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Digitizing downstream oil and gas operations

**A framework for
capturing value**

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EXECUTIVE SUMMARY

Oil and gas companies worldwide understand the potential of digitization for their downstream operations. Yet they often face challenges in launching and executing digitization projects in their core businesses that would lead to a measurable return on investment. Given the fast pace of technological innovation and the complexity of a downstream business, refiners and petrochemicals players can capture the full value of digitization only if they apply a structured, systematic approach. Based on our experience with oil and gas companies, this approach consists of three specific areas.

First, companies need to prioritize their digitization efforts by linking them to the functions with the maximum value. This includes emphasizing operations and maintenance excellence; connecting the supply chain digitally; and adopting smart health, safety, security, and environment (HSSE) and fire services.

Second, companies need to build foundational capabilities in areas such as data and analytics, technology architecture, talent and culture, and cybersecurity. Developing these capabilities will prepare the organization for ongoing digital transformation, regardless of changes to the underlying technology.

Third, rather than the traditional approach to IT implementation — large-scale programs that take years to complete — downstream oil and gas companies should apply a more agile approach. Specifically, they need to assess their digital maturity across selected lines of business, pilot a few new technologies linked to business priorities, and scale up the initiatives that have proven their applicability and delivered associated benefits.

Doing things right will lead to a technology-driven transformation in how downstream oil and gas businesses operate.

THE RIGHT APPROACH TO DIGITIZATION: BUSINESS OBJECTIVES FIRST

The downstream operations of oil and gas companies, both refining and petrochemicals, have always adopted technology to improve operations. These companies have developed innovative approaches that model and manage complex processes, and that interpret data to improve performance. The shift to digital holds even greater potential, particularly given the strategic push by many companies to expand the downstream component of the oil and gas value chain, especially petrochemicals. Many oil and gas company leadership teams understand that digitization is more than an opportunity — it is an imperative (see *Exhibit 1*).

We have found that digitizing downstream operations leads to the following benefits for oil and gas companies:

- operating costs reduced by 12 percent to 20 percent
- throughput improved by 6 percent to 12 percent
- unplanned shutdowns reduced by 15 percent to 25 percent
- efficiency of plants increased by 8 percent to 12 percent
- HSSE performance improved
- workforce productivity improved

Common challenges worldwide

Capturing these benefits is not easy. As a follow-up to the recent Strategy& study on Digital Champions, which surveyed 1,155 manufacturing executives in 26 countries,¹ we interviewed senior executives at national and international oil companies. Those conversations highlighted that most organizations in the industry struggle with common issues.

One is strategy. Many companies lack a clear vision for implementing a digital strategy across the organization. Rather than identifying specific business problems and developing a business case for applying technological solutions, they move hastily to invest in the latest digital offerings. Such an impulse is understandable. Technology companies bombard executives with sales pitches for impressive solutions, showing the power of emerging technologies in operational improvements and transformed business models. However, that kind of hurried approach has significant shortcomings because it is led by the solutions themselves, rather than by the underlying business needs.

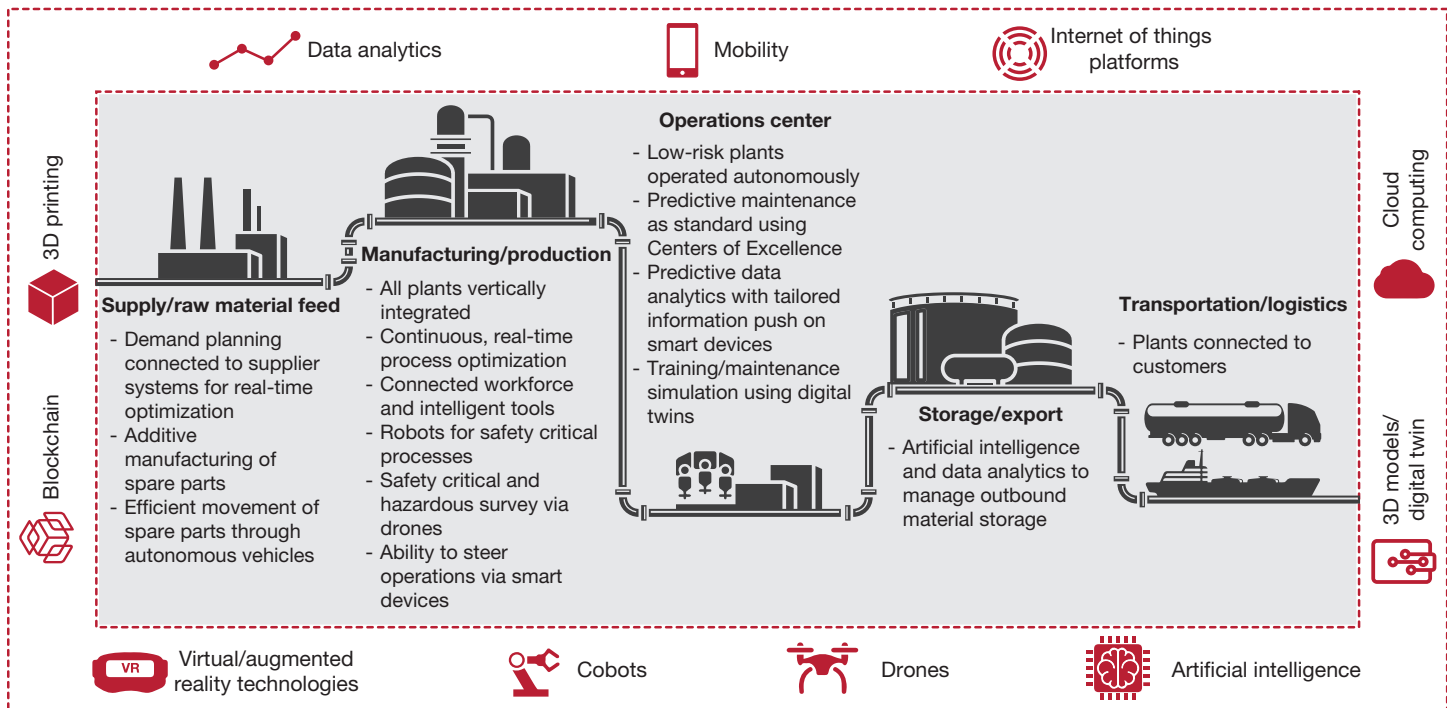
Oil and gas companies face organizational challenges as well. There is over-reliance on traditional, slow, and cascading project management methodologies, rather than agile approaches that encourage collaboration and accelerate implementation. Many wrestle with

1. Reinhard Geissbauer, Evelyn Lübben, Stefan Schrauf, and Steve Pillsbury, "Digital Champions: How industry leaders build integrated operations ecosystems to deliver end-to-end customer solutions (Global Digital Operations Study 2018)," Strategy& 2018 (https://www.strategyand.pwc.com/media/file/Global-Digital-Operations-Study_Digital-Champions.pdf).

data governance and management, lacking standard practices to capture, extract, clean, and visualize data in ways that lead to useful insights. Cultural barriers prevent organizations from developing the right mind-set and capabilities to adopt new technologies. Those that push ahead sometimes do not give sufficient consideration to risk factors such as cybersecurity.

Companies understand the “what” of new digital technologies, but before making any investments, they need to understand the “why” and the “how.” However, without first addressing these common issues, companies risk wasting time and money by investing in technologies that seem attractive but are not right for their needs. Worse, they risk locking themselves out of future technologies that are more suitable. Owing to these difficulties in implementing digital transformation, the downstream oil and gas industry is less mature in terms of digitization than other industries.

EXHIBIT 1
The downstream oil and gas plant of the future

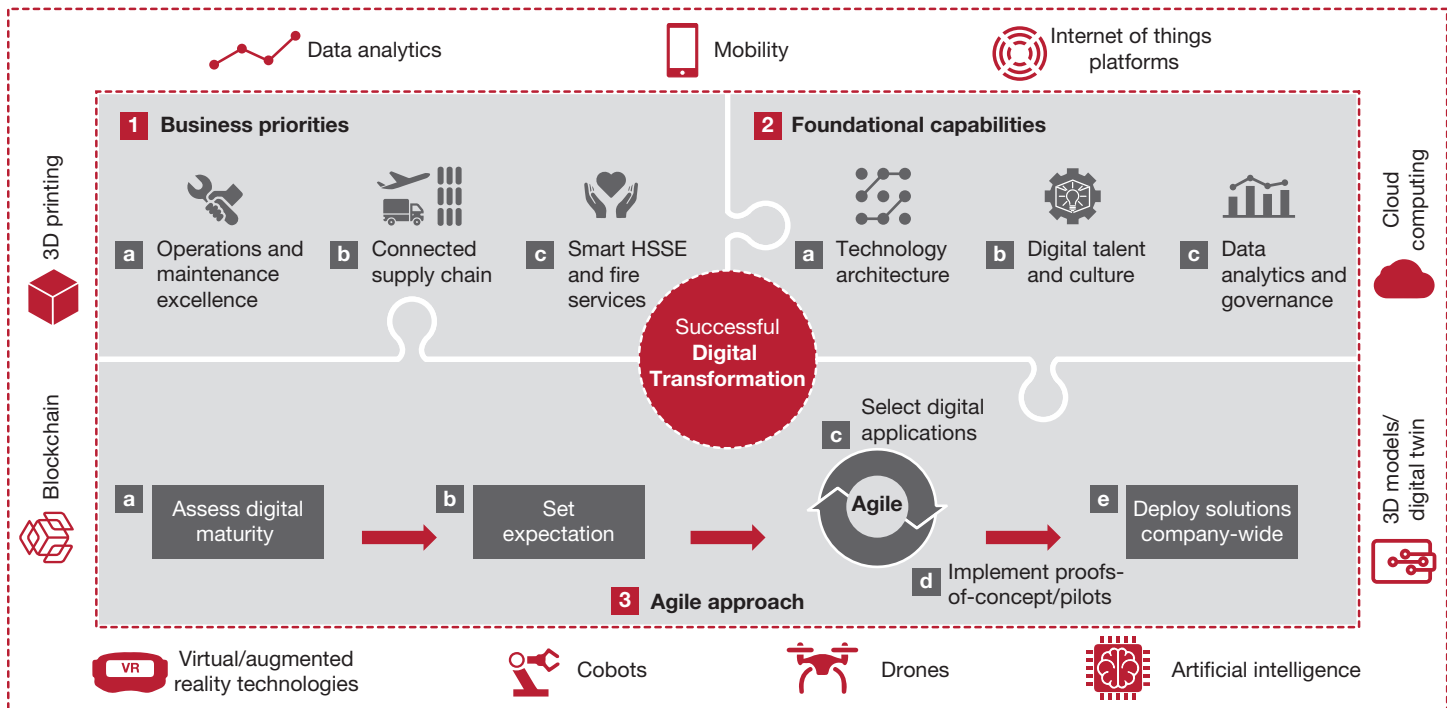


Source: Strategy&

THE DOWNSTREAM OIL AND GAS DIGITAL TRANSFORMATION FRAMEWORK

Based on our experience working with oil and gas companies, we believe digitization calls for a new framework, consisting of three components: business priorities, foundational capabilities, and an agile approach (see *Exhibit 2*).

EXHIBIT 2
Downstream oil and gas digital transformation framework



Note: HSSE = health, safety, security, and environment.
Source: Strategy&

1. Link projects to business priorities

The first component of the framework is for downstream oil and gas companies to focus on key priorities during a digital transformation, as the Strategy& Digital Champions survey of executives demonstrated. Business priorities with the biggest potential for value creation should be selected. A major priority is operations and maintenance excellence. Improving business operations is at the heart of success for a downstream oil and gas business. Moreover, better utilization of maintenance and technical resources can ensure control while also increasing employee productivity. Basic digital support tools such as mobile and hand-held devices and “digital twins” (virtual facilities that can model the effect of changing input parameters and help managers make better decisions) are all promising options. Another area to consider is how to predict and prevent, or reduce, maintenance costs. Basic automation for maintenance and turnaround planning tools use application performance management and artificial intelligence-based (AI) simulations and can easily be added (or “bolted on”) to existing operational systems. Moreover, upgrading sensor systems, to enable best-in-class predictive and prescriptive maintenance tools, can lead to long-term operational efficiencies.

Another priority is to connect the supply chain digitally, giving businesses a closer working relationship with suppliers and customers. Linking the entire network end-to-end, from raw material supplier to customer, can dramatically increase efficiencies, reduce inventory, inform product development, and give customers better service with more transparency. Digital applications can help companies better manage invoices, orders, categories, and suppliers. AI can improve inventory management, and a fully integrated network of warehouses can allow seamless workflow and real-time data analytics, along with material tracking using track and trace through barcodes and radio-frequency identification tagging.

A final priority for downstream oil and gas businesses is smart HSSE and fire services. For companies, basic solutions range from connected emergency response systems to rolling out e-permits and digitizing incident and occupational health reporting. More-advanced options include 3D digital asset data capture through drones, and virtual reality or augmented reality technologies for real-life training and walk-throughs, which have been widely adopted by oil and gas companies. Looking further ahead, building a digital twin of the operations infrastructure can also support the reduction of physical exposure of workforce to the harmful environments of the factory floor.

2. Build foundational capabilities

The second component of the framework is to build the enabling capabilities required to execute on a digital strategy or transformation. Companies invariably need to revamp their technology architecture and foundation to incorporate newer technologies and applications. In some cases, these replace older processes and systems entirely. In other cases, these technologies can sit on top of existing hardware, thereby making implementation faster. For example, a company may need seamless connectivity between its cracker and its distiller through a control room that can monitor automatic processes and override them as necessary.

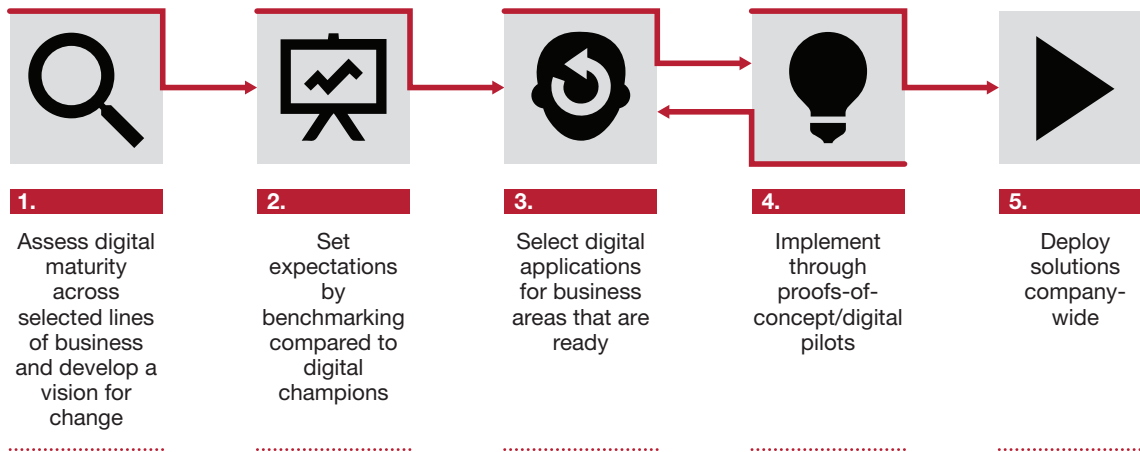
In parallel to the technology aspect, companies need to equip their people with the right skills, via focused digital training programs. Many employees are uncomfortable with technology, and some are too comfortable with old ways of working. To overcome this inertia, companies must make a concerted effort to build a digital culture and enable new ways of working. In some cases, this comes down to incentives. In other cases, companies may need to eliminate any workarounds and remove old systems so that they are no longer an option.

Companies also need data and analytics, which is the most important capability for creating value from digital solutions. Organizations will need data scientists to maximize insights from a vast amount of existing and new data. They will also need to forge partnerships and alliances, such as with original equipment manufacturers, that can help them incorporate cutting-edge solutions more quickly. They should accompany this with a data governance and management model that makes information accessible to the right people at the right time, and cybersecurity to protect critical operations and assets.

3. Apply an agile approach to implementation

The third component of the framework is to use an agile approach to digital transformation. This five-step approach will replace the traditional, slow approach to technology implementation (see Exhibit 3).

EXHIBIT 3
Five steps to digital transformation



Source: Strategy&

1. Assess digital maturity across selected lines of business and develop a vision for change

Management teams must first ascertain their company’s level of digital maturity (see “*The digital maturity scale*”). For each of the key business priorities defined above, companies need to determine where they must lead, where they should remain merely on par with their competitors, and where they can minimize or forego investments entirely. By determining the level of maturity for each business priority, companies can begin to develop a vision for change (see Exhibit 4).

EXHIBIT 4
Digital maturity levels for downstream oil and gas processes

Dimension	Digital maturity level			
	Digital novice	Vertical integrator	Horizontal collaborator	Digital champion
Operations and maintenance excellence	- Fragmented optimization of operations within a single asset - Instrument inspection	- Minimal asset optimization of operations - Fragmented real-time monitoring	- Multiple assets optimization of operations - Real-time assets monitoring	- Network optimization of operations - Predictive and prescriptive maintenance across assets
Connected supply chain	Multiple supply chain functional silos	Internal supply chain integration, track and trace, visibility, and planning	End-to-end supply chain integration and visibility with vendors and customers	Real-time end-to-end planning and full sensor-based visibility and integration
HSSE and fire	Fragmented use of sensors and offline analytics	Integrated use of sensors with online analytics and reactive response	Predictive analytics and response and semi-automated response	Integrated emergency response with partners, use of cooperative bots/AI for resolution of issues

Note: AI = artificial intelligence.
 Source: Strategy&

The digital maturity scale

An organization's digital maturity can be assessed along a spectrum of stages:

- **Digital novice:** The company has some isolated digital technologies and applications in place, but they are primarily limited to the level of individual functions or departments.
- **Vertical integrator:** The company has integrated some internal functions — such as sales, manufacturing, sourcing, or engineering — enabling them to collaborate more closely.
- **Horizontal collaborator:** The company has digitized most of its internal operations and has taken steps to connect digitally with critical external partners and customers, using integrated platforms to exchange information and collaborate.
- **Digital champion:** The company has a clear strategic position in the marketplace with complex and tailor-made customer applications provided through multilevel digital interactions.

2. Set expectations by benchmarking compared to digital champions

Management teams must understand how digital champions are already incorporating technology. Companies in other markets can provide critical insights and best practices, removing the burden for downstream oil and gas management teams to start from scratch. To set expectations for one's own business, it is critical to understand what others have been able to achieve.

3. Select digital applications for business areas that are ready

Once the business identifies its objectives and sets expectations regarding digitization, management teams should narrow their options based on the readiness and maturity of business areas and the availability of digital solutions and vendors. Oil and gas companies need to develop a clear business case with objective, attainable returns for each potential investment in any tool or application. That kind of initial scrutiny is crucial to understand how digitization will create value and if there are proven business models for selected technologies. The maturity of the digital enablers (such as data, technology architecture, and culture) should factor in to the selection of specific solutions.

4. Implement through proofs-of-concept/digital pilots

Management teams need proof-of-concept trials and pilots to test technologies before scaling up. Digitization today is unlike IT initiatives of the past, when companies could spend many years and tens of millions of dollars implementing an enterprise resource planning system for the entire organization. Instead, technology today moves very fast, requiring agility during implementation. For example, a company could launch a pilot project to digitize one process in a specific geographic market. The company could then decide what to do based on the outcome of that pilot. It could then expand the implementation to other functions and markets, or make adjustments based on lessons learned. Alternatively, it could end the initiative and start over with a different technology or application.

5. Deploy solutions company-wide

Once the company has completed initial digital pilots and assessed their performance, it must devise a plan to deploy the solution methodically throughout the organization and showcase the successes. Capturing the full benefits of digitization will only be possible by applying successful solutions at scale. Moreover, an ongoing rollout of new solutions and technologies sends an implicit signal that the organization's culture is also changing. The leadership team should be fully committed to the change and ensure that ongoing digital transformation remains a priority.

CONCLUSION

The latest advances in digitization provide a significant opportunity to change the management and operations of downstream oil and gas facilities in a fundamental way. However, many management teams are overwhelmed by the sheer range of new technologies, the pace at which they are developing, and the complexity of applying those technologies across massive enterprises. To make sense of the options, companies need to take a business-first approach to technology, rather than a technology-first approach to business. By applying the three-part digitization framework discussed here, they can rewire their organizations for better performance today, and position themselves to capitalize on the new technologies that will emerge tomorrow.

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