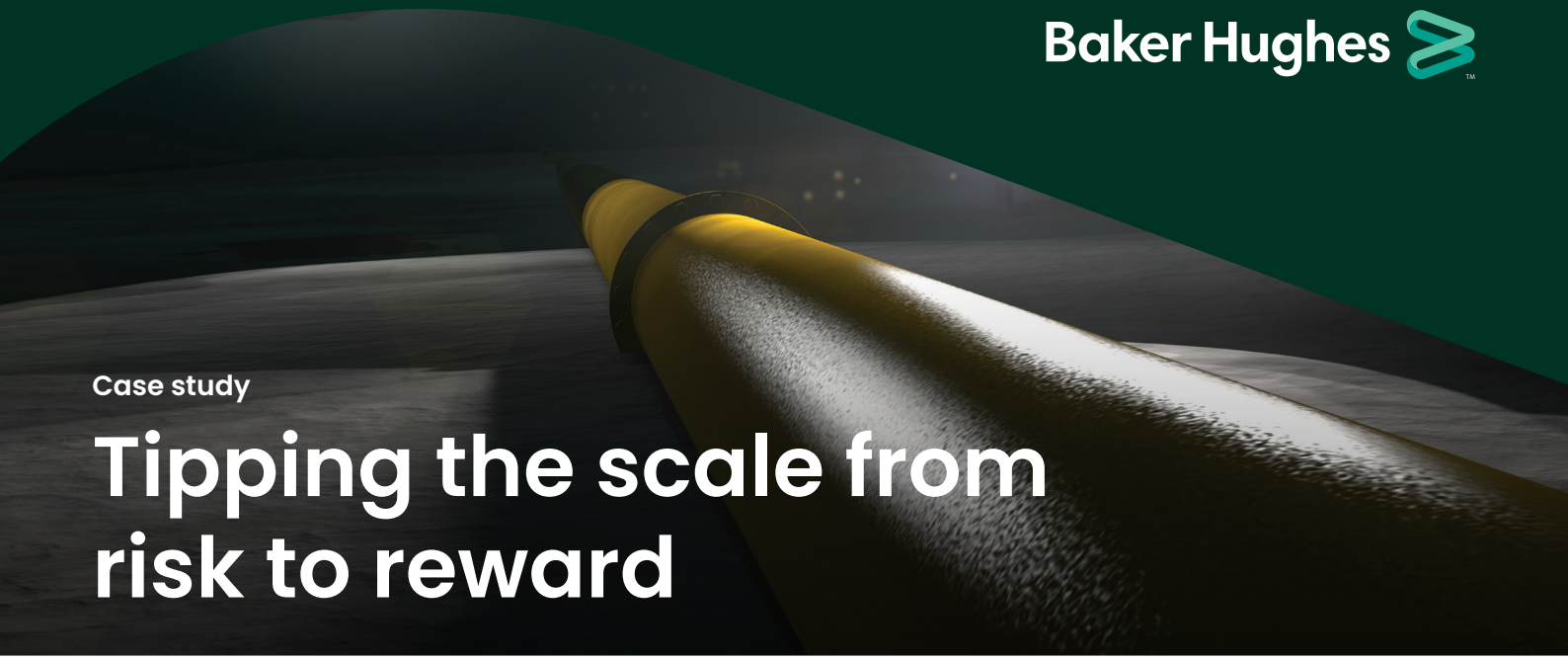

Case study

Tipping the scale from risk to reward

Challenge

It's generally accepted across the pipeline industry that a quantitative, risk-based approach to integrity management is the best way to protect the safety and productivity of oil and gas pipelines. But successfully setting up the appropriate system is a complex task that discourages many operators from proceeding.

Solution

Baker Hughes worked closely with this customer to create both the technical infrastructure and the committed data culture within the organization to successfully quantify risk and improve decision-making by all business functions, for all its onshore and offshore pipelines.

Benefits

During setup, we helped deal with a number of red flags, including mechanical and corrosion risks, and identified several improvements to their Emergency Pipeline Repair System. In total, our PVi PIMS has reduced their annual inspection costs by 31%, and users throughout the organization are committed to its long-term upkeep.

How Baker Hughes helped one customer overcome the daunting task of creating and running a highly effective, risk-based, pipeline integrity management system

Challenge

Pipeline integrity management comprises all the activities required to prevent pipeline failure. An operator's ability to make informed integrity management decisions will depend primarily on its ability to assess and prioritize risk, which is a function of the probability of failure (driven by the nature of threats and how they change over time), and the consequences of failure (driven by safety, environmental, and financial impacts). To that end, a risk-based pipeline integrity management system (PIMS) is intended to help efficiently allocate operational and maintenance resources — to avoid failures and minimize consequences.

The typical cycle of activities for a risk-based PIMS includes:

1. Data gathering, verification, formatting, and analysis
2. Identification of integrity threats and failure consequences
3. Risk assessment and ranking
4. Prioritized integrity assessment
5. Repair, remediation, and prevention measures
6. Planning for continued integrity management

The typical cycle of activities for a risk-based PIMS is generally accepted to be logical and valuable, yet many pipeline operators still don't use a robust PIMS to effectively manage resources and protect their assets. For some, the workload is thought overwhelming or the cost too high. Others make the initial investment, but personnel limitations or employee turnover makes it difficult to properly maintain in the long term. A number of vendors sell software packages, but pipeline integrity expertise is typically beyond their support capabilities, so the systems often get used to limited effect or they are abandoned out of frustration.

One of our customers saw clear value in a quantitative risk-based PIMS, but they also understood the challenges. They asked for our help in creating a system that could quantify risk in a way that can be consistently utilized by all business functions, and objectively acted upon by decision makers regardless of personnel turnover, organizational changes, or growth of their network — which currently includes around 280 miles of piggable and unpiggable pipelines, both onshore and offshore.

Solution

Instead of just implementing software and then walking away, we stayed with our customer's team to implement every aspect of the system into their organization. Most of the work was technical and procedural, but there was also a surprising cultural component that turned out to be crucial.

At the heart of the PIMS is PipeView™ Integrity (PVi), a suite of proven software tools designed specifically to manage, evaluate, and cohesively report on all the different data collected for pipelines. We had completed several magnetic in-line inspections for this client through the years, so most of that data was already formatted for PVi. But there was also a lot of data from other vendors and inspection techniques that had to be properly formatted and loaded into the system.

Next was the critical task of data alignment—accurately positioning all the existing data sets based on the pipeline centreline created in our GIS software. This was quite a complex undertaking because of all the different vendors, technologies, and reference points that the customer has used over time. In fact, the alignment process is a big pain point for most operators, and they typically have difficulty getting it right without specialized technical support. In this case, the customer has used four vendors for major inspections, and many more smaller vendors for localized inspections. Formatting and aligning all this data was a big job.

From there, pipeline segments were grouped into managed segments by function (e.g., platform piping, riser, safety zone, main line, shore approach, onshore, etc.). These were subdivided as dynamic segments, or lengths of pipeline where the attributes that feed the risk models are homogeneous (e.g. diameter, wall thickness, pipe material grade, coating type, etc.). Risk values were calculated at the dynamic segment level, and their risk results were rolled up to managed segments for reporting purposes.

The result is a single, convenient dashboard that enables visualization and analysis of everything recorded about the pipeline network. This brought the project up to the two-year mark—so it's no wonder that most pipeline operators find the idea daunting.

Creating a culture for change

In the beginning, we encountered some difficulties getting complete and timely data from the many different gatekeepers across the organization. Keep in mind that there were a dozen distinct pipelines with a 20-year age spread among them. There were various historical operating silos, different communication and reporting norms across departments, etc. Some people were worried about impacts for their departments or jobs. Others thought it was 'just a corporate program' that couldn't impact work in the field. All in all, there was low employee commitment.

Truth be told, if implemented according to plan, this system would indeed change the way everyone in the company thought and acted regarding pipeline integrity. We've learned through our own big organizational changes that communication is the key to employee commitment. To that end, we organized stakeholder-engagement meetings to clarify how each department's data would interact to enable the overall system. As soon as they saw the analysis and reporting functions in action—and the errors and limitations created by missing information—they were all on board. We repeated these meetings at regular intervals to keep everyone engaged throughout the process and ensure that the PIMS was addressing all their needs.

Benefits

The software requires nearly 100 attributes to carry out the baseline risk assessment—but results won't reflect the real situation if conservative default values are used for risk calculation. For example: a red flag went up due to high external corrosion risk for a section of pipeline between two subsea end manifolds. Our investigation found that there was no cathodic protection (CP) data available for this segment, even though it had been surveyed a year ago by a third-party supplier. The non-conformance concern was raised with the inspection company, and this segment was logged for special review during the next inspection campaign. Meanwhile, we assessed CP readings from adjacent anodes and the anode condition trend, and concluded that CP status was satisfactory.

Risk estimates were also elevated because of a high consequence of failure, driven primarily by the cost of long repair times required to bring these lines back into service after a loss of containment—even though there was an Emergency Pipeline Repair System (EPRS) in place. We followed up with a gap analysis of the EPRS, and identified several improvement opportunities for ancillary equipment, vessel call-off contracts, operational planning, etc. The customer assigned an EPRS expert to close these gaps so they'll be able to respond and resolve offshore failure events much faster.

PVi's Integrity Management Planning module greatly simplified cost-benefit analysis, enabling the client's management team to discuss pros and cons from safety, environment, and cost perspectives, and select the mitigation measures to be included as key performance indicators moving forward.

A second network-wide risk assessment was subsequently performed with updated data, which significantly improved risk values. Assessments are now repeated at regularly prescribed intervals, and we have a dedicated PIMS specialist on contract with the customer's team to continue honing integrity capabilities throughout the organization.

The system has now been in place for several years, and it is paying off. A loss-of-containment shutdown cost for one of this customer's 30" pipelines was estimated at $1.2 million USD per day for 30 days—or $36 million USD in total. By contrast, the cost of maintaining our PIMS for an offshore pipeline for an entire year is only 1% of that LOC estimate. To be conservative, even if two typical preventative repairs were included through the year (e.g. free span rectification and clamp), the full annual cost would be only 5% of the LOC estimate. What's more, thanks to the solid risk-based planning foundation established with PVi PIMS, the customer's actual annual inspection costs have been reduced by 31%.

Reduced cost: inspection optimization

Before PipeView™ Integrity PIMS	% of annual budget*
2 ROV inspections every 5 years	45%*
1 in-line inspection (ILI) every 3 years	13%
	58%
After PipeView™ Integrity PIMS	**% of annual budget***
1 ROV & 1 acoustic every 5 years	29%
1 ILI every 5 years	8%
PIMS activities (data analysis, risk assessment, etc.) and software maintenance	3%
	40%
Savings from PVi PIMS-based inspection program	**31% lower costs**

*Based on budget for a 60 km pipeline with 30 in. diameter

Baker Hughes