



Paradigm k

Paradigm™ k, a native Cloud application: Oilfield automation through incomparable performance

- The Oilfield – reservoir, overburden and the surface facilities—is modeled mathematically with situational physics as one entity
- k, a native Cloud-based application capable of monitoring, processing and interpreting large volumes of data “at rest” (archived) and “in motion” (live data from sensory devices) in real time
- History matching in real time without human intervention (built-in Artificial Intelligence) by honoring all measured data from permanent and episodic sensors, in particular, from a Multiphase Flow Meter
- The model of the Oilfield evolves in real time, garnering predictive capacity, with each update from the history matched data
- At any point in time, k may be triggered to run in predictive mode to give the Oilfield production forecast
- Data history: the user may select a point in time (past or future), causing display of production data corresponding to that time

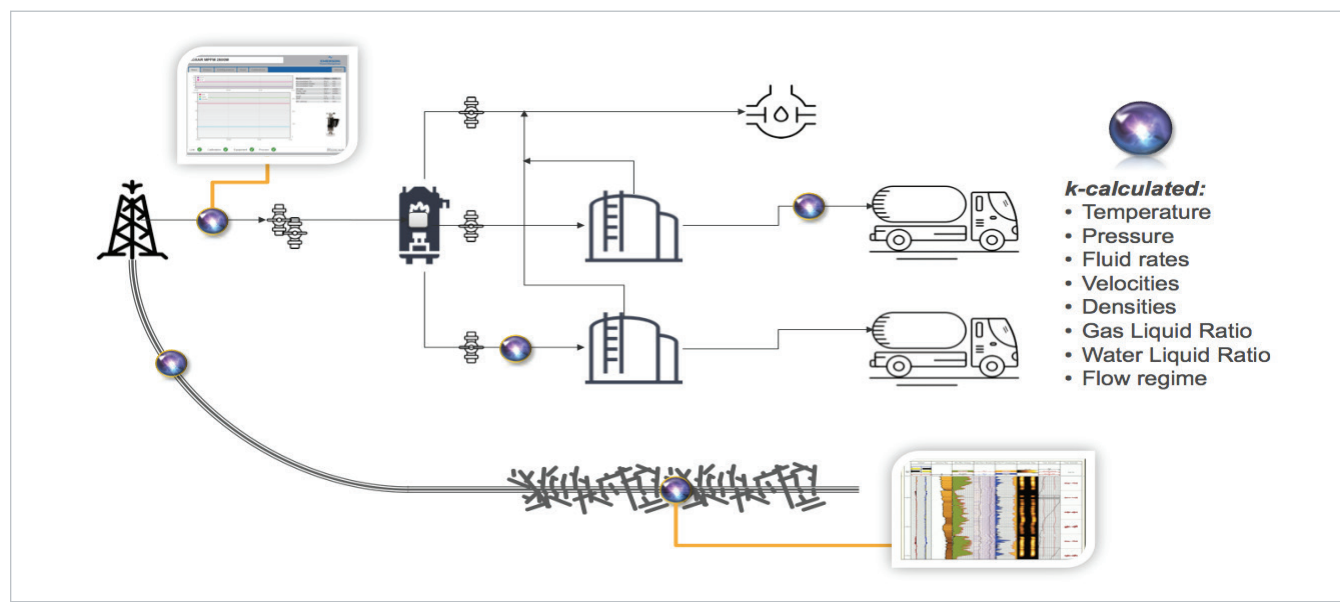
enhance the operational efficiency of an Oilfield comprising hundreds of wells, while optimizing asset performance across the full life cycle of a well. **k** is a fully automated system in the Cloud that offers a holistic solution encompassing a myriad of activities that are central to Oilfield operational efficiency. The system also includes an optional Edge-component that connects directly to a Multiphase Flow Meter (MPFM).

Central to **k** is Phoenix, a hybrid Oilfield simulator of incomparable performance. Taking advantage of the situational physics of the formation, Phoenix mathematically models the Oilfield as one entity on economical Cloud and Edge computational systems. Combined with built-in Artificial Intelligence (AI), Phoenix enables automation of optimization and history matching, leading to diagnosis and prognosis. The model of the Oilfield evolves in real time, garnering predictive capacity with each update from the history-matched data.

The Oilfield consists of three constituents: the reservoir, overburden, and surface facilities. The primary objective of **k** is Unconventional Oilfield Automation by harnessing Internet of Things (IoT) solutions. The **k** IoT, in this context, consists of four horizontal layers of core services: permanent and episodic sensing, archival in a data history, cloud computing and Oilfield simulation. These services are vertically combined to achieve solutions that create a Digital Twin of the Oilfield.

k seamlessly connects real time data from sensors to simulation and analytics, and through which anticipates events to immensely

Phoenix is coupled with a resourceful and efficient IoT system that is capable of reading from sensory devices, processing and analyzing large volumes of data “at rest” (archived) and “in motion” (live data). **k** continuously receives, interprets and diagnoses data “in motion” to anticipate and identify events. In doing so, it enables evocative decisions such as the need for optimal completion design, initiation of gas injection for maximum production, automatic calibration of the subsurface, and continuous updating of optimal gas injection during the entire life of producing wells.



▲ **k** connected to a MPFM can generate virtual measurements at any location in the Oilfield, including details like flow regime, phase fractions.

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k-Connect

k is enriched with its native collaboration tool for communication, knowledge sharing and asset management. Coupled with real-time surveillance, users can register to receive and share real-time notifications of field assets alarms and events. **k-Connect** leverages user knowledge, real-time data, and key meta-tags to achieve reduced downtime and quick response time.

Example Applications

Completion design and optimization: Fast, forward simulations may be performed to optimize completion design based on reservoir quality and economics.

Gas injection planning: The Oilfield simulator Phoenix, which takes into account both the wellbore and reservoir behavior, enables Gas Lift optimization at any time during the life of the well.

Combined choke strategy and artificial lift optimization:

k enables simultaneous optimization of the entire Oilfield to arrive at a production control strategy for the well.

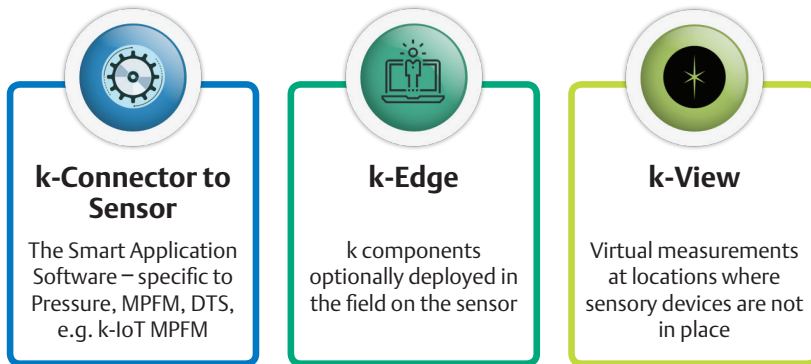
Assessing the true nature of the subsurface model

throughout the life of the well: Having obtained a mere 30 days of production data, k will start to provide information on the subsurface characteristics via AI-boosted automatic History Matching, highlighting any substantial changes to the Oilfield, e.g. fracture or reservoir permeability changes due to neighboring well activity.

Recalibrating choke strategy and gas lift after history match

to predict reservoir producibility: k will, within 30 days of the start of production, automatically reveal the true signature of the reservoir, thereby enabling recalibration of optimal production strategy very early in the life of the well. The task may be automatically recalibrated on a weekly or monthly basis.

k IoT-Solution for Oilfield Sensors Pressure, MPFM and Fiber Optic DTS

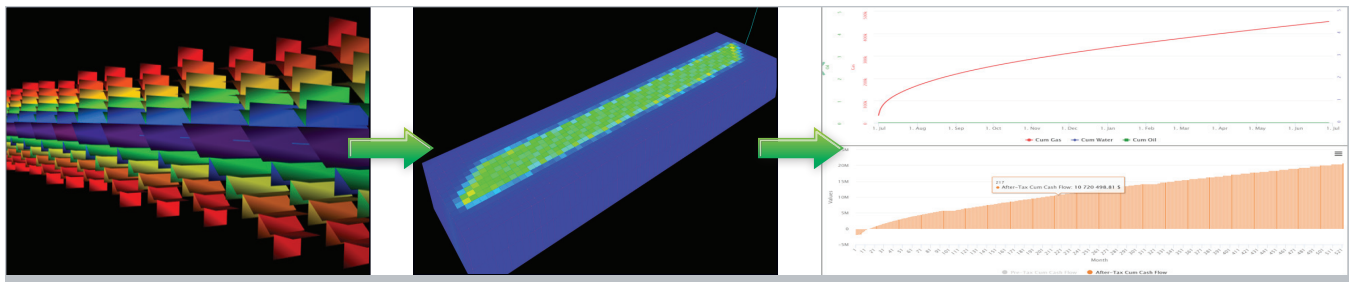


A by-product: Sensory measurements offer an alternative to a costly production-logging tool (PLT) campaign. By simply dragging the k-View from heel-to-toe of the horizontal well bore a virtual PLT response may be constructed.

System Requirements

k is a native Cloud solution and can be run on any Cloud, whether private, public or hybrid. The system requirements can be satisfied with an economical Cloud instance with any vendor, e.g. generic compute-optimized instances in AWS, GCP, Azure or any mid-sized Cloud vendor. It can also be tailored to provide an in-house private Cloud solution.

▲ k provides an IoT solution when connected to sensors; whether at the surface or downhole.



▲ k has been specifically designed and optimized for shale oil and shale gas reservoirs.



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