Flow assurance means different things to different people. To some it can resemble the oilfield version of Roto-Rooter, unblocking wells, tieback lines and jumpers, gathering stations and risers of production-robbing deposits of paraffin, scale or hydrates. Others value a more proactive approach, whereby data monitors are used to feed into dynamic production models that, among other things, enable prediction of flow problems in sufficient time to take mitigating action.

Because the conditions that impede flow are so diverse and pervasive, there is no “one-size-fits-all” solution. Sometimes, the answer is a chemical treatment, other times there is a mechanical solution. Insulating flow lines to preserve flow stream temperature can solve the problem, or perhaps it will be necessary to boost flow line temperature using heating elements. Sometimes a combination of these remedies fills the bill.

Traditional approach is flawed

The traditional approach of flow assurance systems selection for prevention and remediation that combines sampling, laboratory techniques and predictive modeling, is a one-way process. Often this takes place during front-end engineering and design of the well or the production systems. However, without a closed-loop process that provides continuous feedback and analysis results will be suboptimal. Fortunately, the very techniques that support continuous flow assurance also benefit effective reservoir management and production optimization.

Toward a more permanent solution

Unfortunately, many flow assurance techniques are prescriptive in nature, seeking to solve an immediate problem. While effective technology is quite advanced in this area, it is postulated that to transition from a reactive mode to a proactive one requires appropriate and timely information. Only through systematic data gathering can trends affecting flow efficiency be identified and mitigating prognoses be developed. Happily, much of the data gathered for dynamic flow assurance is also used in reservoir and production management, leading to ultimate production optimization. Accordingly, the data acquisition required for flow assurance fits into a continuum or loop that benefits the overall asset management team.

The heart of effective flow assurance management is consistent fluid property data. The validity of these data is ensured by sample integrity and traceability throughout the entire data collection and analysis process. Instrumentation installed throughout the flow stream feeds a comprehensive suite of robust predictive models for organized solids deposition, corrosion, waxy crude rheology and thermodynamic modeling. Measurements, such as distributed temperature and multiphase flow parameters, improve and refine the accuracy of these models in real time.

The result is an effective closed-loop process, using fluids data, predictive flow models and real-time measurements. This loop drives the optimization of remedial strategies and must be included as early as possible into the design of a flow assurance system.
**Flow Assurance**

![Diagram](https://example.com/diagram.png)

**Figure 2.** The challenge of flow assurance is to find the optimum treatment. Between the reservoir and the production platform, changes in temperature and pressure can create deposits of asphaltenes, waxes and hydrates or cause gas to come out of solution. Possible remedies such as chemical injection, pressure boosting, heating or insulation can have counteracting effects. Only through accurate continuous data monitoring can the correct combination be applied to maintain flow.

The value of real-time data monitoring and system control. A key node is the wellhead interface. There is no doubt that new designs can incorporate the additional features needed to enable required data gathering. However, such a design could be excessively complex and not easily retrofitted to existing assets.

A new modular open architecture "plug n’ play" module has been developed that can link all well monitors and controls with surface and flow line sensors. Called the Subsea Monitoring and Control (SMC) system, it incorporates the intelligent well interface standard (IWIS) so instrumentation and control modules from any supplier can interface seamlessly. The module fits on a subsea tree and can be deployed and retrieved when necessary using a remotely operated vehicle (ROV) without interrupting production. The system accommodates real-time production monitoring and control systems including those with fiber optic communication or distributed temperature sensors. It also supports data streams from monitors in downstream nodes including subsea flow boosters or flow line heaters. With real-time system surveillance, the entire production network can be optimized.

In addition to production optimization, flow assurance can be supported using the data to predict potential bottlenecks and schedule remedial actions, from changing the rate of methanol injection to planning a comprehensive workover. Optimization of production equipment such as gas-lift or electrical submersible pumps (whether installed downhole or as subsea boosters) can be facilitated using the SMC. Not only can these systems be kept running at maximum efficiency, but scheduled maintenance and refurbishing can be conducted when it creates the least disruption. Thus production and flow assurance are effectively linked by the SMC module, which is both part of the data gathering function and the solution implementation.

When monitoring and control data exist in a closed-loop dynamic production management decisions and analysis are enabled, providing an optimization path that leads from pore to process.