WHITEPAPER

Digital Pipelines 4.0 – Elevating Pipeline Safety and Operational Excellence

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Executive Summary:

To sustain and thrive in uncertainty, reducing costs without compromising on safety performance is imperative for pipeline companies. The Digital Pipelines 4.0 framework enables operational excellence by helping oil and gas companies take a model-focused approach that quickly turns massive amounts of data into wisdom that generates business value. Leveraging existing operational data, as well as, new data sources available as part of a Digital Transformation, if well executed, will provide great opportunities for companies to significantly improve business performance in terms of equipment reliability, operational efficiency, product quality and safety performance. This white paper will discuss the approach to leverage data, simulation and analytics in a Digital Pipelines 4.0 Strategy elevating pipeline safety and operational Excellence to the next level.

Digital Pipelines 4.0

Introduction

Improved fracking technology is creating an unprecedented boom in oil and gas production, driving demand for new pipeline infrastructure. As pipeline operators earn revenues from transporting oil and gas on their pipelines either for a fee or through crude differentials, the strong volumes are driving unprecedented profits for their operations in the recent years. However, any favourable market climate for encouraging investment in new pipeline capacity may adversely affect supply-demand equilibrium down the road. Compounding the business risks, the negative perception of fossil fuels, increasing scrutiny of new pipeline projects due to environmental concern and rising trade tensions are adversely affecting not only business costs but also fossil fuels demand in the coming years. To sustain and thrive in uncertainty, reducing costs without compromising on safety performance is imperative for pipeline companies.

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 drive optimised operations and improved asset availability as these are more scalable and have a shorter lead time, enabling them to swiftly respond to market changes.

Midstream Data Challenges

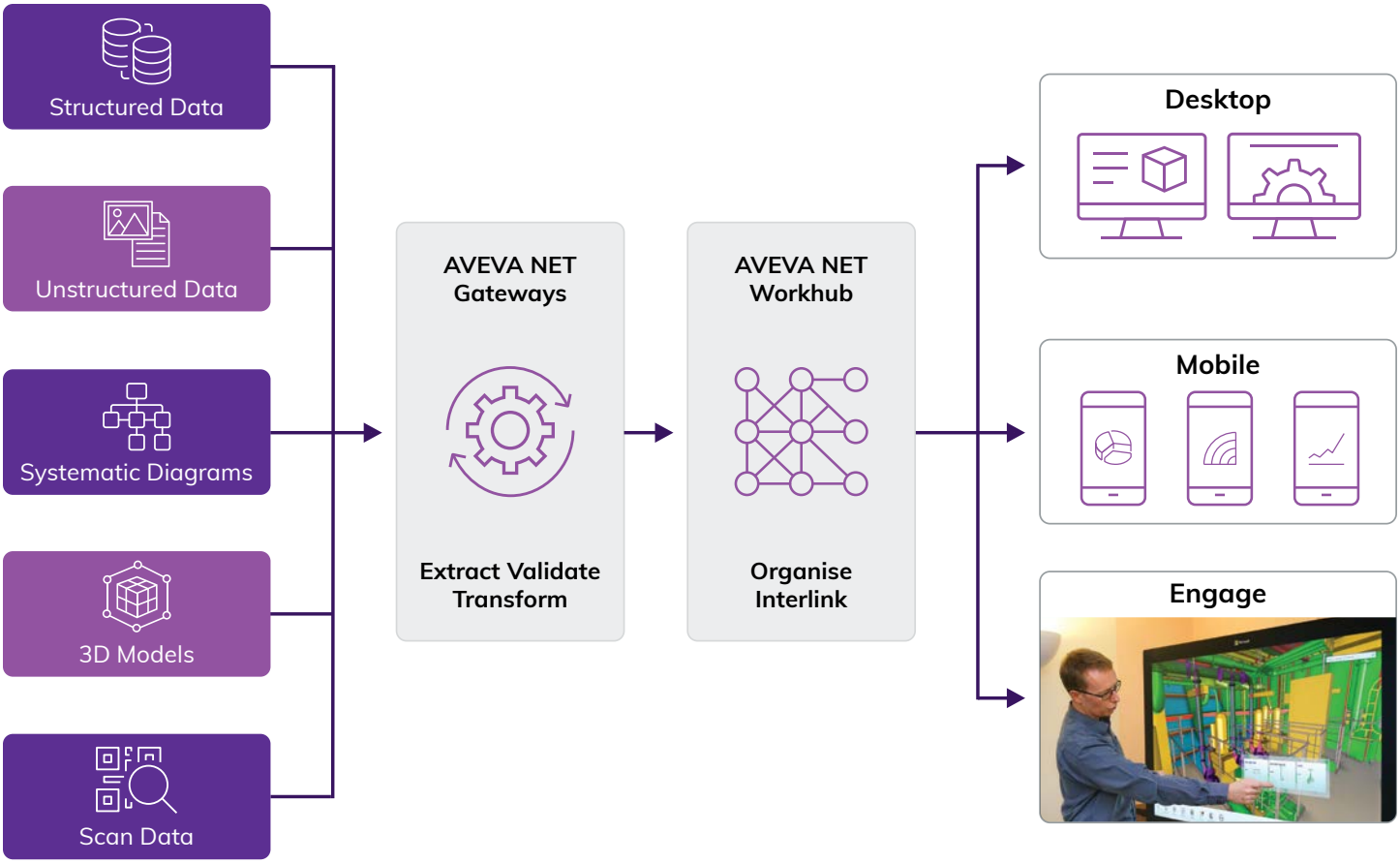
Midstream Oil and Gas pipeline companies have been collecting huge amounts of operational data – from SCADA to Pipeline Applications, to ERP systems and others, long before the Industrial Internet of Things (IIoT) term was coined. However, turning that vast amount of raw data into contextual information around equipment and processes for operational improvement was often challenging due to technology limitation in the past. However, with the advancement in technology in recent years – cloud computing, analytics and Artificial Intelligence – plus greater clarity on the use cases, companies are starting to realise the benefits that digital tools enable from unprecedented real-time insights of their operations, to elevating their operational excellence to the next level. Leveraging existing operational data, as well as, new data sources available as part of a Digital Transformation, if well executed, will provide great opportunities for companies to significantly improve business performance in terms of equipment reliability operational efficiency, product quality and safety performance. For instance, a 0.1% increase in throughput due to improved pipeline uptime and operating efficiency can easily yield several millions of dollars in additional revenue.

First steps to enable Digital Pipelines 4.0

A digital twin is a complete 360-degree replica of a physical asset, such as pipelines, gathering systems, heat exchangers, turbines, pumps, compressors or entire facilities that enables analytics and Artificial Intelligence (A.I.) to model the process and control while monitoring the equipment health. It is the foundation of a digital transformation that optimises pipeline throughput, detects equipment problems before failures occur, uncovers new opportunities for process improvement, all while reducing unplanned downtime.

At the engineering phase, a 3D model is created that allows multi-disciplinary teams to interact with the data visually. This model is then tagged with all the necessary attributes and engineering documentation – such as geometry, layout, connectivity of key components and process data, and other business and safety-critical engineering and design information. Through a robust information gateway, information and data around the asset are extracted from disparate data sources and validated for accuracy against known standards to create viewable renditions of documents and drawings. This acts as a data validation layer to ensure that all data meet the correct standards throughout the asset lifecycle.

With the unified data-centric models, engineers are empowered with the ability to visualise the downstream impacts of their actions when they make design changes during the project execution. As a result, it eliminates information silos and reduces the design cycles through improved collaboration and change management process.



AVEVA NET gateways provide the interface to the source data

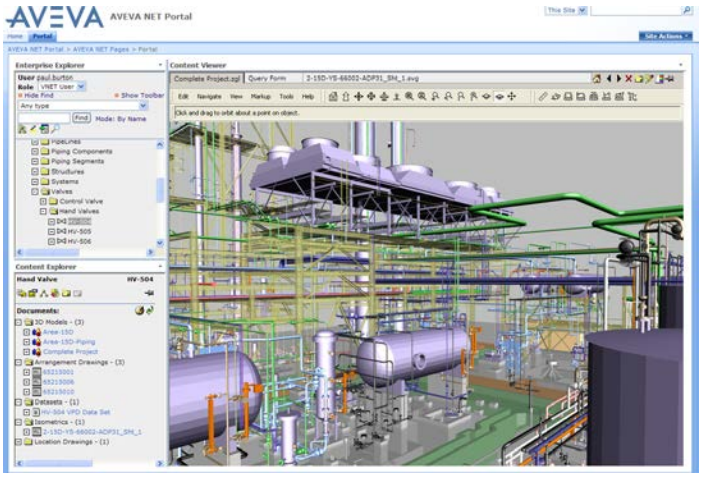
A good illustration is the data-centric engineering and design platform deployed by Aibel[1] that facilitates collaboration across multiple offices, enabling them to deliver the Johan Sverdrup offshore platform on time and under budget. Aibel is a leading service company within the upstream oil and gas industry. It delivers customized turnkey solutions for engineering, construction, modifications and maintenance, operating out of nine offices spread out across Europe and Southeast Asia.

Next, these common set of data and information are shared across departments – from engineering, to procurement, to construction, to commission, and to operations.

Empowering field operators to better interface with machine

As the operational life continues, the digital twin is updated automatically, in real time, with current data, work records, and engineering information, to optimise maintenance and operational activities. With this, engineers and operators can easily search the asset tags to access critical up-to-date engineering and work information, diagnose the health of a particular asset. Previously, such tasks would take considerable time and effort, and would often lead to issues being 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 preventative, instead of reactive. Benchmarking of operational performance such as pipeline throughput, energy consumption and others can be easily performed to uncover gaps and improve pipeline efficiencies.

A good illustration is the ADNOC's Panorama Digital Command Centre[2] that provides operational visibility across the entire hydrocarbon value chain – from exploration to distribution of products, breaking down information silos and providing real-time operational insights based on a single, trusted view. This not only improves operational efficiencies, but also uncovers new pathways to optimise performance.



3D visualisation of assets using a single, integrated source of up-to-date, trustworthy information

Digital Pipeline 4.0: Enabling Analytics and Simulation

The real-time process data from the digital twin, in turn, can be fed into analytics and simulation with the ultimate goals of optimising overall pipeline throughput, process conditions and even predicting equipment failures ahead of time. These analytics leverages advanced pattern recognition, statistical models and machine learning technology to model an asset's operating profile and processes. Relevant data is then transformed into useful contexts with decision support, empowering workers to make technical decisions on-the-fly to improve uptime of pipeline throughput and to optimise operating conditions.

With the advancement of analytics in capturing and preserving higher-fidelity data for more accurate models of real-world pipeline operations, this, in turn, enables the expansion of more predictive applications:

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

Gas Pipeline operations: Advanced simulation tools can be used to model gas flow behaviours that enables pipeline operators to better balance supply and demand from insights into predicted loads for current and future gas days in near real time. This not only helps optimise capacity but also enables better adherence to gas contracts, thus improving return on assets.

Pipeline Leak Detection: Analytics can be used to simulate liquids and gas flow to detect any subtle changes based on Computational Pipeline Monitoring (CPM) API RP 1175 Pipeline Leak Detection that could point to a leak in pipelines. Multiple detection technologies to improve leak detection – no one size fits all - is often necessary to pick up different types of leaks that may exhibit dissimilar flow patterns and go undetected under a single technology. Identifying pipeline leaks quickly is key to minimising risks, preventing major spill overs in the event of pipe leakage.

Pipeline Trainer: Training controllers are critical for ensuring the safety and integrity of pipeline operations are maintained at all times and adhering to a pipeline operators' safety and compliance program. Pipeline Trainer is an Operator Training System (OTS) that allows pipeline controllers to train on normal and abnormal operating scenarios in a safe and realistic environment for operator qualification. Based on dynamic simulation replicating actual pipeline operations, operators can be trained on procedures to address real experiences in a safe and controlled classroom environment before they assume the roles and responsibilities as a controller in a real-time operating environment. Major oil and gas operators have already reaped significant benefits using simulators as part of their enterprise-wide training programs, enabling them to significantly reduce training costs and time to proficiency.

Predictive analytics to monitor equipment health: Predictive analytics enables modelling of rotating equipment performance – such as pumps and compressors – using advanced pattern recognition and machine learning algorithms to identify and diagnose any potential operating issues, days or weeks before failures occur. Operating models including past loading, ambient and operational conditions are used to create a unique asset signature for each type of equipment. Real-time operating data is then compared against these models to detect any subtle deviations from expected equipment behavior, allowing reliable and effective monitoring of different types of equipment with no programming required during setup. The early-warning notification allows reliability and maintenance teams to assess, identify and resolve problems, preventing major breakdowns that can cost companies millions of dollars in production slowdowns or stoppages.

Digital Pipelines 4.0 is not just about Technology

In a recent MIT Sloan Management Review article[3], George Westerman said, "Technology doesn't provide value to the business. Instead, technology's value comes from doing business differently because technology makes it possible."

Digital transformation allows companies to create new capabilities, new business models, and innovate ahead of their competition. It is a journey through deployment of information management systems, powerful analytics, automation of workflows and work orders, and driving behavioral change in workforce – changing when, where, which, and how work is performed and evolved.

Although digital transformation may seem like a daunting task to some, making the transition successfully can be profoundly rewarding for pipeline companies, since even slight improvements in asset utilisation can result in huge gains in revenue and cashflow.

Conclusion

The Digital Pipelines 4.0 framework enables operational excellence by helping oil and gas companies take a model-focused approach that quickly turns massive amounts of data into wisdom that generates business value.

These powerful data insights mean asset failure can be predicted, hidden revenue opportunities can be uncovered.

References:

1. https://sw.aveva.com/hubfs/assets-2018/pdf/success-stories/SuccessStory_AVEVA-Aibel.pdf
2. https://sw.aveva.com/success-stories/adnoc
3. MIT Sloan Executive Education, Nov 2017. 'Digital is not the answer—transformation is'. Retrieved from https://executive.mit.edu/blog/digital-is-not-the-answertransformation-is

About the Author

Eddy Lek, Industry Marketing Manager, AVEVA, is responsible for expanding awareness and marketing of its engineering and design, simulation, training, analytics and advanced control software in the Oil and Gas Industry. He is passionate in advocating the use of digital tools to help companies improve operational efficiency. He has more than 15 years of experience in product management, marketing, business development and application consultation in process and industrial automation including controls, sensors, instrumentations and industrial software. He holds a Bachelor of Engineering from Nanyang Technological University and a Master's in Business Administration and a Graduate Certificate in Management of Business Analytics Project from National University of Singapore.