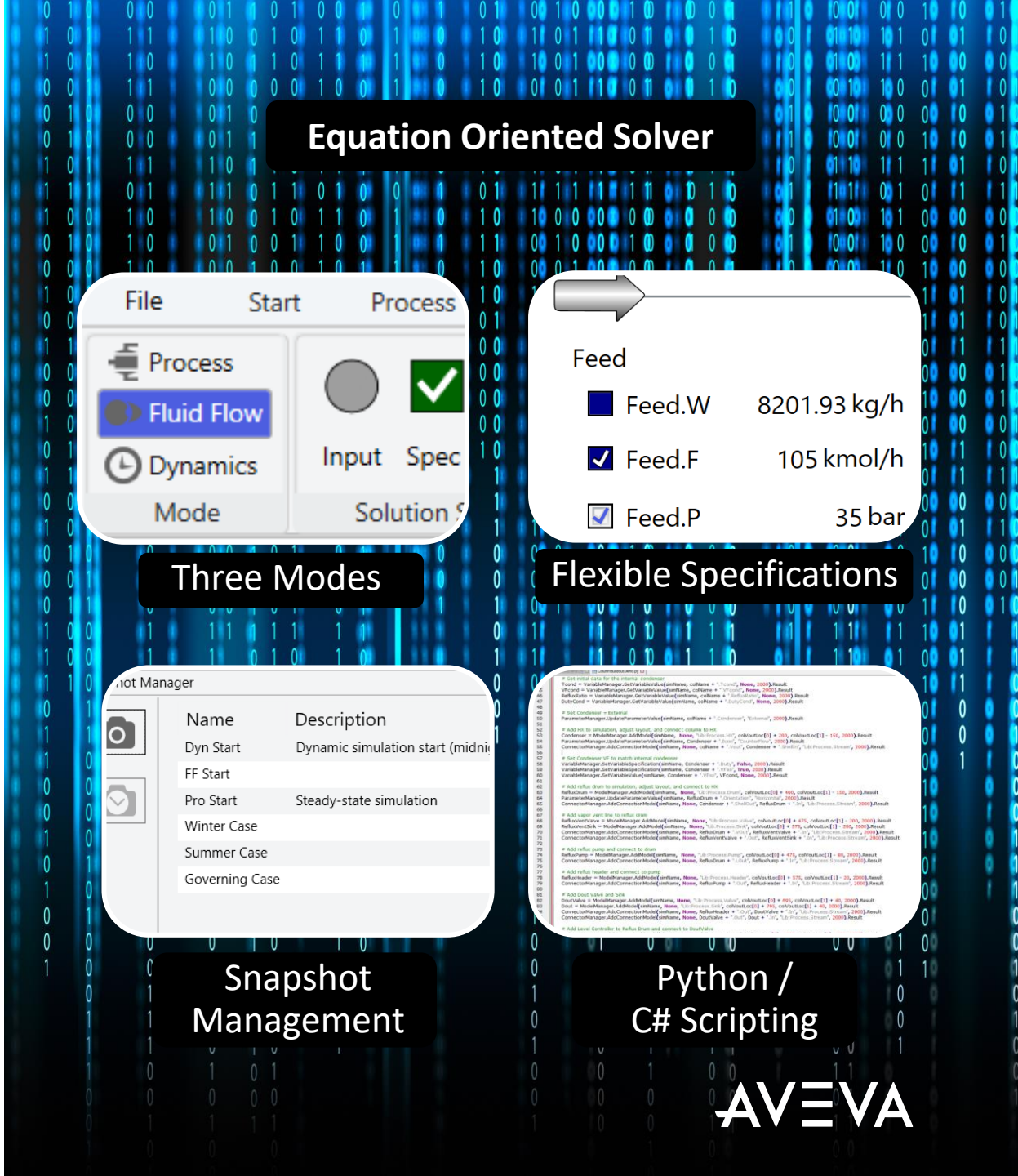
Key features of APS

…that make this Digital Twin possible

- EO – basis for powerful calculation
- Three modes – H&M-Balance, Design Optimization, Hydraulic Rating and Dynamic Studies
- Scripting interface – automated and full control of APS without opening the GUI
- Snapshot Management – calling different cases and saving of different calculation results
- Flexible Specification – fast and easy problem definition, data reconciliation and optimization

Unique feature set for digital twin development



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Principle of automated digital twins

Simulation Queue Features

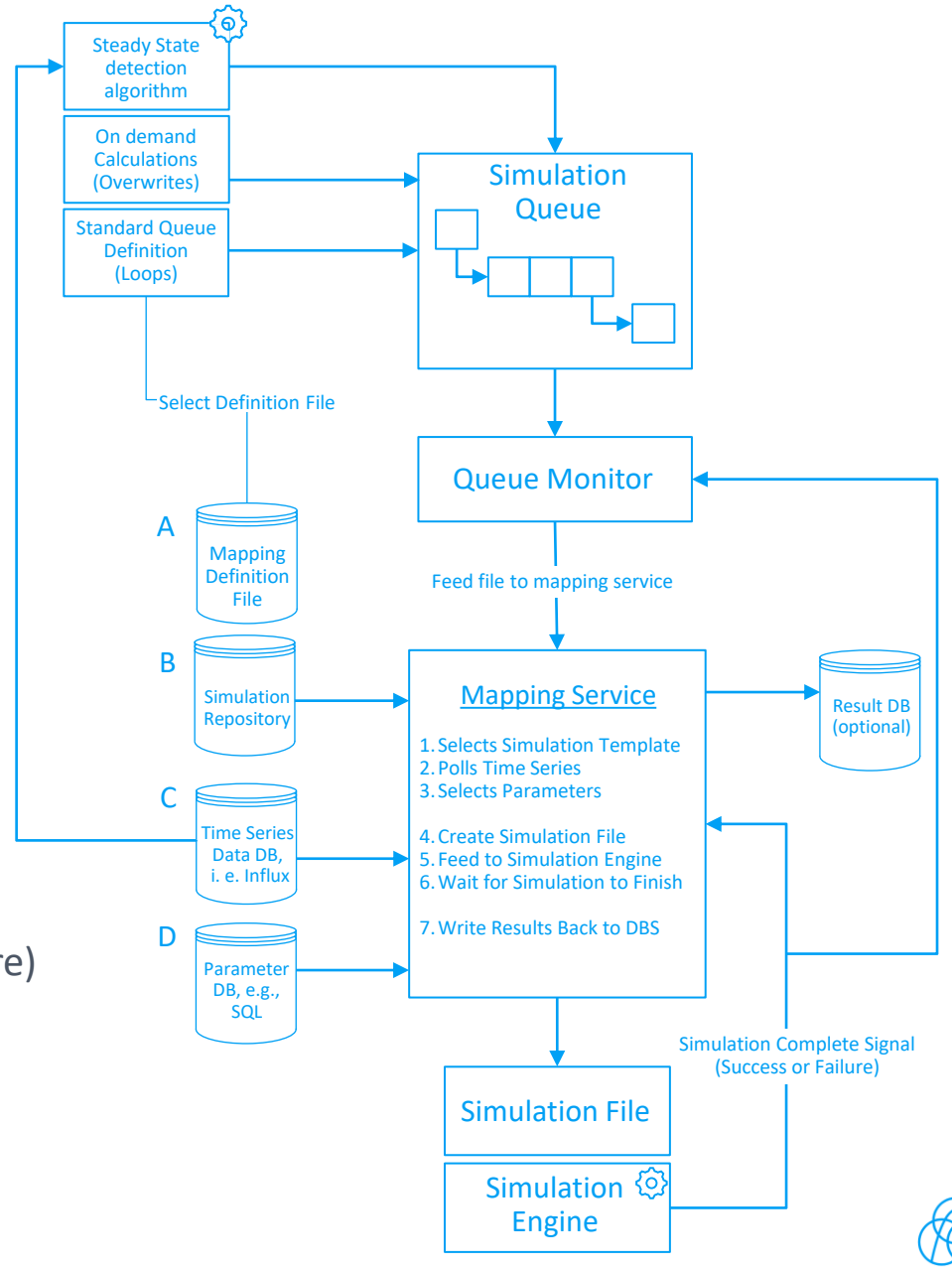
- Plant data processing to detect abnormal operation or steady state
- Standard simulations run continuously in a predefined sequence
- On demand or conditional interception of standard loop

Mapping Service Features

- Define & receive plant specific simulation from repository
- Connect plant measurements with variables in simulation
- Run simulation & transfer variables to result database
- Error handling, if data retrieval or calculations fail

Queue Operations

- Get order from simulation queue (standard, cron or priority job)
- Retrieve & check plant measurements, error handling (e.g. skip, replace, ignore)
- Configure & run simulation, error handling (log event & reset simulation)
- Store simulation results in database



Update on using automation to guide process operations with APS

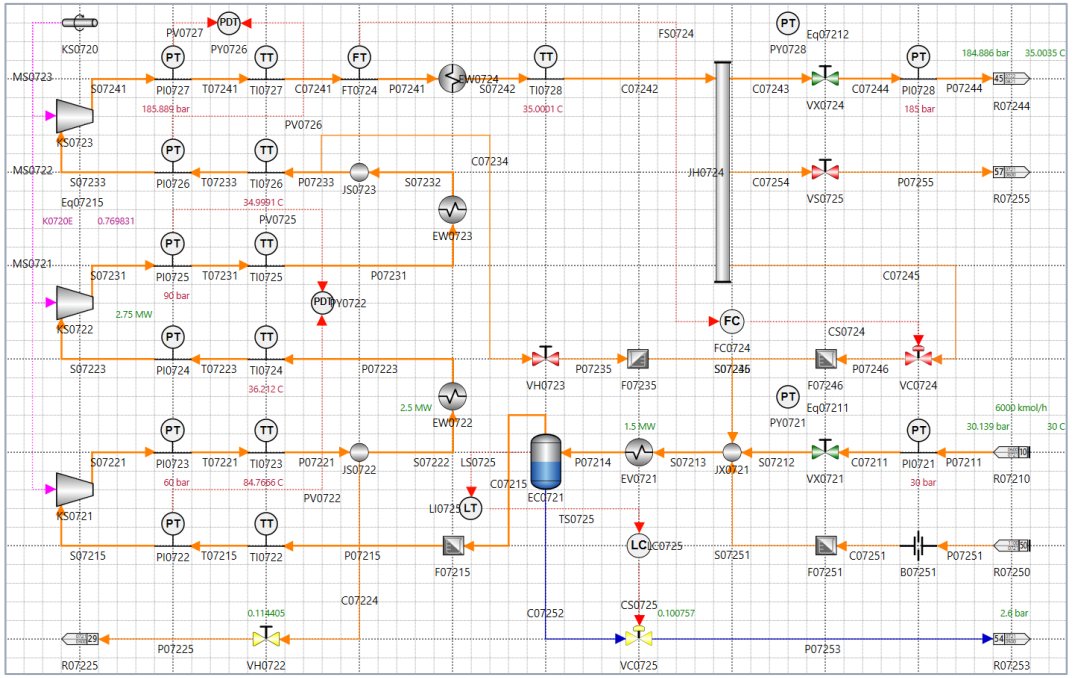
Simulation setup for automated digital twins

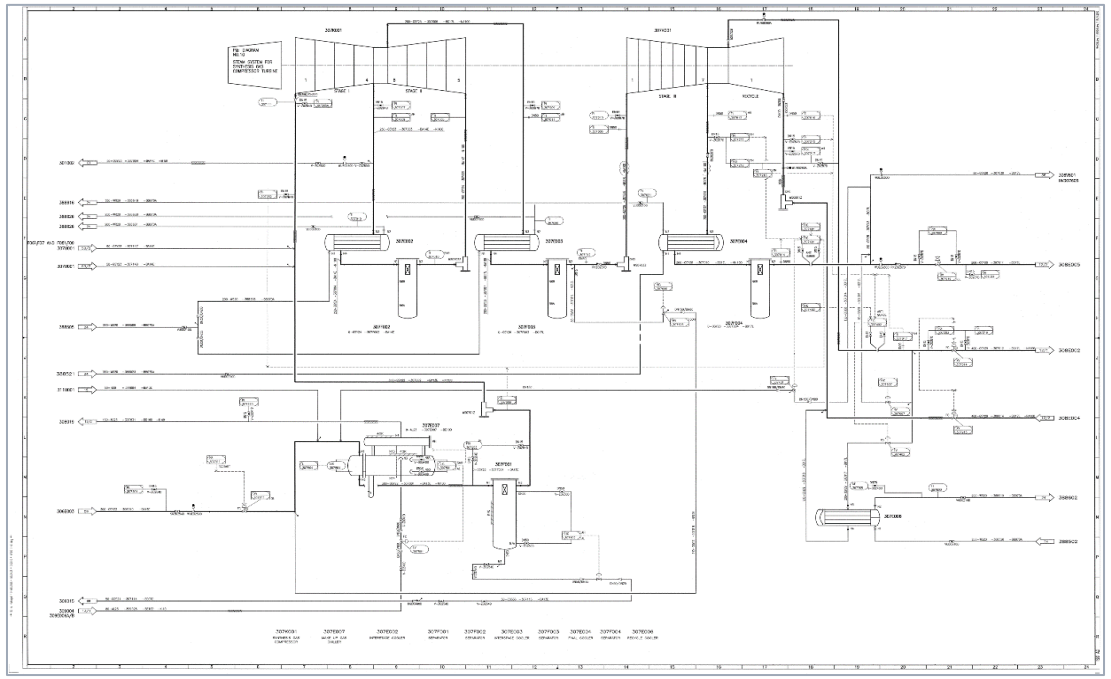
Configuration based on PID & 3D model for normal operation

- Startup, turn down & emergency functionality skipped
- Compressor performance curve, simplified geometry, heat transfer area
- Pressure profile at design used for reference condition

Simulation Features

- Equipment described as detailed as necessary (compare with operation)
- Pipe size, elevation & fittings (holdup & pressure drop)
- Parametrization used to adapt simulation to plant operation
- Stable convergence in steady state fluid flow mode



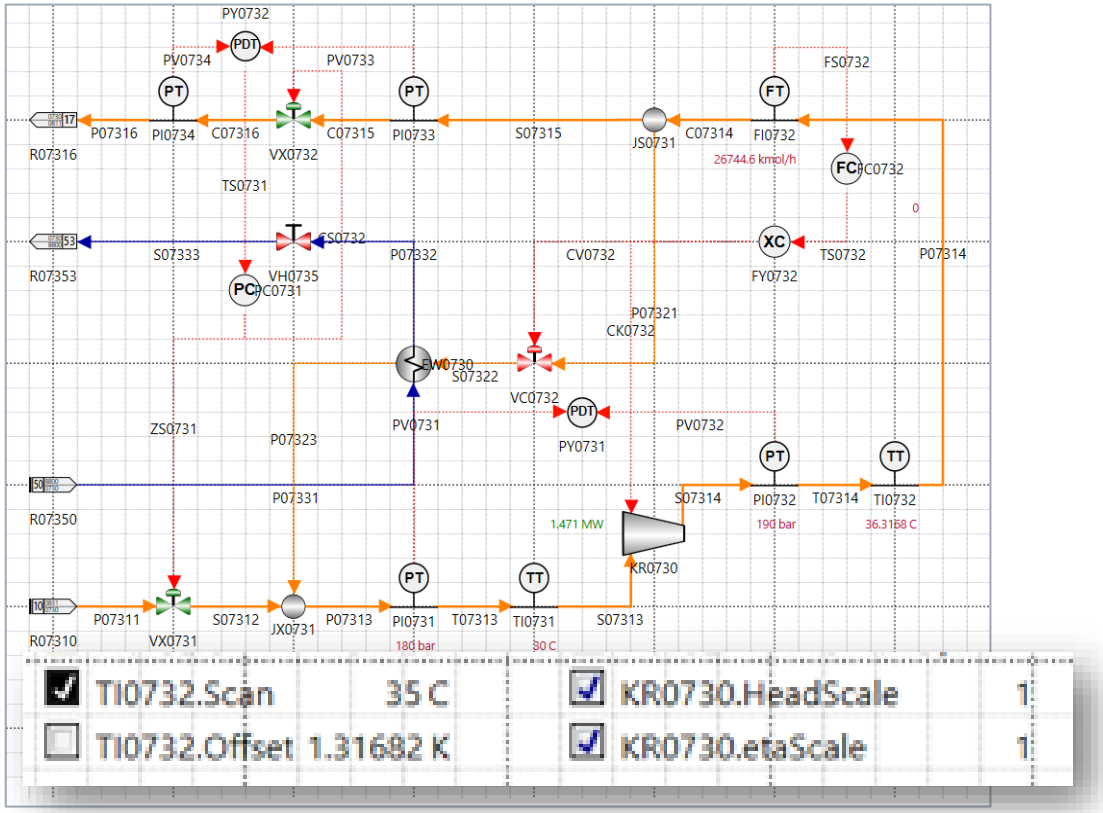


Update on using automation to guide process operations with APS

Parametrization of simulation by plant measurements

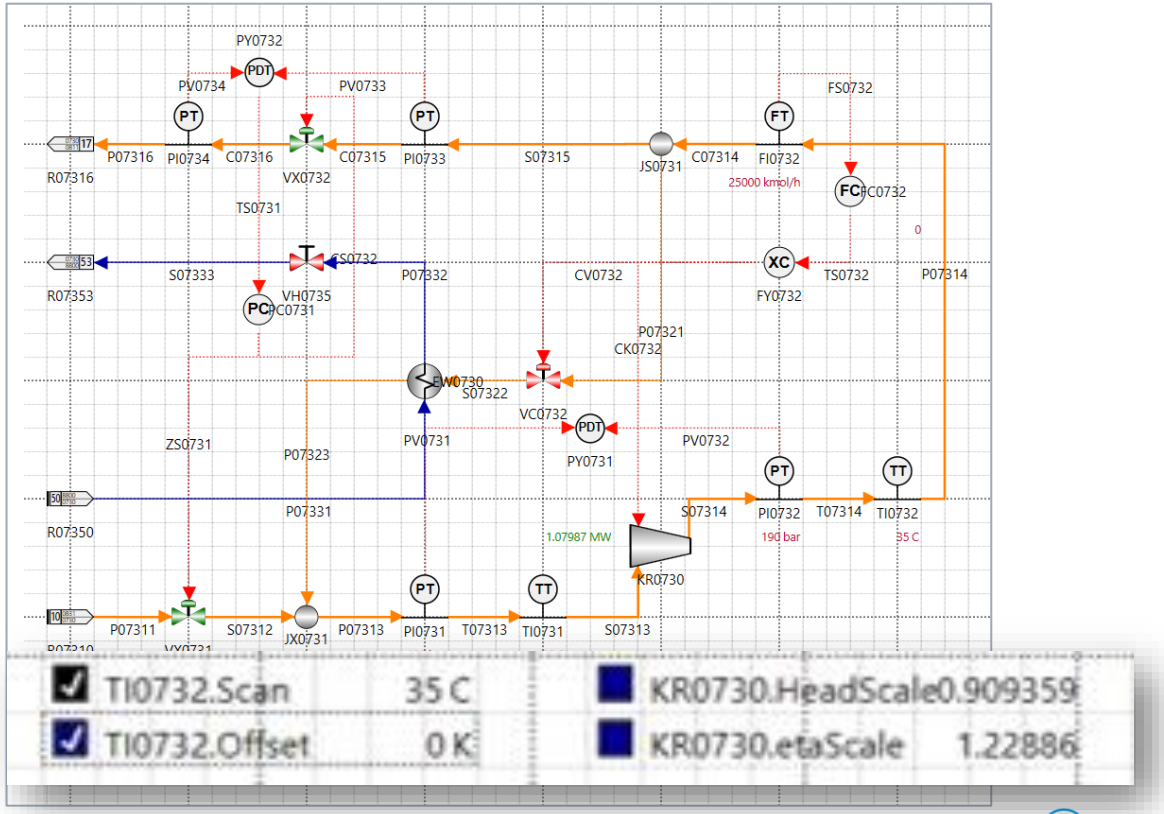
Simulation describing current plant operation

- Setting Scan & Offset of inlet results in deviations for outlet
- Increasing offsets indicate deviation of simulation & operation



Simulation Features

- Setting Scan & Offset of inlet & outlet allows parametrization
- Updated parameters FlowScale & etaScale are stored in snapshot



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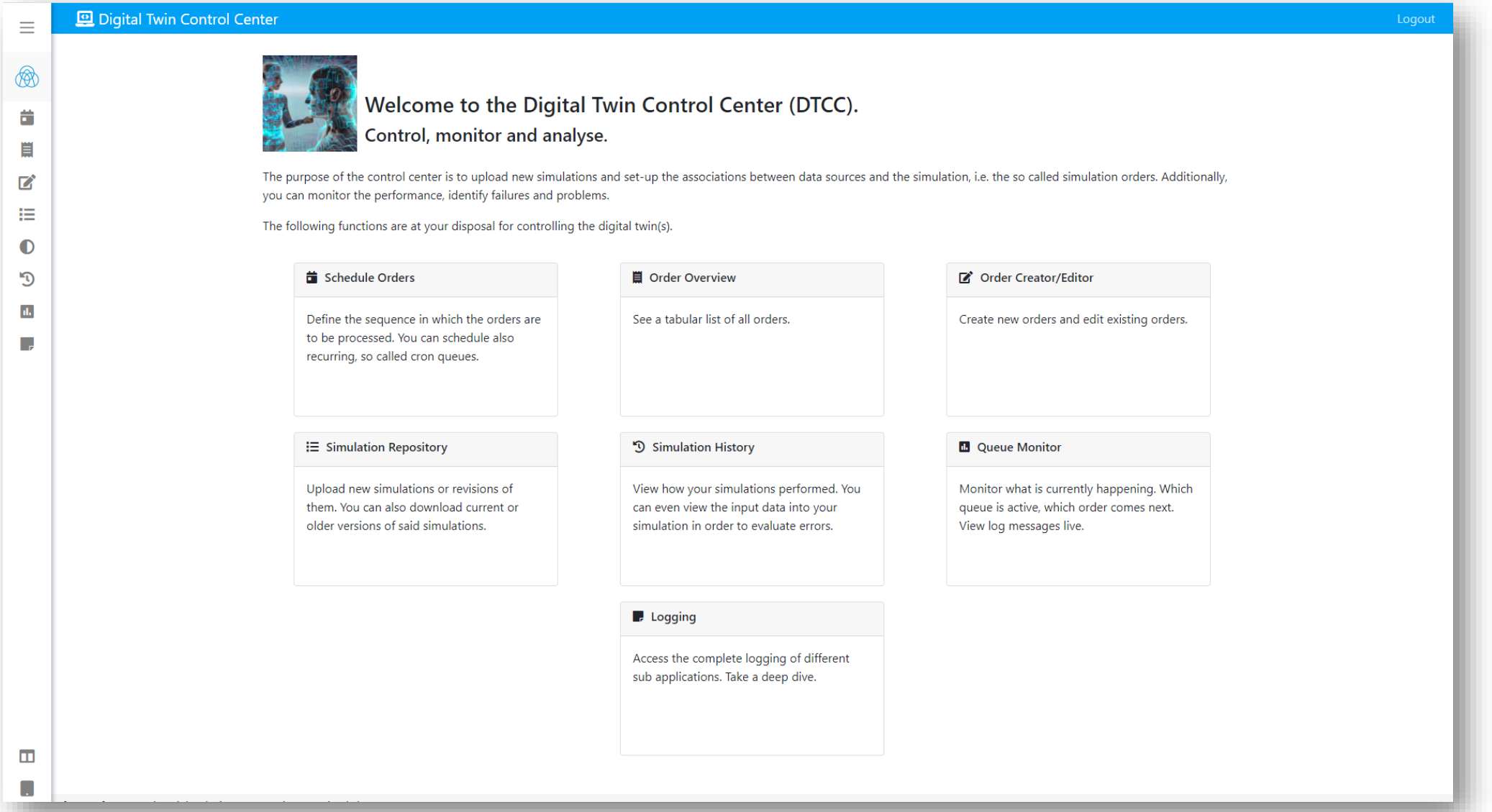
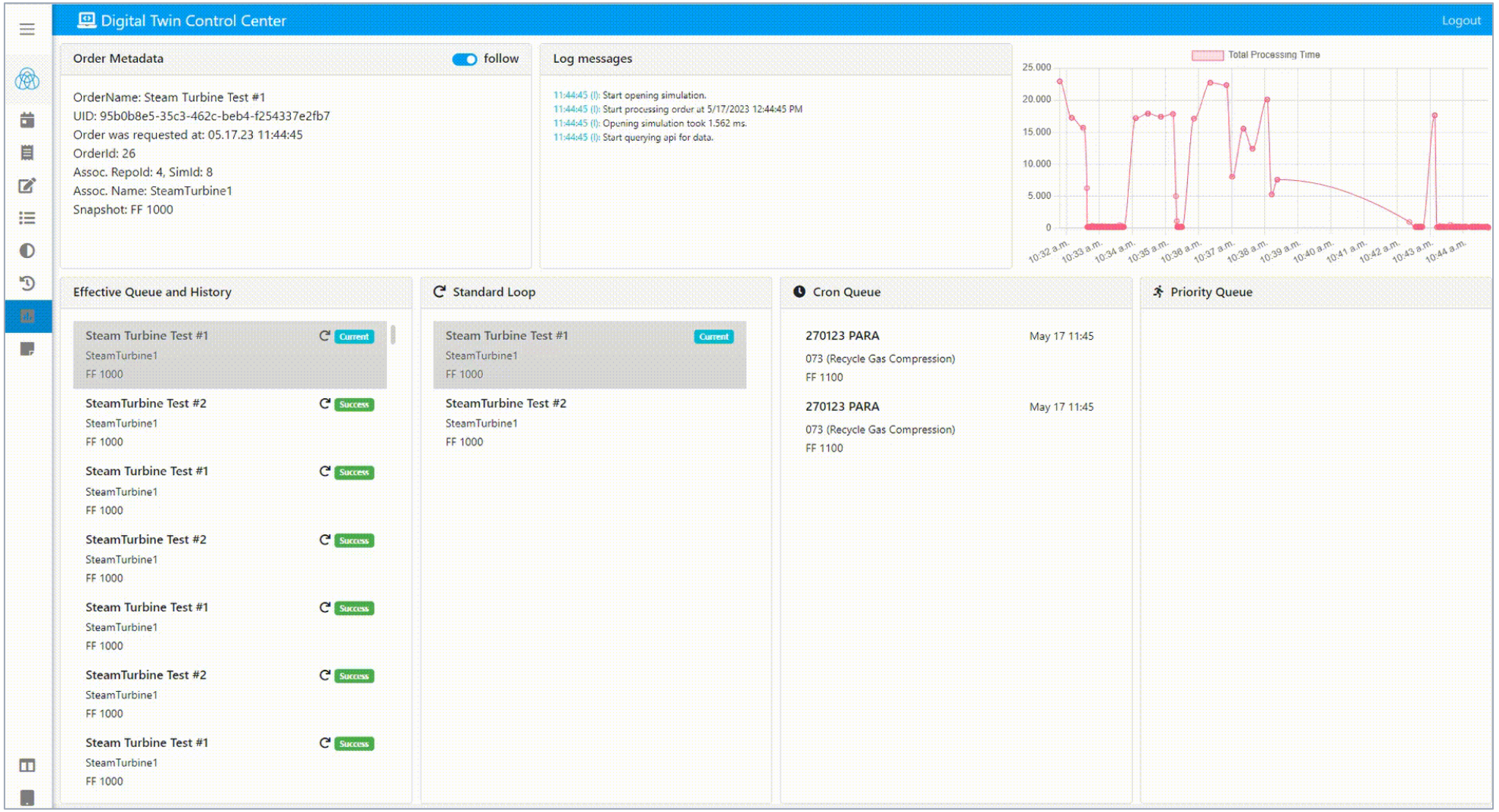
Digital twin control center overview



Update on using automation to guide process operations with APS

Digital Twin Control Center Video



CHEMICAL INDUSTRY | GERMANY

Scripting Automation to Guide Process Operations with AVEVA™ Process Simulation

Challenge

- Development of a digital twin for the customer, to obtain better operational excellence, without having the expertise in simulation
- Cloud solution (on premise possible)
- Provide stable and fast user experience
- Unlock increased efficiency and sustainable operations

Solution

- **AVEVA Process Simulation** + Python- / C#- Scripting interface for automated simulation handling and case execution
- Self-developed scheduler and web interface

Results

- **Versatility: One model from Steady State to Dynamics & easy automation**
- **Transparency: Plant & Maintenance Insights for better decision making (incl. the application of virtual sensors)**
- **Sustainability: Increased process stability, flexibility and efficiency**

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Questions?

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Please remember to…

Navigate to this session in your mobile app to complete the survey.

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Thank you!

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ABOUT AVEVA

AVEVA is a world leader in industrial software, providing engineering and operational solutions across multiple industries, including oil and gas, chemical, pharmaceutical, power and utilities, marine, renewables, and food and beverage. Our agnostic and open architecture helps organizations design, build, operate, maintain and optimize the complete lifecycle of complex industrial assets, from production plants and offshore platforms to manufactured consumer goods.

Over 20,000 enterprises in over 100 countries rely on AVEVA to help them deliver life's essentials: safe and reliable energy, food, medicines, infrastructure and more. By connecting people with trusted information and AI-enriched insights, AVEVA enables teams to engineer efficiently and optimize operations, driving growth and sustainability.

Named as one of the world's most innovative companies, AVEVA supports customers with open solutions and the expertise of more than 6,400 employees, 5,000 partners and 5,700 certified developers. The company is headquartered in Cambridge, UK.

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Trends in sustainability

AVEVA Process Simulation may be applied to 5 areas of sustainability

Greenhouse Gases

Predict the amount of GHG emissions to improve process design or operations

Carbon Capture

Model amines and other solvents to remove CO2 from effluent streams.

Energy Transition

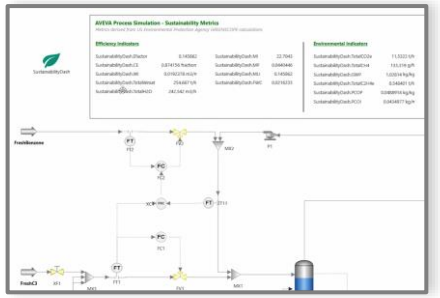
Use solar and wind to electrolyze water to create hydrogen

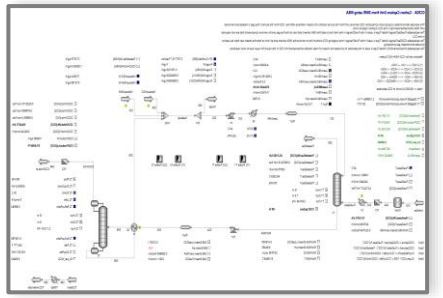
Power To X

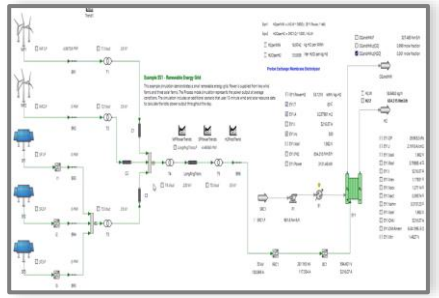
Synthesize chemicals and fuels (e.g., Ammonia) from electrolysis products.

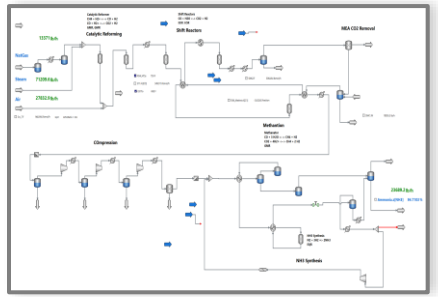
Circular Economy

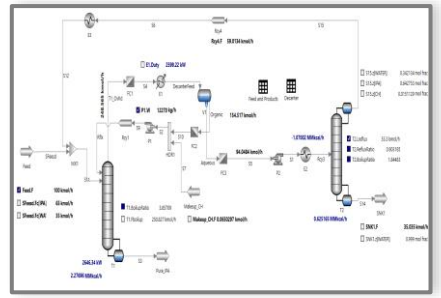
Chemical companies must reinvent portfolio of products with sustainability in mind











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Presentation template brief

- A Style Tips and Best Practices document accompanies this template.
- As you develop your slides, **browse different slide layouts by right clicking the slide preview and selecting Layout (See screenshot at right)**
- The next slide suggests a sample flow for your presentation. **Adapt it for your work.**
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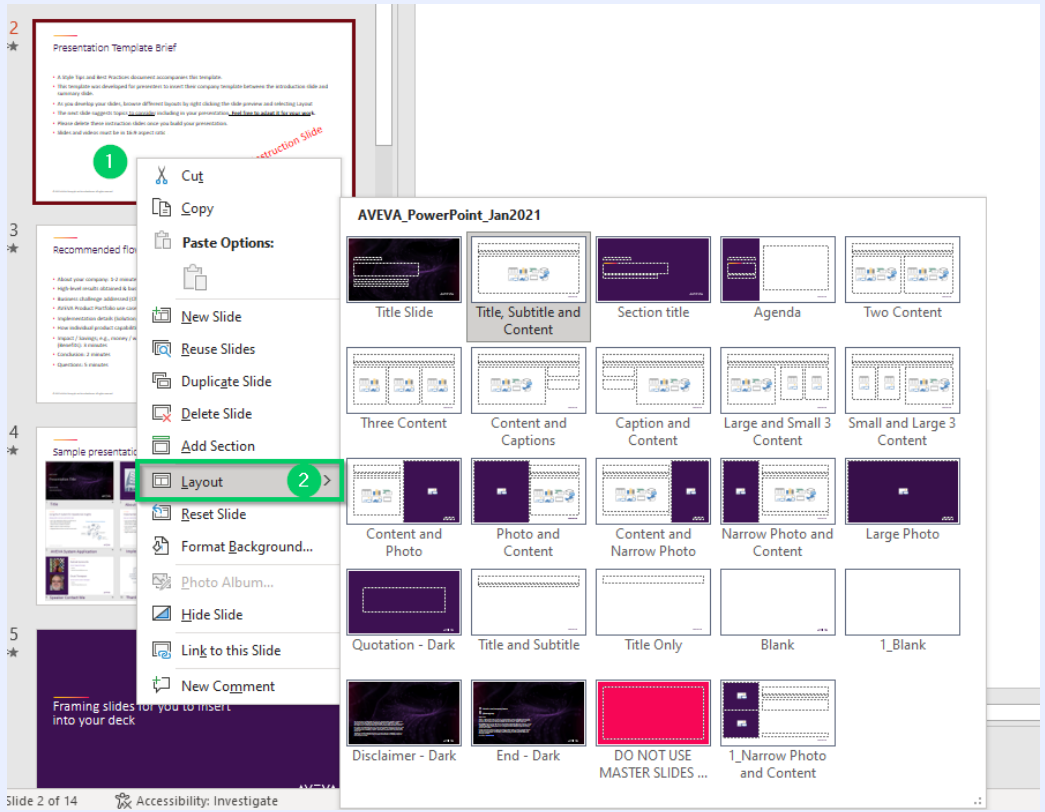
- Slides and videos **must** be in 16:9 aspect ratio.



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Recommended flow of topics in agenda

Remember – 20 minutes goes by fast! How can you best summarize your success story?

- About your company: 1 minute
- High-level results obtained & business impact (Challenge/Solution/Benefits slide): 1-2 minutes
- Business challenge addressed (Challenge): 2 minutes
- AVEVA Product Portfolio use case/application (Solution): 3-4 minutes
- Implementation details (Solution): 3 minutes
- How individual product capabilities solved your business challenge (Benefits): 3 minutes
- Impact/Savings; e.g., money/Work time saved, quality improvement, increased understanding of the process (Benefits): 3 minutes
- Conclusion: 2 minutes
- Questions: 5 minutes

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Framing slides for you to insert into your deck

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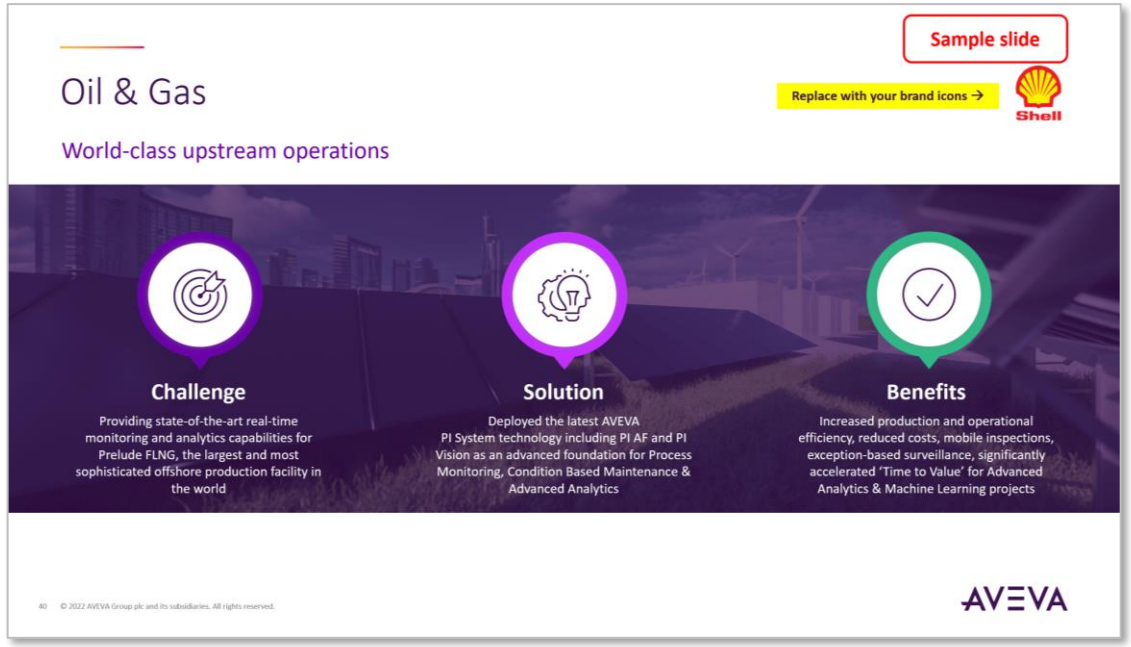
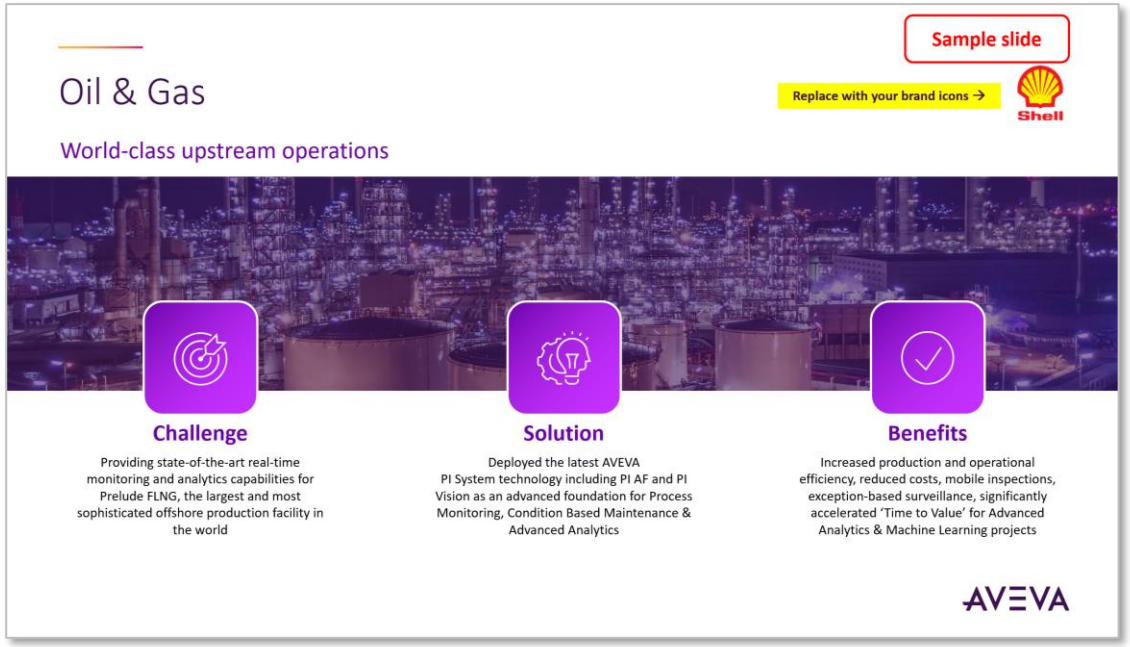
Instruction slide

Examples of summary slides

Summary slide examples are found on the next two slides. Choose one and modify it for your presentation. Every presentation should include a summary slide. You may position the summary slide anywhere it fits, usually near beginning of talk or near the end.





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Sample slide

Oil & Gas

Replace with your brand icons →

World-class upstream operations

Challenge

Providing state-of-the-art real-time monitoring and analytics capabilities for Prelude FLNG, the largest and most sophisticated offshore production facility in the world

Solution

Deployed the latest AVEVA PI System technology including PI AF and PI Vision as an advanced foundation for Process Monitoring, Condition Based Maintenance & Advanced Analytics

Benefits

Increased production and operational efficiency, reduced costs, mobile inspections, exception-based surveillance, significantly accelerated 'Time to Value' for Advanced Analytics & Machine Learning projects

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Speaker name

Speaker title

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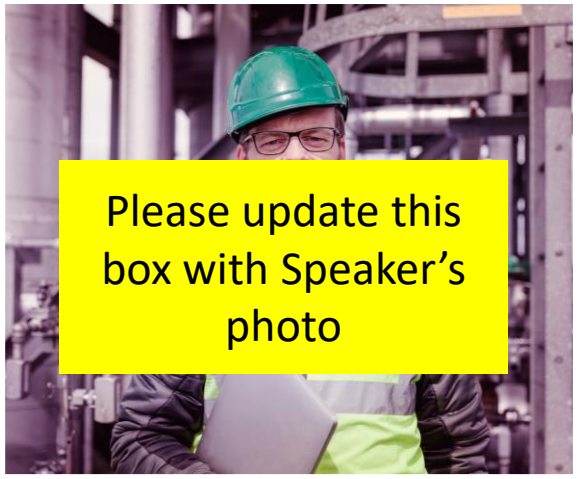

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Introduction

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Update on using automation to guide process operations with APS

Agenda

TKIS overview slide

Update on using automation to guide process operations with APS

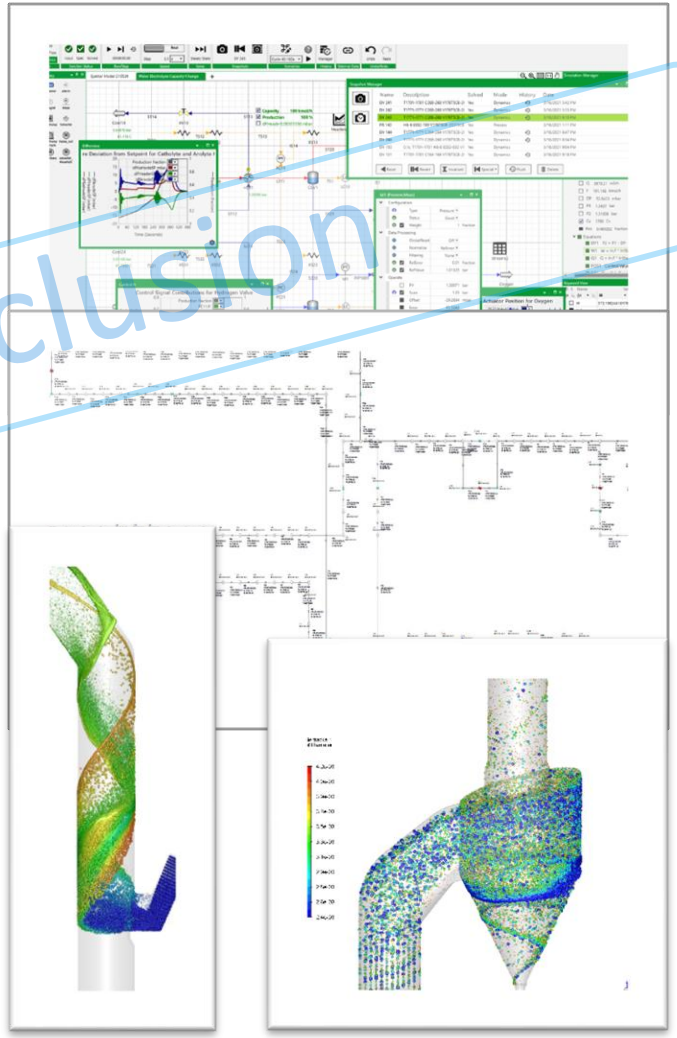
Summary & Conclusion

Application & Integration of APS within Digital Twin Development

- Simulation engine for Digital Twins
- Development of web-based scheduler to exchange
- Cloud-based databases with multi-factor authentication

Applications of APS at tkIS Uhde

- APS is versatile part of engineering toolbox
- Comparison & validation of different engineering tools
- Steady state & dynamic simulations for Digital Twins



Formulate own conclusion