MAY 2022

AVEVA[™] Process Simulation for Sustainable Process Engineering

PI World 2022 Amsterdam

Stefan Millhoff



Agenda

- **1.** Vision and Strategy
- 2. New Platform for Process Engineering
- 3. Modelling Sustainability
- 4. Online Simulation
- 5. Closing



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

AVEVA Process Simulation Mission Statement

What is process simulation?



For chemical process engineers,



... who need a mathematical representation of the chemistry, separation, reactions, heat transfer, and hydraulics,



... to design plants, improve operation, increase efficiency, improve safety, and reduce greenhouse gas emissions



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A three-fold strategy for sustainable process engineering

How do process engineers rise to the challenge before us?





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The Process Side of Digital Transformation

Designed from the Ground Up

Delivering the Process Digital Twin

To t Ger

To the Next Generation of Process Engineers

• Modern Architecture

- Greater Connectivity (PI System)
- Custom Models for New Processes
- Design, Rating, and Dynamics
- Engineering Digital Twin
- Operations Digital Twin
- Groundbreaking Ease of Use
- Instantaneous Results
- Python scripting Enabled





The only simulator designed with the user in mind

The next generation of process engineer is not content with a simulator developed in the 1980s

| Feature | Description | AVEVA Process Simula | ation | Legacy |
|------------------------|--|---|-------|--------|
| Three Modes | Change from steady state to fluid flow to dynamics and back with a single simulation | | × | |
| Flexible Specs | Freely swap specifications (without controllers) | | × | |
| Continuously Solved | Solves whenever it can and keeps user | | × | |
| Snapshots | Save multiple results with a single simulation topology | | ~ | × |
| Undo | First simulator with a restore a hidden sna | an Undo button and pshot | ~ | × |
| Model Writing | Write your own moo by typing in the varia | lels or entire libraries ables and equations | ✓ | × |







AVEVA Process Simulation is disruptive



Like the value of a smartphone is greater than the sum of the separate devices, AVEVA Process Simulation is more than a set of single-purpose applications.

AVEVA Process Simulation drives Digital Transformation

One simulation platform from concept to operations



50% reduction in simulation effort across the lifecycle Collaboration internally and externally Improved Engineering Workflow **Enables True** Z Digital Transformation

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Engineering Digital Twin

Shorten the engineering time to design sustainable processes







- Design verification and validation
- Global cloud collaboration
- Warnings if plant does not operate as expected
- Automated case execution

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Trends in Sustainability

AVEVA Process Simulation's integrated Sustainability Capability









Greenhouse Gas Emissions

Use simulation to predict the amount of GHG emissions so that you can improve process design.

Carbon Capture

All process industries must reduce the amount of equivalent CO2 they release

Energy Transition

Transition from "Oil & Gas" to "Energy" using renewable power and hydrogen

Circular Economy

Chemical companies must reinvent portfolio of products with sustainability in mind











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Amines for Carbon Capture to turn Gray to Blue

Blue Hydrogen Production

- Amines like MEA, MDEA are adsorbents that can remove carbon dioxide from flue gas and other process streams.
- Amines are the technology that turns "gray hydrogen" to blue hydrogen using steam methane reforming.
- AVEVA is leading the way towards improved amine simulation to accurately design the future adsorbers to remove CO2 from Traditional processes to make them "blue"



New Rate Based distillation column using electrolyte NRTL to model a CO2 adsorber with MEA



Renewables for Green Hydrogen

Green hydrogen production

- Blue Hydrogen still has a CO2 waste stream that must be removed and stored.
- Green hydrogen can be produced through electrolysis with no CO2 produced at all
- AVEVA Process Simulation has the renewables models for wind, solar, and water electrolysis to design green hydrogen plants and integrate them into your existing facilities.



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Hydrogen Value Chain

Model the entire hydrogen value chain from production to liquefaction



AVEVA[™] Process Simulation Version 2022

Renewables Library



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Deploying Online Models

How do I reuse engineering models

- Deploy simulation models online for real-time asset monitoring and KPI calculations
- Backfill KPIs from historical data to train predictive machine learning models
- Connect with a range of applications for alarm notifications, predictive maintenance, and time to failure estimation





(1) Fluid Flow

Model Library:

Source Sink Valve Pipe

Turbine ExtTurb ParTurb Header Drum Pump Desup HX

Perfix HNC HXSC Orifice P5V Shaft GasSource GasSink ⇒ ⇒ ® ♦ HeatSourt HeatSink Generator Stream

PipeRig Recycle ClosedLoo Seq

Remain the subsalit subsalit e

Compose Steam Natvetaam DefPump

PumpEse PumpMap TurbEff GTExemul mple Example e (C) IN AL

Real-Time System (RTS) in AVEVA Process Simulation

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Data Rec 🔹 🕨





| External Data Ma | inager | | ▼ - ¤× |
|------------------|---|--|---|
| + | Name Measurements KPIs AssetRunning SimStatus Data Rec Outputs | Time Selection 4/7/2022 2:32 PM -1 minutes 4/7/2022 2:29 PM -1 minutes 4/7/2022 2:29 PM -1 minutes 3/18/2022 9:04 AM -1 minutes 4/7/2022 2:29 PM -1 minutes | Description Measurement collection to read KPI collection to write Speed > 4500rpm Simulation Status Flag Reconciled measurments |
| | | | |

Step 1: Read Measurements from PI

File Start Process Fluid Flow Dynamics Edit/View AVEVAT Engineering Advanced. Help

▼ 4 × SteamTurbineOnline +

LastGoodDRCase

Auto

Input Spec Solved

| T1.Speed | 5145.06 rpm |
|---------------|--------------|
| FT1001.Scan | 426699 lb/h |
| PT1001.Scan | 597.225 psig |
| 🗹 TT1001.Scan | 717.361 F |
| PT1002.Scan | 74,6988 psig |
| TT1002/Scan | 373.849 F |

Step 2: Data Reconciliation

| FT1001.TotalError | |
|-------------------|-------------|
| 🗹 Feed W | 426699 lb/ |
| Feed.P | 597.225 psi |
| 🗹 Feed/T | 717.361 |
| 🗾 Exhaust.P | 74.6988 psi |
| 🗾 Exhaust/T | 373.849 |

Step 3: Write KPIs to PI

| T1.Power | 18.1106 MW |
|----------|------------|
| T1.eta | 76.4644 % |
| T1.CV | 420.76 Cv |

Al-driven predictive asset optimization

Combine engineering knowledge and machine learning for operational insight



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Asset Framework accelerates digital twin deployment

AVEVA Process Simulation works with PI Asset Framework

- Creating online models is tedious and error prone if you must look up tag numbers.
- AVEVA Process Simulation allows you to use PI System Asset Framework Assets to quickly connect process models to online data



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Operating Digital Twin

Monitor and operate to reduce greenhouse gas emissions

You'll see why this space also left blank.



- Troubleshoot past operations
- Provide soft sensors
- Improve future operation and efficiency
- Predict equipment degradation and failure



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Lifecycle Digital Twin for a Sustainable Future

Same simulation for Engineering and Operations enabled by a new process simulation platform



Shorten the engineering time to design sustainable processes Monitor and operate to reduce greenhouse gas emissions

Our current generation of plants were improved by evolutionary designs over the last century, we need a revolutionary digital transformation to design the next generation of sustainable plants over the next few decades to achieve the economic success of the current generation of plants.

The Sustainable Process Engineer Mission Statement





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Learn more at <u>www.aveva.com</u>