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Intelligent Midstream: Elevating pipeline safety and operational excellence

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Executive summary:

To thrive in the midst of market uncertainty, pipeline companies must reduce costs without compromising safety. The Intelligent Midstream framework enables oil and gas companies to quickly turn massive amounts of data into wisdom that generates business value. By using existing operational data as well as new data sources, companies can take a model-focused approach that puts them on the path to operational excellence. When organizations successfully execute these digital transformation strategies, teams can uncover opportunities to significantly improve equipment reliability, operational efficiency, safety, and overall business performance. This white paper will discuss how operational data management, pipeline management, and enterprise visualization create the Intelligent Midstream framework.

Introduction

Improved fracking technology created boom in oil and gas production, and that boom is driving demand for new pipeline infrastructure. Now, midstream executives must now balance many stakeholder expectations, including affordable and flexible energy, profitability, and environmental sustainability--particularly mandated decarbonization targets. Companies must strive to reduce operational costs and their carbon footprints across complex value chains, including a growing and ecosystem of stakeholders and business partners.

As a result, more companies are looking towards digital transformation to drive effective capacity, not only through CAPEX, but also OPEX investments. By using analytics to augment and empower the workforce, pipeline operators can optimize operations and improve asset availability, creating scalable business models with shorter lead time, all while swiftly responding to market changes.

Data challenges

Midstream oil and gas pipeline companies have been collecting huge amounts of operational data long before the term 'Industrial Internet of Things' (IIoT) was coined. However, turning vast amounts of raw data from SCADA, pipeline applications, ERP systems, and more into contextualized information around equipment and processes is often challenging. Contextualizing this data ultimately enables operational improvement.

However, not all data is equally useful. Not only does a wealth of raw data, devoid of context, structure, or quality, rarely pay dividends, those tasked with utilizing that data often find it difficult and cumbersome to extract insights. If users are too slow to develop and implement sustainable solutions, the company will accrue significant lost opportunity costs. When unstructured operational data builds up in data lakes, traditional IT technologies can create more problems than they solve, as businesses must spend more time wrangling data than using it to deliver business value.

Unfortunately, many companies are rushing to layer in new technologies and solutions such as cloud, machine learning, edge, IIoT, and predictive analytics before building the right data and analytics foundation. Adopting these new solutions can potentially deliver new and valuable insights, but midstream companies must first enact solid data management and analytics strategies. Deploying an enterprise-level, real-time data management platform lays the foundation for future technology success.

Operational data management is first step to transformation

To produce actionable intelligence, data must be structured and accessible to those who can best use it, particularly subject matter experts (SMEs) who have the knowledge and experience to put data insights into action.

Digital transformation success hinges on having a single source of truth for operations data. Operations data must first be standardized and contextualized before it can be analyzed and visualized.

AVEVA™ PI System™ lays the foundation for operations data integration, data validation, and analytics. PI System is an agnostic data management platform that combines, abstracts, and normalizes disparate data sources from multiple control systems and information silos into one centralized location.

A centralized operations data management platform uses standardized and templatized tag-naming conventions and assets are cataloged in a flexible hierarchy. This platform becomes an operational system of record, creating the foundation to democratize insights across any midstream business model.

Using the data model in Asset Framework (AF), the contextualization layer of PI System, companies can accelerate digital transformation by combining operational data into a digital replica of physical assets. AF also allows users to easily pivot between different asset hierarchy views.

With this groundwork, teams can make data-driven decisions around asset performance management, condition-based maintenance, environmental compliance, inventory and commercial accounting, and more.
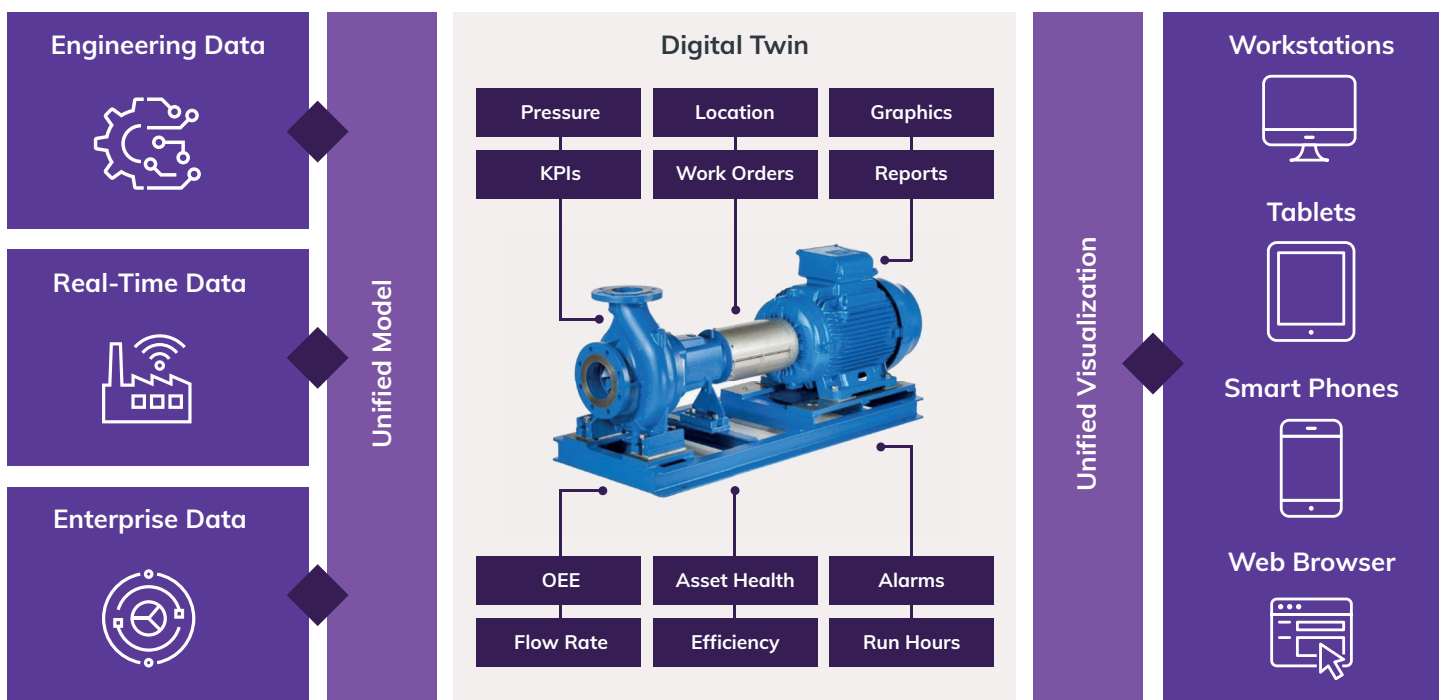
AVEVA PI System serves operational data management platform and enables single version of truth

Enterprise Pipeline Management System

For over 35 years, AVEVA has been the global market leader in pipeline management systems. AVEVA's Pipeline Management System is based on AVEVA Enterprise SCADA. The pipeline management system enables advanced analytics and simulation capabilities to deliver safe and efficient pipeline operations, leak detection, and operator training software.

The real-time process data from the pipeline management system can be fed into analytics and simulation modules with the ultimate goals of optimizing overall pipeline throughput, process conditions, and even predicting equipment failures. These analytics use advanced pattern recognition, statistical models, and machine learning technology to model an asset's operating profile and processes. Below are Intelligent Midstream use case scenarios of how companies are using data analytics on top of an enterprise pipeline management system:

Liquid pipeline operations: Advanced simulation and analytics tools can be used to model and predict fluid flows in pipeline. This not only allows product and batch tracking and line pack, but also helps uncover improvement of throughput in existing assets. This improved visibility into operations enables pipeline operators to optimize throughput. In addition, they can plan for future infrastructure expansion to increase efficiencies and throughput to improve competitive advantage.

Gas pipeline operations: Advanced simulation tools can be used to model gas flow behaviors and predict loads for current and future gas days in near real time. These insights enable pipeline operators to better balance supply and demand, optimize capacity, and better adhere to gas contracts.

Pipeline leak detection: Quickly identifying pipeline leaks is key to minimizing risks and preventing major spill overs, and many leaks go undetected by a single solution. There's no one-size-fits-all solution, and multiple detection technologies are often needed to detect different types of leaks that exhibit dissimilar flow patterns. Analytics can simulate liquids and gas flow based on Computational Pipeline Monitoring (CPM) API RP 1175 Pipeline Leak Detection and detect any subtle changes that could point to a pipeline leak.

Pipeline training simulator: Training controllers are critical for ensuring operational safety and integrity while making sure all operations are adhering to a pipeline operators' safety and compliance program. The pipeline training simulator is an operator training system that allows pipeline controllers to train on normal and abnormal operating scenarios in a safe and realistic environment. Operators can navigate actual pipeline operations and receive certifications before they assume the roles and responsibilities as a controller in a live operating environment. Major oil and gas operators have significantly reduce training costs and time to proficiency by using simulators as part of enterprise-wide training programs.

Fiscal measurement: The accurate measurement of volumes is extremely important to ensure correct and timely accounting, both internally and at custody transfer points, and midstream companies must use available data to improve accuracy.

While SCADA and production measurement software provide features to identify issues with measurement, there are opportunities to perform analytics on measurement and raw data to provide earlier indications of measurement issues.

In gas measurement software, for example, the measurement data is subjected to validation checks based on deviations, balances, prior values, timestamps, and more. This enables users to identify missing data, and lost and unaccounted for (LAUF) gas. However, this occurs after the fact and can take significant effort to consolidate.

Performing analytics in real-time means the system can analyze data for a measurement point and either automatically enable or disable validations or provide recommendations.

Autonomous control: Through analytics, expert systems, and artificial intelligence, future operational systems will become even more automated–from the scheduling through to product delivery. This level of autonomous control will be enabled by better data for operator decision making, followed by recommendations and what-if scenarios, and will gradually result in automated control during normal, and eventually abnormal, operations.

Pipeline companies are starting to make use of action sequences which allow "canned" sets of commands chained together with pre-and post-action verification to ensure the commands are executed safely and correctly.

For example, action sequences are used for:

- Emergency Shutdown (ESD) command sequences to safely and quickly stop all flow within a pipeline or a section of the pipeline.
- Pipeline Startup command sequences to repeatedly start a pipeline (starting pumps, opening and closing appropriate valves) safely and efficiently.
- Pipeline Operational Mode switches to execute changes from one safe mode of operation to another safe mode of operation.

These sets of commands can be triggered either manually or automatically by a system event such as:

- Change in a status point
- Alarm occurrence
- Another application (such as line blockage or line protection)

Utilizing pipeline data analysis to drive actions using a rule-based approach can enable pipeline companies to improve outcomes when performing operations where timing of the actions is critical.

For example, when changing the mode of operation for liquids pipelines with sharp changes in elevation, the timing of pump and valve changes avoid problems, such as cavitation. Rather than relying on operator reaction to the data being presented, system analysis of the data can trigger the next action sequence more efficiently and effectively.

Intelligent Midstream is based on data-driven operational decision-making. This can be enabled by developing a digital twin of the entire system using information such as drawings, 3D models, materials, engineering analysis, dimensional analysis, real-time pipeline data, and operational history.
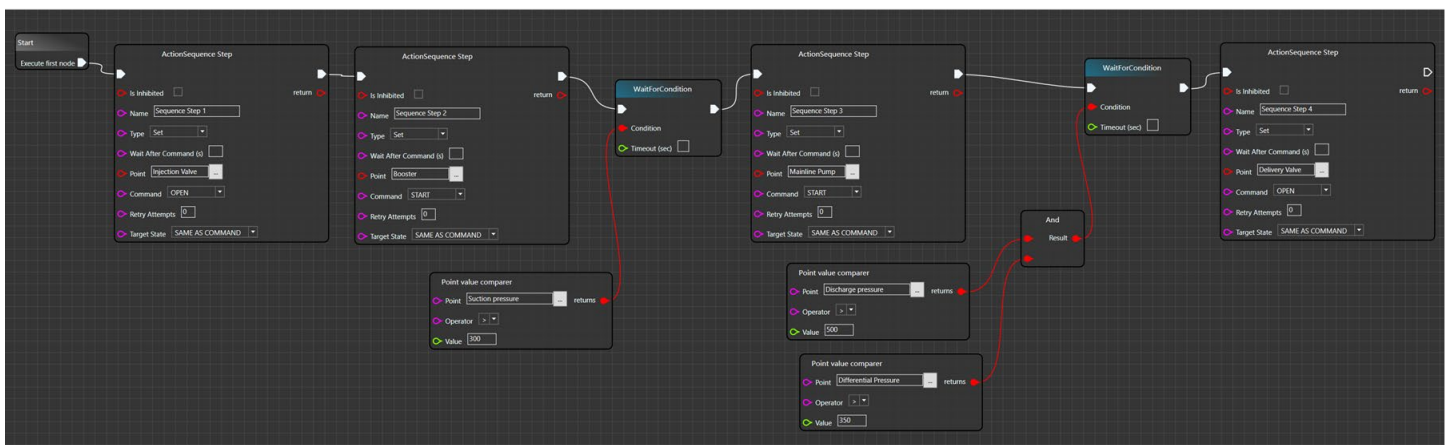
AVEVA Enterprise SCADA offers Action Sequence Engine to automate complex pipeline operations
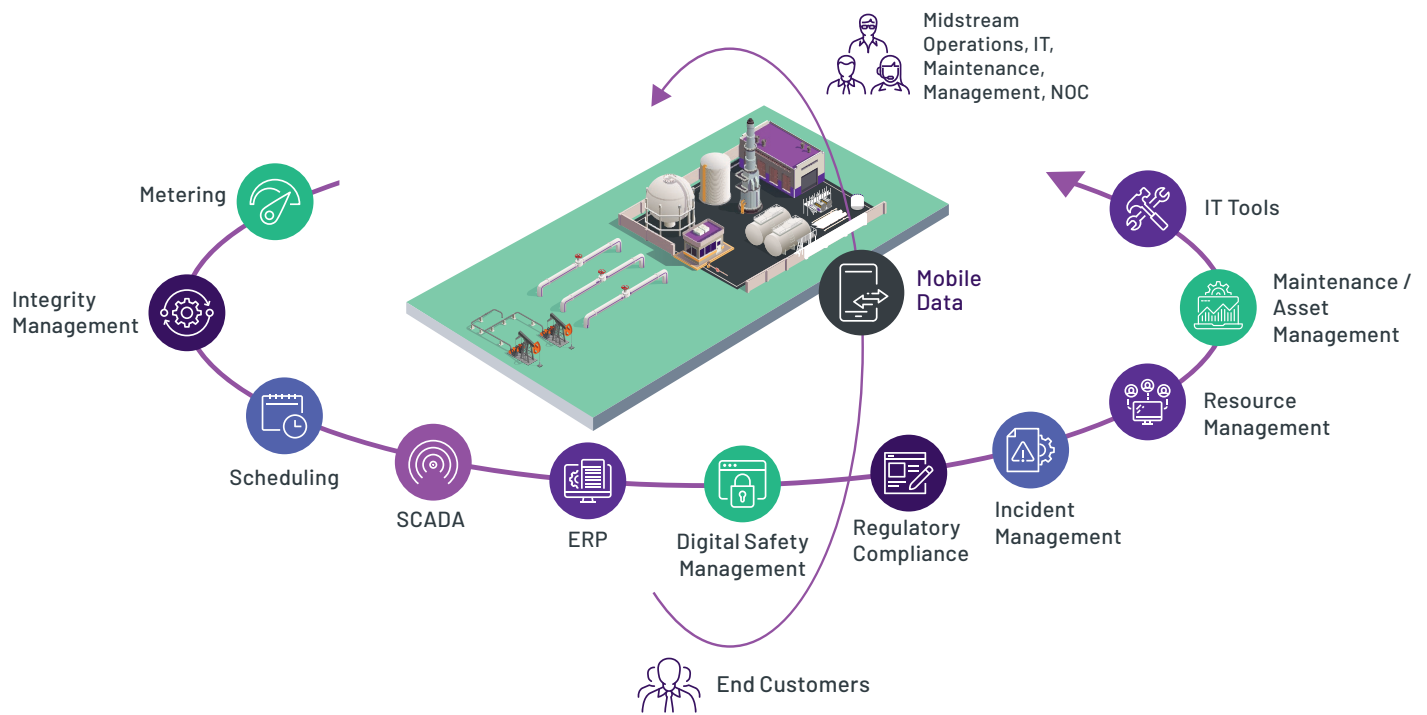
Unified Operations Center for Midstream

During the operational life cycle, the digital twin is updated automatically, in real time, with current data, work records, and engineering information, to optimize maintenance and operational activities. Engineers and operators can easily search the asset tags to access critical up-to-date engineering and work information in order to diagnose the health of a particular asset.

Previously, such tasks would take considerable time and effort, and issues were often missed, leading to failures or pipeline outages. With the digital twin, operational and asset issues are flagged and addressed early-on and the workflow becomes proactive instead of reactive. Midstream companies can easily benchmark operational performance, such as pipeline throughput and energy consumption, to uncover gaps and improve pipeline efficiencies.

Unified Operations Center for midstream is based upon a system of systems approach that converges OT and IT technology into a single pane of glass solution. In this solution, contextualized, actionable information provides an overall perspective into oil and gas transportation management as well as the sub-systems that manage specific areas, such as pipeline operations, supply chain, regulatory compliance, maintenance, safety systems, and workforce status.

Metering

Integrity Management

Scheduling

SCADA

ERP

Digital Safety Management

Regulatory Compliance

Incident Management

Mobile Data

Midstream Operations, IT, Maintenance, Management, NOC

IT Tools

Maintenance / Asset Management

Resource Management

End Customers

UOC for Midstream serves as Enterprise Visualization and enables IT/OT convergence for all pipeline operations

Conclusion

The oil and gas midstream is under tremendous pressure to continually improve operational safety, adhere to constantly changing regulatory requirements, and increase agility to succeed in a rapidly changing business climate, and meet global sustainability goals.

This intelligent midstream strategy enables companies to create new capabilities, new business models, and innovate ahead of the competition. By deploying information management systems, powerful analytics, automation of workflows, and driving behavioral change in workforce, oil and gas companies can evolve and change how work is performed to build a sustainable, profitable organization.

About the author

Omer Qadri is the HMI SCADA product marketing manager at AVEVA. He has over 15 years experience in industrial automation software. He is passionate in advocating the use of digital tools to help companies improve operational efficiency.

For more information about Intelligent Midstream please visit aveva.com/en/industries/oil-gas/ transportation-pipelines/

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