

WHITEPAPER

Top digital approaches for the next downturn

The digital petrochemical plant

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Executive summary

The Oil & Gas Downstream market is currently highly volatile. One that is affected by price fluctuations, demand uncertainty, and more stringent environmental constraints. As a result, a “new normal” scenario is applying pressure to the entire value chain, forcing Chemical and Petrochemical companies to re-evaluate business and operations management. They must keep an eye on the future to make faster, better decisions at any time, including during a crisis.

It is therefore critical to remove organizational silos to reach unmatched levels of efficiency. The transparent flow of information and goals among disciplines in the cloud enables real-time collaboration with cross-functional decision making throughout the asset lifecycle and supply chain.

Investments in digital capabilities today are not only driven by the competitive market pressure, but also by the need to optimize and grow ensuring safe operations and analyzing the right data across the organization to make business decisions.

From now on, companies will need to be nimble and resilient, connected, and collaborative to survive in the long run. Full visibility on business impacts from market changes and mechanisms in place to mitigate these risks and explore the small windows of opportunity will make the strong players stronger.

How digital will beat uncertainty

The new reality is shaping how technology enables and empowers the workforce through the Digital Plant, to become a connected workforce. In the Digital Plant, the applications interoperate seamlessly to address complex use cases and provide boundaryless workflows. No matter how complex or domain intensive the underlying functionality, the relevant information needs to be contextualized and presented simply and clearly.

Automated guidance and learning support are necessary to provide digital expert assistance. Industrial software has become as easy to use as the technology we use at home to ensure the continuity of safe operations and maintenance.

Here are four key aspects to face the challenges in the current scenario full of uncertainty and to be ready for a future downturn:

1. The supply chain needs to be managed differently than before, to increase agility for robust decision making
2. It must be possible to optimize the value chain based on real-time operational and economic data to improve margins

3. A reliable maintenance platform is required to ensure an effective maintenance plan reducing costs and increasing safety
4. Edge-to-enterprise visualization and control in the cloud are critical to providing the workforce with clear, concise, and comprehensive information, enabling confident decisions and faster reaction time under normal conditions and during a crisis

Planning and network optimization

Against the backdrop of the price fluctuations and uncertainties in demand, supply chains need to be managed differently. Companies must continually evaluate their production planning. They need to be flexible to re-plan as much as required, possibly several times a day, to rapidly react to market fluctuations. To take advantage of economic opportunities and quickly react to every market change, the planning process must evaluate numerous scenarios with different feedstocks, prices, and possible future demands. The agility for running scenarios to build short and long-term plans for maximum profit and the best use of assets will define who will succeed.

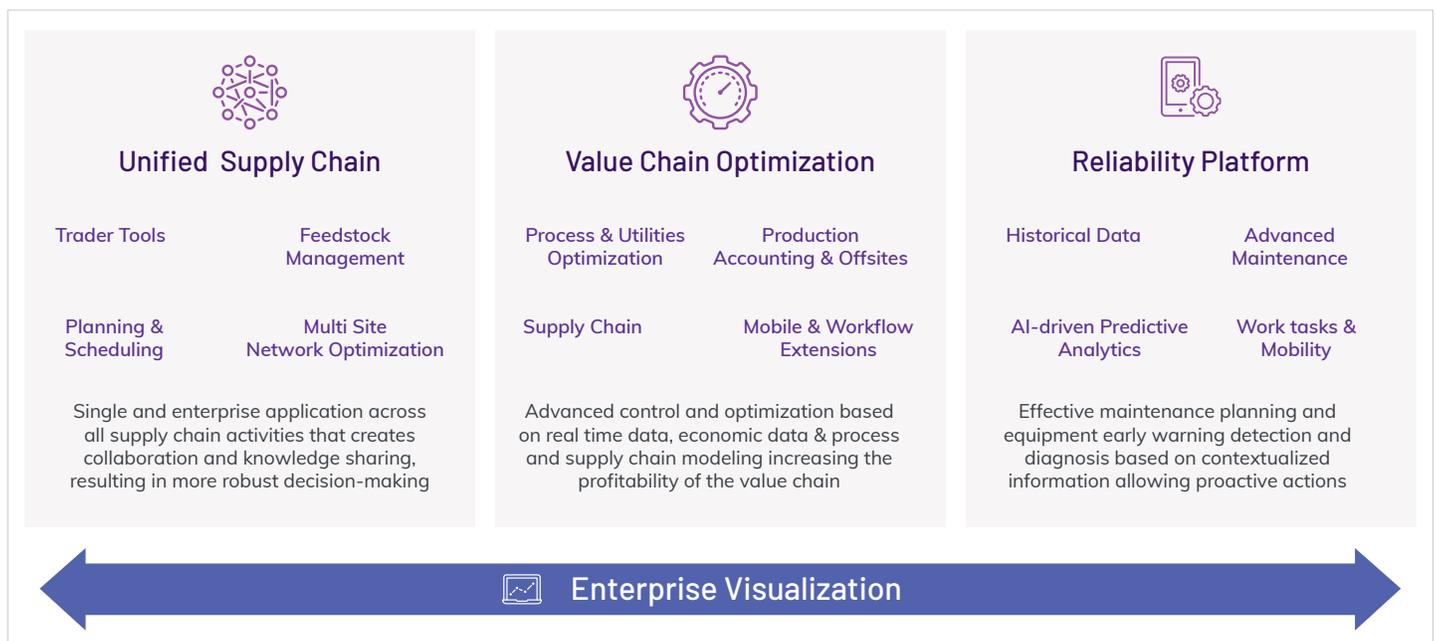


Figure 1: The digital plant

For larger players, single and multi-site modeling with network optimization (see **Figure 2**) will improve the understanding of the interaction between assets and sites and the business itself. This is the type of visibility required to allow the best decisions with rapidly changing or uncertain information.

Beside selecting the best technology and defining the best processes to enable traders and planners to work better and more collaboratively, there is another critical aspect to ensure success: cloud-enabled solutions. In the past few years, the cloud was considered an emerging trend adopted by companies ahead of their time and seeking to improve efficiency and reduce IT costs. Today, the cloud is crucial to promote speed and collaboration as many employees continue to work from their homes. In 2017, BP moved several applications to the cloud, including its unified supply chain management platform.

The implementation was so successful that Claire Dickson, CIO of downstream at BP, made the following statement about the production planning application:

“ Believe it or not, for the same data set, the same crude and feed stocks, the same units, what used to take us **seven hours** to run now takes just over **three minutes**. I have to admit I didn't really think that we'd get that out of cloud, so it has been quite revolutionary for us.^{1,2} ”

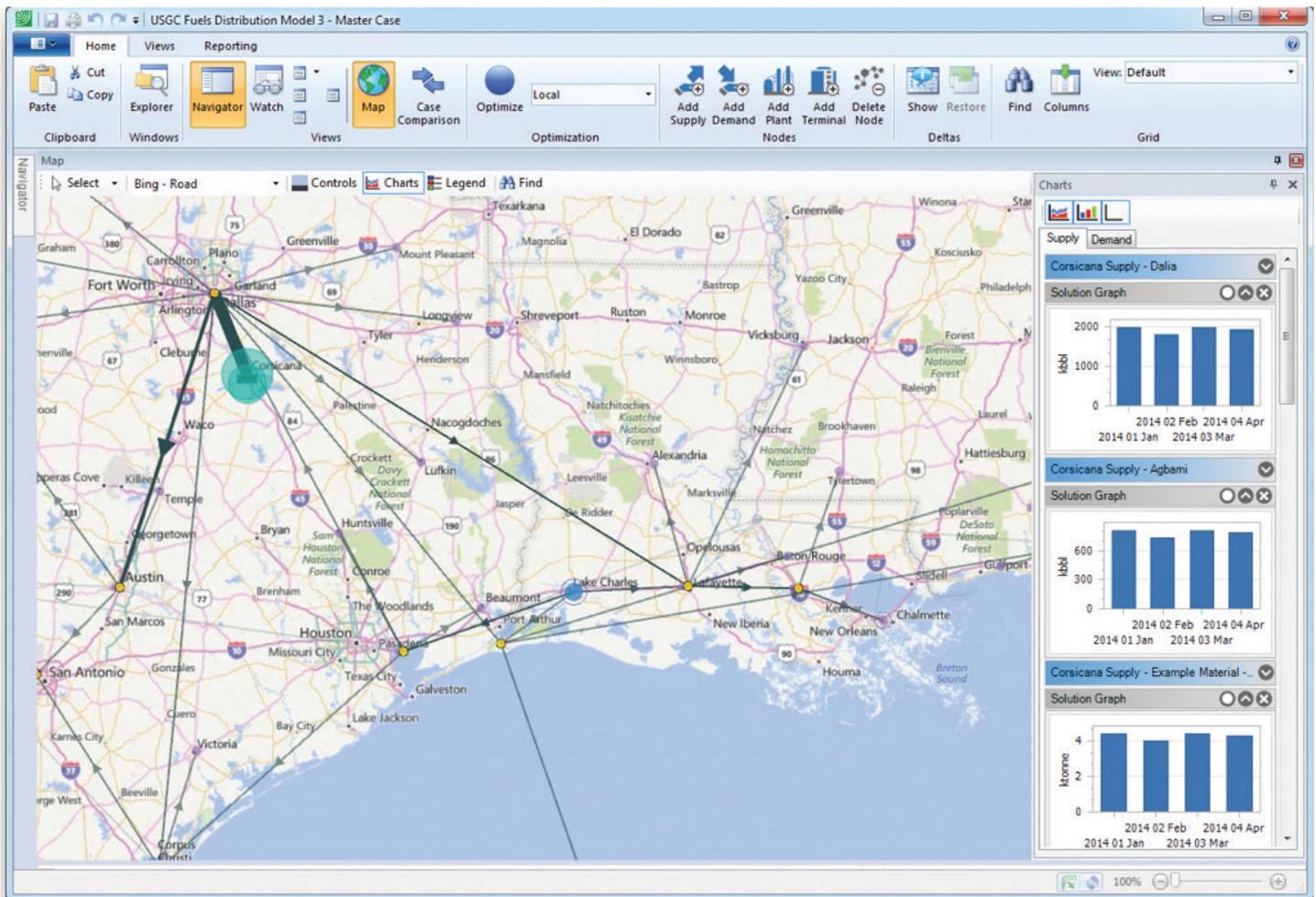


Figure 2: Network distribution optimization model

Value Chain Optimization

Market instability makes the energy and chemical industries even more complex than before, requiring a holistic optimization of the entire value chain to improve margins. Despite the widespread use of technology, many plants today are managed by a series of point solutions throughout their value chain. With each point solution comes its underlying assumptions, data models, and constraints. This makes decision-making across the value chain opaque and often results in a series of value leaks across the operations value chain. An investment in digital capabilities must be wisely designed so organizations can recover faster and more robustly. A strategic roadmap must be developed for the Digital Transformation journey, unlocking extra benefits within existing assets both in the short and long terms.

In addition to production planning, the optimization of the value chain must consider production accounting, offsites management, process optimization, energy management, daily scheduling, quality analysis, and logistics. In this new world, the different disciplines in the plant will need to work with common objectives within a single application that drives collaboration and knowledge sharing.

Value chain optimization will result in faster and more robust decision-making and align with risk management and margin improvements. Here are the typical challenges faced by an ethylene plant, for instance:

- Feedstock selection
- Overall severity (includes C2/C3, C4,C5, PGH, heavies production rate/ balance)
- C2/ C3 recycle to crack or Fuel Gas
- Overall steam, fuel and power balance
- LP Vectors for planning model
- Overall optimization and set points to APC for closed loop RTO
- Furnace Management
- Real Time Performance Monitoring
- Engineering case study
- Faulty instrument identification improve instrumentation accuracy

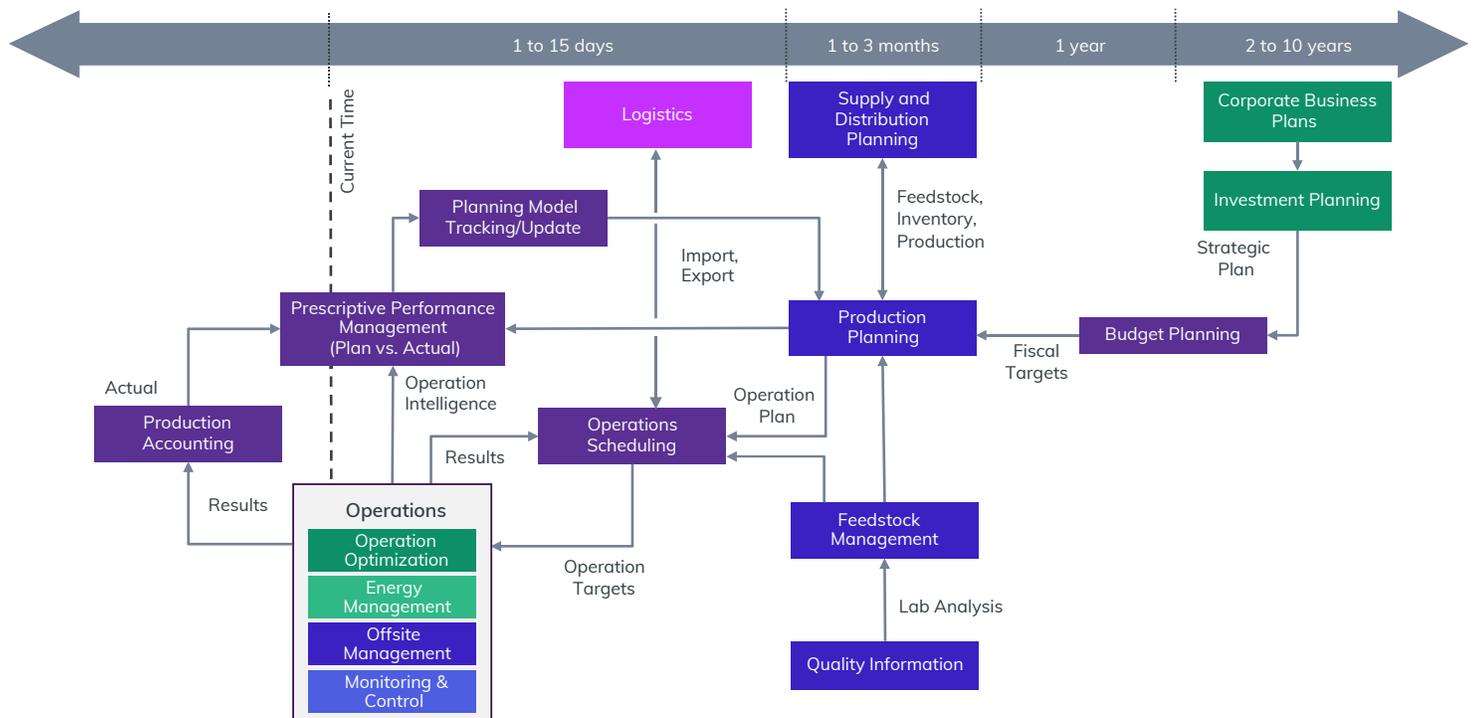


Figure 3: Elements of the value chain in petrochemicals

The specific benefits achieved by companies that have invested in holistically optimizing the value chain are:

- Supply chain:
 - Feedstock Purchase: Faster feedstock selection process, Reduced cost
 - Planning, Scheduling, and Logistics: Increased throughput, increased yield
- Process Performance: Longer equipment life, increased availability, increased quality, increased yields
- Blending and Oil Movements: Reduced giveaway, no rework, minimum inventory, minimum downgrades, higher fuels agility
- Energy Management: Reduced energy conversion cost, reduced energy consumption cost, reduced cost of crude for energy
- Production Management: Reduced accounting losses, reduced inventory, reduced hydrogen, and steam consumption, increased throughput
- Operations Management: Reduced unplanned shutdowns, increased yield, reduced hydrogen, and steam consumption, increased throughput

BASF recently shared that they have been optimizing their ethylene plants in real time for over 15 years. The application helps to increase profit, adjusting between **80 and 100 set points** in each optimization run. Besides the economic return, other benefits include offline use for what-if scenarios, feedstock evaluation with the same optimization model, online calculation of estimated parameters, better process knowledge for engineers and operators, and measurement error detection.³

AI-Driven Predictive Analytics

Reliability is crucial for asset-intensive businesses such as the petrochemical sector because any unplanned shutdown of critical assets can lead to severe disruption throughout the production chain. A Reliability Platform is required to ensure an effective maintenance plan reducing costs and increasing safety. It comprises of several elements to predict equipment health, monitor performance, and enable advanced maintenance across its operations to eliminate unplanned downtime.

One key element of a digital reliability platform is AI-driven Predictive Maintenance. Process simulation and Artificial Intelligence (AI) are well-known technologies used to understand equipment and process behaviors and to support the identification of unexpected events. The ability to run models under different scenarios and get faster answers during critical times is even more important. Under uncertainties, plants can operate with various capacities, increasing unexpected events since operators are not used to working under those different conditions.

Some approaches for running models can be time-consuming without the full range of options and possibilities. Today, enhanced AI can be used to increase model speed and accuracy. AI-driven Predictive Analytics combines AI, deep learning, rigorous first-principles models, and real-time optimization. AI is infused with results from the rigorous process simulation and optimization algorithms, creating a sophisticated model capable of providing advice about the best cost-effective choices for operations and maintenance.

One of the main benefits of a conventional predictive analytics model is providing early warning notification about equipment failures; however, when you combine AI with rigorous models and a deep learning approach, the benefits are stretched:

- The model operational range is extended, that is, it is not being limited to the operating range used to “train” the model, which is called High Dynamic Range Models
- The model works for assets with limited historical data, so it can be applied as soon as the equipment is commissioned, or as soon as a completely new operation condition is imposed
- The model sensitivity is higher, so the process and equipment failures detection is provided much earlier, allowing enough time to plan for maintenance or a planned shutdown

- It provides a single enterprise early warning notification system for any event related to unexpected process or equipment behavior
- The system is capable of estimating the remaining useful life of an asset, prescribing actions for planned outages
- The system provides automated risk versus cost impact analysis, and it’s capable of determining if constrained or loss of equipment is a viable scenario

An AI-driven Predictive Analytics Platform provides a **360° view of risk related to asset and process health degradation**, enabling the optimization of operational efficiency, production, and costs based on known constraints or loss of equipment. As a result, the plant can manage risks, thus decreasing production loss to downtime and optimizing operations and maintenance strategies.

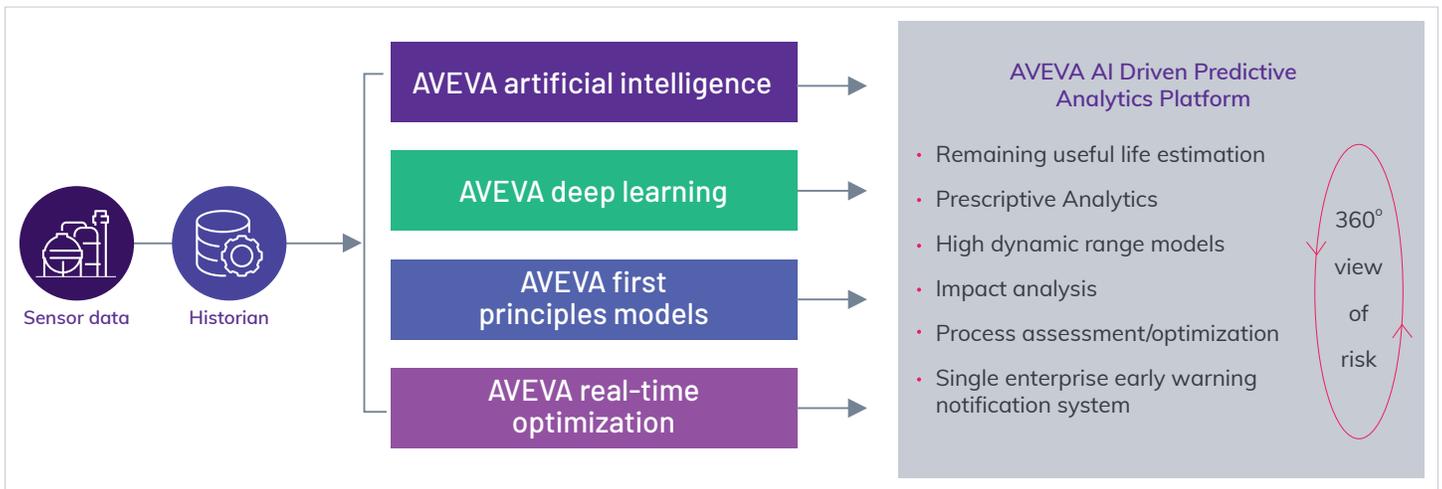


Figure 4: AI-driven Predictive Analytics

Enterprise visibility

Now, more than ever, the integration of information technology and operational technology is a critical step. Companies need to bring data from software and operational silos into a single view to align the “connection of things,” bringing insights to the connected worker. Edge-to-enterprise visualization and control in the cloud can provide the workforce with clear, concise, and comprehensive information, enabling confident decisions and faster reaction time under normal conditions and crises.

Remote communication from edge IoT devices, instruments, and equipment, entire production lines, processes, and sites are now available through existing technology. This entire chain of equipment, processes,

and sites must be converted into a common single pane solution for visualization, analysis, and action. As a result, companies can operate remotely, safely, and intelligently through enterprise visibility to support real-time decision making.

This single enterprise-wide view consolidates engineering information with operational context, maintenance strategy, energy management, real-time operational displays, interface to specific applications (such as optimization models and machine learning), and financial data, providing actionable guidance when considering different situations. It’s a transformative integration approach for assets, people, processes, and technology to drive operational excellence across multiple sites, enabling up to a **40% increase in operational efficiency**.



Image 1: Enterprise visibility

ADNOC (Abu Dhabi National Oil Company) has implemented the Panorama Digital Command Centre, which generated over **\$1Bi** in value in the first three years of operations⁴. It is a fully integrated, real-time data visualization center that empowers ADNOC's sharpest minds to gain insights, unlock efficiencies, and identify new pathways to optimize performance. This application integrates **fourteen organizations** operating within its hydrocarbon value chain (including gas processing facilities, refineries, and petrochemical plants), with over 120 dashboards displaying about **200,000 data points**. They can monitor every site and asset in several layers, with a common source of information. They monitor KPIs, predictive analytics results, planning and scheduling, and energy management, guiding their teams based on trusted information.

It generated a paradigm shift in the way they think, allowing people to be data-driven and more confident in taking action and innovating. The savings for optimizing the integrated production planning can be between **\$60 and \$100 Million from a single model run**.⁵

“The importance of embedding digital technology in businesses has never been greater and ADNOC's continuous investment in digital transformation over the last three years allows us to be more resilient, agile and responsive in navigating today's market landscape. Our Panorama Digital Command Center acts as our 'eyes on the ground' and enables speed, accessibility, and integration across our operations – key attributes that are required to make smart business decisions.”

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Abdul Nasser Al Mughairbi, Senior Vice President, Digital, at ADNOC.⁴



Image 2: ADNOC Panorama Digital Command Center

We can't predict market change, but we can certainly be ready for it!

There are many aspects of life that we can't control, so we need to dedicate time and efforts to those aspects that we can address! We can't predict market changes, but we can be ready to act fast, ensuring business continuity and safety.

Digital Transformation has always been an objective for most companies, but now it has become an essential requirement to remain competitive. A strategic digital roadmap must be designed based on a thorough understanding of an organization's own maturity level to best support business objectives and the overall business strategy. Done the right way, digital transformation acts as a business catalyst.

But don't forget, a digital roadmap must also address environmental risks. More than ever, the sustainability and business goals must be interconnected, and digital technology must be used to continually innovate and enable the solutions for sustainable growth. If you haven't started on that journey, look for guidance and real examples along with proven technology so you can accelerate the time to value.

How to start?

Take a few minutes to assess where your business is on the Digital Transformation journey. AVEVA offers a few ways to help you start:



Take our free APM Maturity assessment



Take our free Automation Maturity assessment



Digital agility forges digital resilience
Access the smart whitepaper

To learn more:



BP Revolutionizes its Oil & Gas Downstream Business with AVEVA's Solution in the Cloud



Webinar: Value Chain Optimization for Ethylene Production



Webinar: AI-Infused Value Chain Optimization: See BASF's journey optimizing Ethylene plants and find out what's next



ADNOC Maximizes Value and Improves Operations

About AVEVA

AVEVA is a global leader in engineering and industrial software driving digital transformation across the entire asset and operations life cycle of capital-intensive industries. The company's engineering, planning and operations, asset performance, and monitoring and control solutions deliver proven results to over 16,000 customers across the globe.

Its customers are supported by the largest industrial software ecosystem, including 4,200 partners and 5,700 certified developers. AVEVA is headquartered in Cambridge, UK, with over 4,400 employees at 80 locations in over 40 countries. Learn more about AVEVA at www.aveva.com.

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2. BP: Digital Transformation enables 'Magical' innovation beyond IT
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4. ADNOC's Panorama Digital Command Center generates over \$1bn in value, enables an agile response during Covid-19
5. ADNOC maximizes value and improves operations

About the author

Fernanda Martins is Sr. Marketing Manager for the chemicals industry at AVEVA. She holds a B.Sc. in Chemical Engineering from the Universidade de São Paulo and a post-graduation degree in business administration. She started as a process engineer working in big projects for refineries in Brazil.

Her career evolved around software and technology, and, in almost 20 years of experience, she has helped companies to adopt and explore a variety of transformational solutions in areas like process simulation and optimization, and workforce empowerment for enhanced operations and maintenance. Lately, she has dedicated most of her time to support companies on how to increase profitability and safety by applying technologies and concepts like unified engineering, extended reality (XR), artificial intelligence (AI), predictive analytics, and value chain optimization.