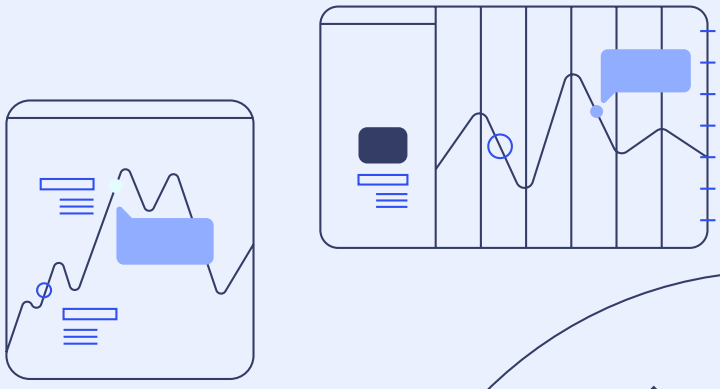
Drilling into the data

The transformative potential of visual data science for exploration and production in the oil and gas industry



Spotfire™

From price fluctuations to shifting geopolitical risks and changing regulations, few industries face the level of complexity and volatility seen in the global energy sector. For individual oil and gas companies, tackling these challenges demands constant adaptability and foresight—a requirement compounded by the industry's long, complex asset life cycles and high operating costs.

At the same time, opportunities to become more efficient and strategic proliferate. New technologies, especially artificial intelligence (AI), promise an era of rapid advancement. This progress is supported by the increasingly high-resolution data produced by complex Internet-of-Things (IoT) systems, as well as the terabytes of geological, seismic, and production data generated through exploration and drilling.

The promise of all that data? More efficient, streamlined, and profitable operations. However, to use it effectively, companies must embrace analytics tools capable of rapidly transforming complex data into actionable insights.

In that environment, many oil and gas executives are deploying advanced analytics capabilities to enhance their operations. In fact, around 67 percent of energy companies are already using tools like AI to generate business value,[1] but many of these efforts are still in their infancy. A large percentage are probably also destined to fail, or, at best, provide only a fraction of the true value they could bring to the company—typically because companies lack a structured, cross-functional, and cohesive approach to how data is managed, accessed, and visualized.

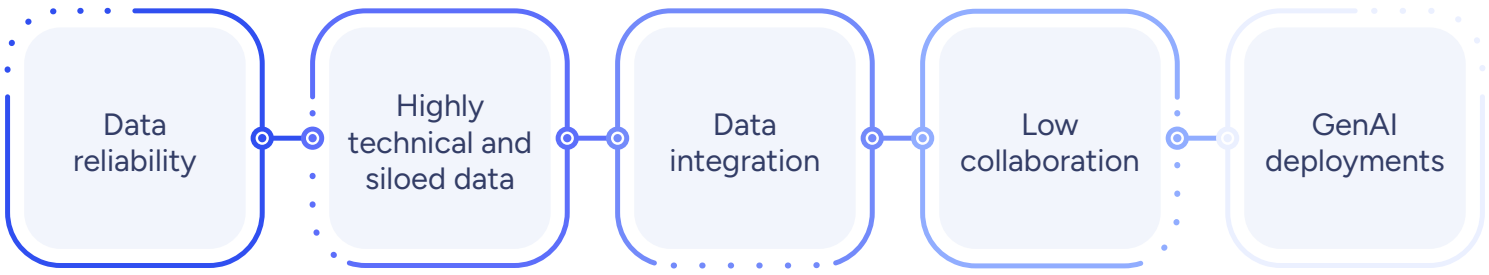
In this e-book, we make the case for using a combination of data analytics, data visualization, and AI—collectively known as visual data science—to offer a more comprehensive view of exploration and production operations. This approach empowers companies with rapid insights into site conditions and real-time operational data, providing them with the competitive edge needed to thrive in increasingly competitive markets.

The big data challenge in the energy industry

One of the biggest challenges in the energy sector is the sheer volume of data available to decision-makers. As increasingly complex systems come online—including a growing number of equipment sensors and the data analytics and collection tools used by scientists, engineers, and analysts—that volume is set to grow exponentially.

For decision-makers, the issue isn't that they don't recognize the value of having oversight and access to the full spectrum of data. Instead, it's a matter of practicality and accessibility in an environment where critical decisions often need to be made quickly and decisively. In other words, in the face of rapid decision-making, data access must be just as fast and reliable to add real value to live operations.

Additional big data challenges faced by the industry include:



[1] KPMG global tech report: Energy insights

Data reliability

For data to be truly usable, it must be reliable and trustworthy. For analysts, this means spending an inordinate amount of time cleaning up null values and duplicate data points, as well as ensuring data is scaled correctly (i.e., standardized) before analysis. The cleaning process often consumes a significant portion of an analyst's time—time that could be better utilized for generating insights to improve operations and boost profitability.

Highly technical and siloed data

The complexity of exploration and production operations and their technical requirements translate into a large body of highly heterogeneous data sources. Each of those data sources also requires specialist knowledge, so typically only workers within specific roles, such as reservoir engineers or data scientists, have access to the fine-scale insights derived from those datasets.

That's fine to a certain extent (after all, these individuals have been hired to leverage their specific expertise), but that lack of accessibility can limit opportunities for insights and discovery between technical teams.

Data integration

An additional challenge of working with big data is accessing information from different systems and machinery to get a clear picture of overarching trends. This includes both:

- Historical data, like engineering reports, maintenance logs, formation and GIS data, and the like
- Real-time data emerging from sensors and live equipment (for example at wellheads or along the bottom hole assembly)

Though these data points are a rich source of potential insights, integrating them in a single repository to extract those insights is often a frustrating process—especially where data is formatted differently or stored across systems that don't easily connect. The result for many energy companies is that they miss out on potentially profitable opportunities. As McKinsey notes in a recent report,[2] the data available to energy companies from these types of sources is "ripe for exploration" and often "proprietary enough" that being able to exploit it would grant a real competitive advantage.

[2] Beyond the hype: New opportunities for gen AI in energy and materials

Low collaboration

The technical nature of oil and gas data makes collaboration an added challenge—and not only between technical teams. Most of the industry's tools and platforms are designed for engineers, and as such they generally fall into two categories: specialist tools and statistics tools. Both types have a steep learning curve for those who want to engage in data exploration or discovery, and it's hard to find engineers who are skilled in both, let alone to make these tools accessible to the broader team.

This causes companies to rely on a small subset of team members to process and interpret even simple data, leaving others disconnected from the insights that drive decisions. And without user-friendly tools and reusable analytics applications to democratize data access, organizations risk losing out on valuable perspectives and cross-functional input that could lead to more innovative solutions.

GenAI deployments

Finally, the introduction of Generative AI (GenAI) has created a fresh set of challenges, and opportunities, for the energy sector. If harnessed properly, GenAI has the potential to revolutionize the way companies operate, driving gains in profitability, efficiency, and production speed.

The catch is that, despite the technology's great potential, over 90 percent of GenAI projects are stuck in the pilot phase, and many will never move into production.[3] Issues like a lack of alignment between business needs and GenAI deployments, and "pilot fatigue"—where companies can no longer justify spending time and energy on AI trials—contribute to these implementations coming up short.

In the oil and gas sector, the bar for implementing GenAI successfully is particularly high. One of the biggest challenges, once again, is the complexity and specificity of the industry's data and the broad range of job functions and roles that need to collaborate on the same data.

To make their GenAI-infused deployments high-impact, energy companies must have tools that can adapt to those challenges by being:

- Customizable (with industry-specific algorithms)
- Designed for easy visualization, sharing, and exploration of data
- Easily integrated with human expertise

The last point refers to a concept known as "human-in-the-loop"—the belief that real benefits and insights can only be gained through a combination of AI's unparalleled pattern recognition and the domain-specific knowledge and intuition of human experts.

[3] Reasons Why Generative AI Pilots Fail To Move Into Production

Why adopt AI?

AI has the potential to address some of the oil and gas industry's greatest challenges, especially when thoughtfully and strategically integrated into human workflows. Initial work in this space is already seeing operators derive benefits like:

- Up to 85% reduced manual intervention in energy operations[4]
- 20% improvement in reservoir modeling accuracy[4]
- 36% reduction in unplanned downtime on offshore rigs[5]
- 25% reduction in well drilling costs due to improved modeling and simulation capabilities[5]

[4] Living Digital: Agile Reservoir Modeling
[5] The great AI debate in the oil and gas industry: balancing job loss concerns with the thriving potential of AI applications

As AI technology improves in the coming years, these benefits are likely to be just the tip of the iceberg.

For many, the challenges outlined above create a barrier to unlocking the full value of their data. Without technologies that make data reliable, accessible, and actionable, oil and gas companies remain stuck grappling with overwhelming, siloed datasets. To move forward, upstream operators require a more structured, integrated approach—one that transforms their scattered data and tech into a cohesive foundation for smarter decision-making.

From overload to insight: Leveraging visual data science to extract real-time value from energy data

The challenges outlined above often lead to "data overload," where identifying critical operational information becomes difficult, if not impossible. Making things even more complicated is the fact that traditional analysis tools are often function-specific, siloing data and making it difficult to visualize information from different sources in a single pane.

Gaining meaningful access to data—and deriving actionable insights—requires a new approach: one that integrates data science, data visualization, and AI into a single entity. This concept, also known as visual data science (VDS), is at the heart of Spotfire's approach to data analytics and visualization.

An immersive data experience

By blending agile, exploratory visualization capabilities with advanced, energy-industry-specific algorithms, the Spotfire® platform empowers individual team members to derive and share business insights effortlessly.

This data environment is designed to be completely immersive, presenting information through a single "pane-of-glass" experience that includes:

This means that users can manipulate, analyze, and visualize data from multiple sources in a single place. That includes both historical and streaming data, so teams can gain real-time insights into changing conditions as they occur. The Spotfire platform also supports importing, refining, and preparing data within the same environment, reducing time spent hopping between different tools.

Combined with the platform's easy-to-use functionality, these features open up data wrangling and analysis for users across the business, from data scientists and engineers to executives and production managers.

Spotfire also supports the creation of specific **data functions** or "building blocks." Using this functionality, data scientists, analysts, and engineers can create scripts to run any calculation or visualization on demand, making it even easier for non-technical users to reuse those highly specialized functions on their data. In addition, **Spotfire Copilot™ AI tool**, empowers everyone to easily create custom data functions—streamlining the development of tailored analytics apps.

Because of these features, Spotfire empowers both technical and non-technical teams across the business to find their own answers to complex challenges, without having to exclusively rely on data engineers or other specialists to access, compile, and analyze data. The result is a democratized data access environment where any team can tackle complex challenges or produce key insights that transform the business.

> *"We have a variety of petrophysics tools, but we prefer Spotfire because it quickly investigates any imaginable large scale data analysis scenarios."*
>
> - Reservoir Engineer, Large U.S. Oil & Gas E&P with 200+ engineers using Spotfire

A customizable and extensible toolkit

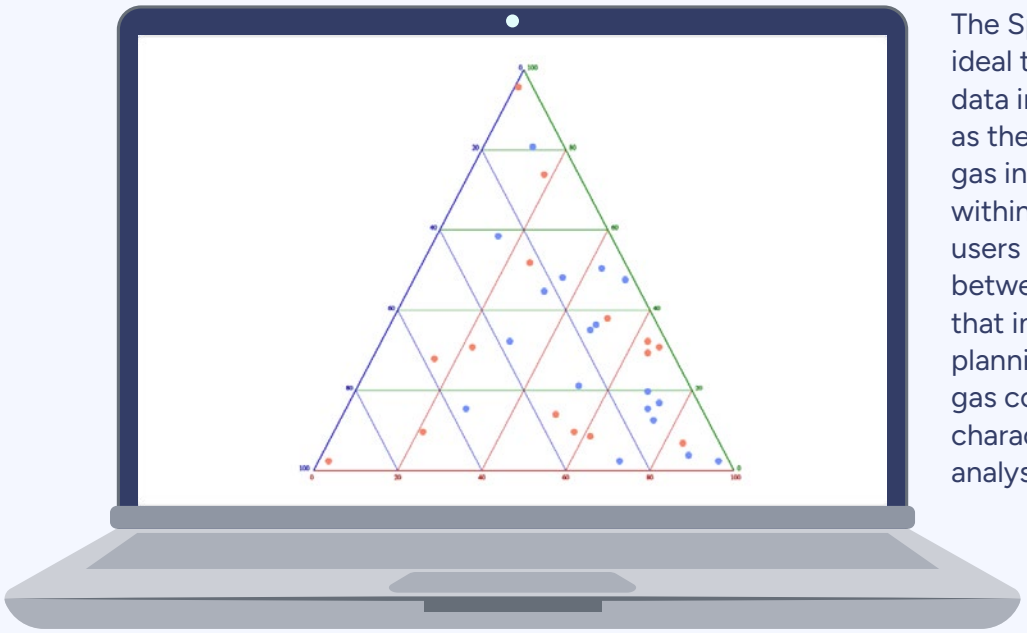
To truly unlock their data, companies must be able to tailor analytics to the needs of a specific business. Within the energy industry, that includes combining data from multiple sources and systems and customizing analysis options based on the characteristics of a site or operation.

The extensive application programming interface (API) and software development kit (SDK) in Spotfire make meeting those challenges easy. They allow developers to seamlessly integrate Spotfire with existing systems and to develop new tools for uniquely flexible and scalable analytics.

Meanwhile, low-code custom visualization and analytics apps—known as **Spotfire® Mods**—offer a range of grab-and-go solutions. These Mods are designed to be visual and accessible, removing the barrier of code-heavy analysis for non-technical team members. There are also several energy Mods available, including:

Well Log Mod

The Spotfire® Well Log Mod presents and analyzes geophysical data collected during drilling. Using this Mod, measurements like changes in resistivity, porosity, and lithology values can be plotted against the depth of a borehole, for a fine-scale understanding of subsurface conditions. That data empowers engineers and geoscientists to make critical decisions during drilling and production, optimize drilling strategies, and assess reservoir potential.



Ternary Plot Mod

The Spotfire® Ternary Plot Mod is an ideal tool for visualizing and analyzing data involving three components—such as the composition of oil, water, and gas in a reservoir. Data is presented within an equilateral triangle, enabling users to easily identify relationships between the variables and gain insights that inform drilling and production planning. Potential applications include gas composition analysis, crude oil characterization, fluid saturation analysis, and phase behavior analysis.

3D Scatter Plot Mod

The Spotfire® 3D Scatter Plot Mod visualizes relationships between three variables in 3D space. The chart can be rotated and reoriented to examine details from any angle, making it a go-to tool for visualizing 3D well trajectories. This capability allows engineers to confirm that target pay zones were accurately reached with the correct lateral length. Additionally, during well completion, a visual representation of the wellbore helps track critical operations like pump or perforation jobs.

Well Spacing ("Gun Barrel") Diagram Mod

The Spotfire® Well Spacing Diagram Mod allows users to visualize the spacing of horizontal wells across a lateral section in relation to one another and relevant formations (such as rock layers). This enables engineers and geologists to make critical decisions during planning and completion, such as how wells are spaced, where they will be drilled, and how to maximize production while avoiding issues like well interference.

A wealth of tools at your fingertips

In addition to these tools, the **Spotfire Community** provides a wide range of other energy-industry-relevant Mods, including the Spotfire® List Mod (for exploring and filtering large datasets) and the Spotfire® Timeline Mod (for visualizing events or activities over time). There is also a broad range of analytics **data functions**, supporting use cases like data preparation and transformation, which can be downloaded through the community.

For the energy industry specifically, the Spotfire Community offers several **accelerators**, including the **IoT drilling accelerator** which empowers technical users like drilling engineers with real-time analytics and insights from drill-head data. This provides a continuous, up-to-the-minute view of rig status, enabling teams to quickly detect and resolve anomalies.

Using the Spotfire toolset, companies gain new options for how they access, combine, analyze, and visualize their data. This empowers them to derive new insights and create new paths forward based on a fresh take on their most pressing challenges.

> *"Spotfire has been indispensable in my work; for example, I can quickly visualize fault angles, investigate tubing collapse, and handle tasks no other tool could. Without it, data science would be far less sophisticated and less engaging."*
>
> - Sr. Data Scientist, Mid-size private exploration company with 40+ engineers using Spotfire

A solution built for the energy industry

The combination of customizable features, ease of access to data and data integrations, and advanced analytical capabilities makes the Spotfire platform a perfect fit for the oil and gas industry, especially in the area of exploration and production.

Across the globe, many energy industry leaders are already tapping into those unique capabilities to enhance operations, gain real-time efficiency insights, and refine their approach to driving business value.

Boosted reservoir performance

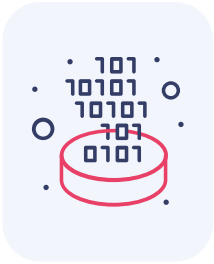
Using Spotfire, companies can improve reservoir performance by easily analyzing vast amounts of well data. This allows teams to quickly identify trends and pinpoint underperforming assets. Meanwhile, a combination of predictive analytics and natural language-powered insights empowers companies to improve recovery rates and reduce uncertainties in resource exploration.

Improved well integrity and uptime

Spotfire serves as a powerful predictive maintenance tool, putting essential data at teams' fingertips to minimize downtime. That includes being able to rapidly analyze well performance, real-time monitoring, and identifying potential failures before they happen, maximizing uptime and improving safety.

Streamlined production operations

Spotfire's focus on data accessibility and "self-serve" analytics makes it the perfect tool for streamlining production operations. By breaking down operational silos, Spotfire also boosts the ability of teams across the company to make smarter, more collaborative decisions and to draw sharper insights from the information available.



Easy data access through natural language

The **Spotfire Copilot™ AI tool**, a GenAI extension for Spotfire, makes the platform's analytical capabilities available through natural language queries. This makes it even easier to transform raw data into actionable insights. It also means that users across the company can respond to operational challenges with speed and agility—keeping things on track throughout the upstream lifecycle.

Experts who innovate with Spotfire

Spotfire's combination of human-in-the-loop data science, data visualizations, and AI technologies like machine learning and GenAI leads to powerful analytical insights for domain experts across the oil and gas industry. Examples of specific use cases across job roles include:

Reservoir/GeoScience engineer: Portfolio lease valuation

Using Monte Carlo simulation on existing production data, logs, and prior pricing data, engineers can estimate how much to bid for new leases, improving the business bottom line.

Completions/Drilling engineer: Infill drill plan

By using well logs from nearby wells, along with seismic data, completions or drilling engineers can identify the optimal locations and drilling paths for infill wells, maximizing production.

Production engineer: Workover prioritization

Using production and pump performance data, production engineers can prioritize the wells that most require maintenance, ensuring operations stay on budget and efficient while also improving uptime.

Process/Equipment engineer: Process quality troubleshooting

By using data from multi-variate process tracing, spectroscopy, and product quality data, process and equipment engineers can quickly identify and fix process issues. This improves process consistency and optimizes efficiency, ensuring smoother production.

In the case study below, we will run through how one of our partners, Wintershall Noordzee, leveraged Spotfire capabilities to revolutionize how its team uses and accesses data.

Accelerating Wintershall Noordzee's data exploration for instant insights

Company context

Wintershall Noordzee is one of the larger producers of natural gas and oil in the Southern North Sea. Compared to companies like Shell, however, it is still a mid-sized operator, working within the pressures of a highly competitive and data-driven energy market. As with any operator of that size, this means the company's competitive edge lies in being more agile, and more responsive to data, than the bigger players.

The challenge

When Wintershall Noordzee approached Spotfire, it was drowning in data and using outdated data analysis and management methods. Its data engineering team was also relatively lean, and struggling to keep up with requests from the company's exploration departments—most of which required collating data from multiple silos in a process that could take a single employee up to eight hours, using up to five different applications.

Another challenge the company faced was the fact that, depending on the country in question, operators in the North Sea must release their data publicly within 3–5 years. This makes it imperative for the Wintershall Noordzee team to maximize the insights they gain from their data before it's committed to public repositories.

The Spotfire solution

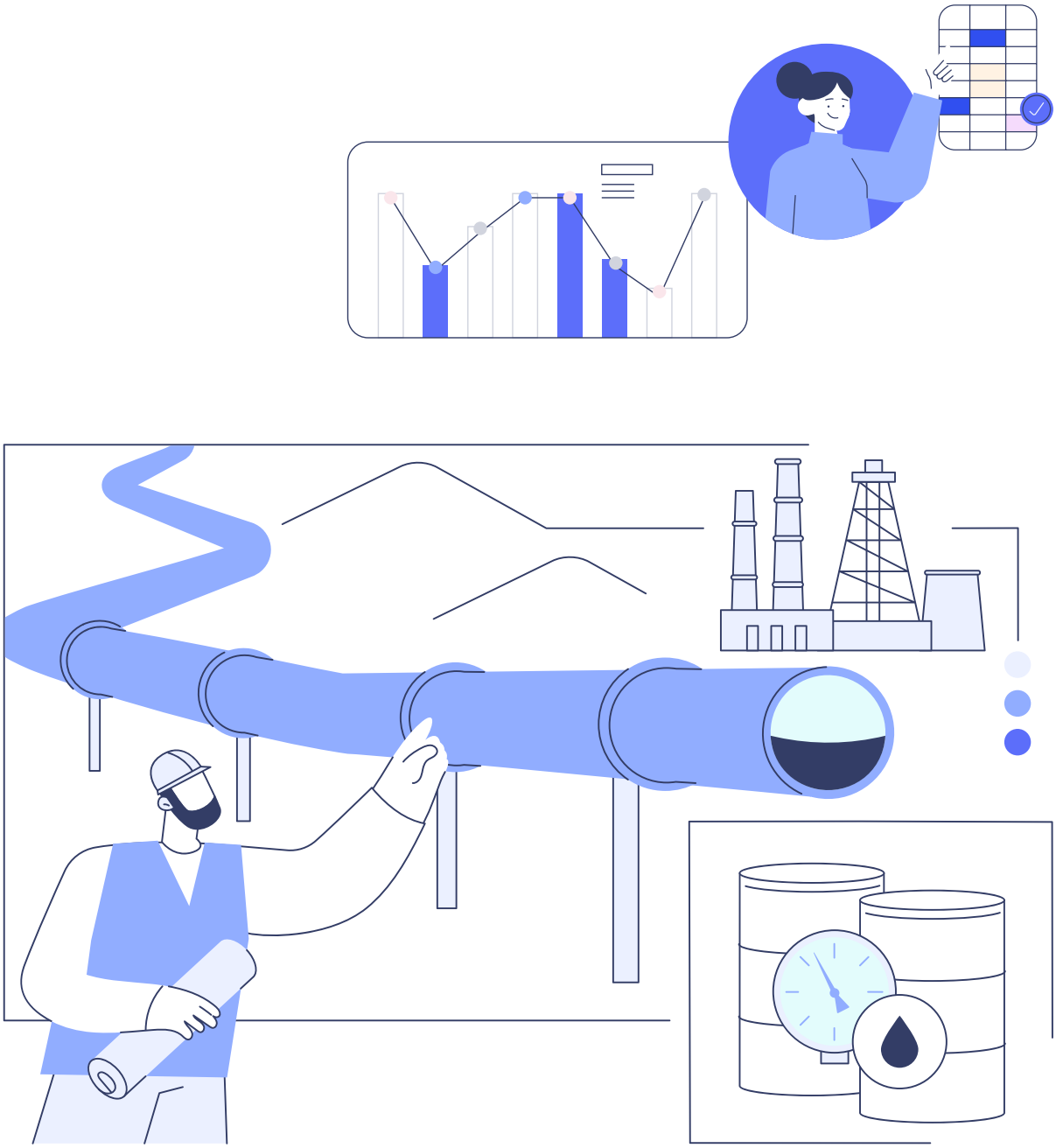
Using Spotfire, the Wintershall Noordzee team created a custom internal data analytics platform, which they named "Crossfire." The platform brought all of the company's data sources together into a centralized repository and data analysis environment that was searchable and accessible by their scientists and engineers. It also reduced the number of data-wrangling tools from five to a single platform.

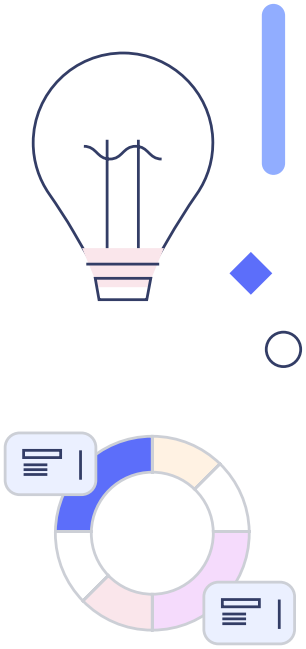
- This means that members of all teams can now easily see what data is available, and can interact with that data in a format that is visual, accessible, and no-code.
- For the company's scientists, this translates into rapid-fire analysis of dozens of variables, and a much faster discovery process. The new platform also gives the team quick insights into the most promising locations for drilling exploration wells, maximizing the chance of development and production.
- Meanwhile, for the data engineering team, the platform has reduced time spent collating data from an eight-hour process to near-instantaneous. This frees them up to tackle more valuable tasks, like ingesting publicly available data sets for the exploration team to validate their findings with.

Looking ahead

Wintershall Noordzee's success with Spotfire has emboldened its team to find even better ways of streamlining and optimizing data management. In the future, the company plans to boost its public data ingestion efforts using a combination of machine learning, natural language processing, and Spotfire data virtualization capabilities.

Dejan Zamurović, data engineer at Wintershall Noordzee, sums up the benefits like this: "Before Spotfire analytics, when a user had a question, I would have had to plot the data on a map after using five different tools to get the desired information from our data. Now, they can do it themselves, and they're just one click away from considering other variables (such as the rock unit, or borehole geometry), which previously would have cost me hours of extra work."





Building a better data environment with Spotfire

Across the globe, visual data science capabilities are empowering companies in the energy industry to turn complex technical and scientific data into clear, actionable insights. Using these tools, energy companies can shift from reactive to proactive decision-making—optimizing their operations, enhancing production efficiency, and improving outcomes across exploration, drilling, and beyond.

As the leading visual data science solution, Spotfire is proud to partner with these operators, giving them the tools they need to maximize data value and uncover new opportunities.

Ready to take the next step? **Learn more about Spotfire.**

Spotfire®

Spotfire® is a visual data science platform that makes smart people smarter by combining interactive visualizations and advanced analytics to solve complex, industry-specific business problems.

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