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Silo busting with the digital twin

Information silos within oil and gas companies harbor significant inefficiencies and hinder the achievement of operational excellence. The desire for a single source of truth for all data types that can be consumed in decision-making and execution has been driving the pursuit of IT/OT convergence, which has largely remained elusive. The key to change is a digital twin that works.

The ideal. The digital twin should be an accurate virtual representation of an asset's full lifecycle and range of operation. It is ideally created during the initial study to evaluate asset feasibility and is used and further developed during asset design, construction and commissioning. It facilitates the optimum design of the asset and the training of asset operators. It works in the present, mirroring the actual plant in simulated mode, but with full knowledge of the plant's historical performance and an accurate understanding of its future potential.

Is a process simulator the same as a digital twin (FIG. 1)? Not really. A process simulator should be able to transition from a rigorous design tool into a digital twin driving operations, including production management and supply chain optimization.

Most well-run plants will have a process simulation model of the plant, possibly created during plant design or since that stage. The use of process simulators for operations support is, however, limited to ad-hoc use by unit engineers for troubleshooting and investigating improvements. Process simulation requires the engineer to determine what is likely to happen and then configure and use it for what-if scenarios to attempt a calculation of where the best value lies.

This approach presents challenges: improvements are only identified when engineers are focused on the right areas, if at all. Often, operators lack confidence in the results of the ad-hoc model, so unit engineers want to review the model again when making changes or an unexpected outcome occurs. The rate of change slows or results in no improvement, and unit engineers often stop using the model or build and test the model excessively, thereby losing focus on other more valuable improvements. This leads to increased time and cost, delayed optimizations, missed improvements for the business and lost profits.

For more than a decade, Petro-SIM has been a rigorous design tool that applies in-depth physics and chemistry to real-time production data to drive business decisions for production management and supply chain optimization activities.

Collaboration. In February 2019, KBC announced a collaboration with OSIsoft to accelerate digitalization across the energy and chemical industries and eliminate the disappointment of big data analytics.

Through this collaboration, Petro-SIM has been configured to enable everyone to see inside and perceive things that are not being directly measured. High-quality and accurate predictions are instantly available and run in a consistent way that can be understood and agreed on. It enables automated creation of PI Asset Framework (PI AF) templates from Petro-SIM and automated updating of PI AF templates if the Petro-SIM model changes. It enables automated population of the Petro-SIM model with current PI data and automated population of the PI database with Petro-SIM outputs. Any PI tag changes trigger automatic notification to Petro-SIM.

Automated calculation of unit performance analytics allow "What if?" and "What's best?" scenarios to be run automatically to determine available strategies that maximize profitability.

All Petro-SIM model outputs are automatically written back into the PI system, in real-time, significantly enhancing the quality and richness of data in the PI system. This includes comparison of measured vs. simulation model vs. LP model outputs to help track when models and actual plant performance diverge. Other parameters include (but are not limited to) temperatures, pressures, flows, densities, viscosities, stream characterization of feeds and products, catalyst activity and run length projections, catalyst circulation rates and heat exchanger/fired heater fouling. In turn, a higher fidelity record of operations in the PI system will help drive smarter decisions across the enterprise by bringing Petro-SIM insights to PI Vision dashboards and other systems integrated with the PI system. This also enables drill-down into Petro-SIM models from PI Vision (FIG. 2).

The necessary first step is provided toward making Petro-SIM not just a rigorous design tool, but also the asset's digital twin that can perform monitoring, surveillance, supply chain optimization and other advanced applications and services.

The significant value offered by Petro-SIM-based digital twin addresses:

- Making the right decisions on bad data
- False positives arising out of analytics initiatives
- Needing measurement in parts of the system where it is risky and difficult
- Decision-making on a plant-wide and individual unit level between siloed groups
- Reliability and maintenance being optimized in isolation of process/yield/energy considerations
- Planning errors or inaccuracies having to be "mopped up" by storage/system flexibility, and proliferating errors from one plan to the next
- Operator training on actual situations experienced in the plant
- Distrust of and lack of understanding of plant-wide and individual unit operations/economics in real-time
- Sub-optimal decisions made because of non-utilization of available non-measured/inferred indicators
- Engineering time wasted by doing repetitive tasks
- Non-compliances with corporate engineering/design standards
- Inability to "plug in" proprietary IP, knowledge and know-how into routine activities.

Used in these ways, Petro-SIM boosts the value derived from production management and supply chain optimization activities, as well as reduces total cost of asset lifecycle simulation. ●

Traditional simulator	VS.	Digital twin
An accurate representation of a particular operating case	→	An accurate representation of the asset over its full range of operation, all the time
Static provision of a snapshot in time	→	Captures the full history and future of the asset
Built on an ad-hoc basis to answer a question	→	Automated, regular model runs; built-in to business work flows
Owned and used by isolated groups on an ad-hoc basis	→	Centralized single version of the truth, used by everyone; outputs delivered directly to the business; strong governance systems

FIG. 1. Comparison of process simulator and digital twin, which is always aligned with and drives business data model.

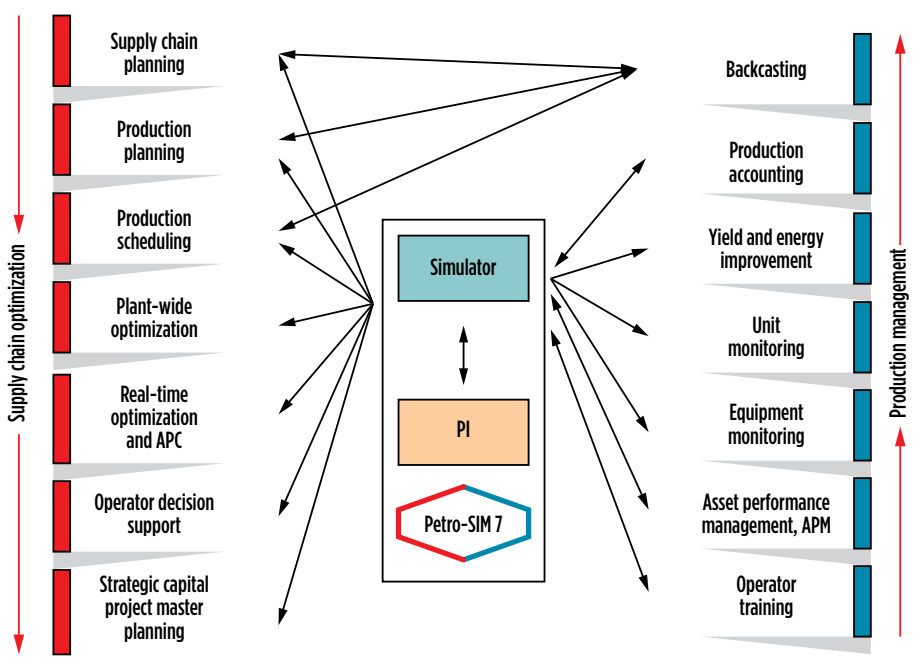

FIG. 2. All Petro-SIM model outputs are automatically written back into the PI system, in real-time, including the comparison of measured vs. simulation model vs. LP model outputs.