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Capturing the next frontier of value: Operating models for oil and gas fields of the future

Petroleum Asset eXcellence (PAX)

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Introduction

As the global energy transition accelerates, upstream operators must modernise and shift to more economic operating models. Where and how should they seek the next generation of efficiency gains?

As predictions of an early peak in oil demand take hold, upstream operators must find ways to produce more energy, more efficiently. Many have made significant performance gains in recent years. Across the sector, production costs are down 30 per cent; safety incident frequency has fallen by a third; and production losses have declined by 15 per cent since 2014. Yet more is necessary.

A marked spread in performance remains between bottom and top quartile operators in every basin. On the UK Continental Shelf (UKCS), for instance, over 40 percentage points separate the lowest production efficiency asset from the top quartile. Similarly, the highest cost asset on the UKCS has twice the unit operating cost as the median and four times that of the top quartile in the basin[1].

Furthermore, new technologies and ways of working are resetting top quartile performance levels. Our research[2] shows digital technologies may improve total cash flows by USD 11 per barrel across the offshore oil and gas value chain, adding USD 300 billion a year by 2025.

What distinguishes the success cases from the also-rans? What sustains their improvement momentum? Through our extensive experience of leading asset turnarounds in Petroleum Asset eXcellence, we observe that upstream operators who sustain their improvement momentum do two things well.

First, they challenge five interlinked drivers of their operating model in an integrated way. These drivers are: their asset strategy; physical equipment-in-place; work required to operate and maintain that equipment; workflows and methods used to conduct that work; and the competencies required from the team deployed to do it. While each driver will yield some efficiency gains when used alone, in aggregate, they can more than double the value potential of existing operations.

Second, having had one go at improving their operating model, these operators are willing to build on what did not work in round one, and take a second, third or even fourth look. In fact, they build a continually evolving operating model that achieves higher and more predictable production performance, operating costs for a ‘lower forever’ price environment, and smaller, flexible and more diverse teams that are better suited to the industry’s aging pool of skilled labour.

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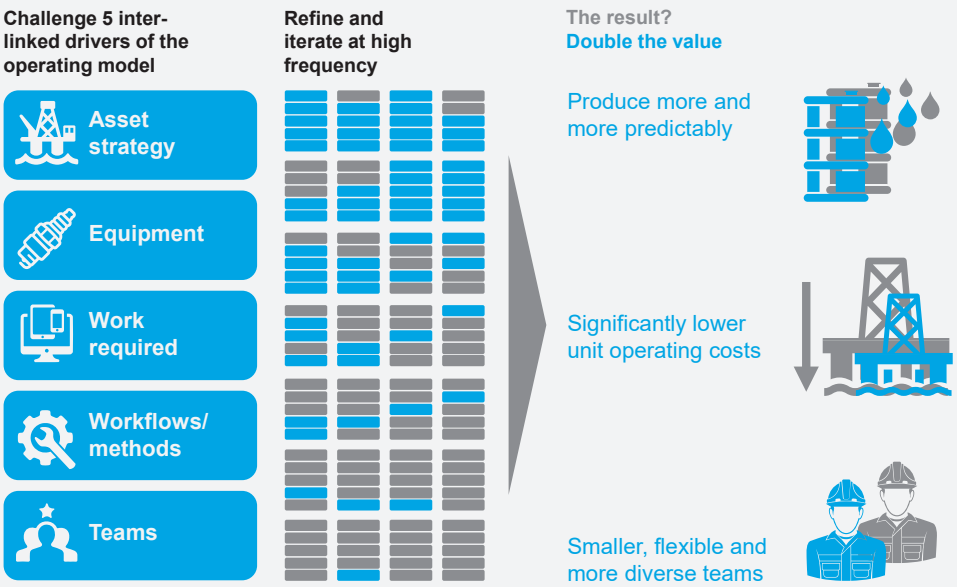
[1] Data from the Energy Insights Global Operations Benchmark

[2] Why oil and gas companies must act on analytics; Anders Brun, Monica Trench, and Thijs Vermaat describe the increase in production potential to be captured by deeper advanced analytic methods

Exhibit 1

What do successful operators do well?



This article lays out a concrete logic that any operator might use to develop a continually evolving operating model, and illustrates through real examples the success factors of making this change happen.

Developing a clean-slate vision of your operating model

In early 2015, an operator with upstream assets in various life stages found itself with negative cash flows, declining production and escalating costs. A vertiginous price drop and unconvincing track record of operational performance made any prospect of recovery seem unlikely. The operator went back to a clean slate: it took a hard look at its field and hub strategies – reprioritising its efforts across near-field exploration, wells-reservoirs-facilities management and asset rejuvenation; made radical choices to optimise lifting costs and staffing levels; and pursued capital productivity relentlessly across its portfolio. Over the next year, as the operator's competitiveness improved, its confidence rose as well.

It took another look at its operating model, replicating this end-to-end clean-slate approach, and emerged with an ambitious agenda to restore positive cash flows within two years. Since then, this operator has divested non-core assets, rezoned unwanted surplus capacity on declining assets, improved front-line agility and embraced digital technologies. With a continually evolving operating model, it has reverted to positive cash flows a year earlier than planned, marking a first in its recent history.

How did the operator build a clean-slate vision of its operating model? What logic does it apply every year? Below are the five interlinked drivers of operating model redesign and provides a checklist of questions any operator might ask itself.

1

Asset strategy

How does my asset strategy fit my asset's life stage?

- What is my ideal portfolio?
- How do I maximise recovery and replacement?
- How can I differentiate my operating model based on my assets' life stages?

2

Equipment

What is the leanest physical footprint for my asset?

How do I …

- … standardise/modularise?
- … use new materials?
- … match needs to means in operating envelopes?

3

Work required

How can I compress my workload?

What opportunities do new techniques offer?

- Risk-based?
- Digital technologies/automation?

4

Workflows/methods

How can I multiply the work hours I obtain?

Can I …

- … deepen the use of lean tools?
- … remove employee pain points?

5

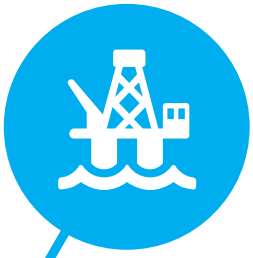
Teams

What is the minimum organisation I need to achieve my business goals?

Can I …

- … zero-base it to my baseload activity set?
- … increase organisational agility?

Value

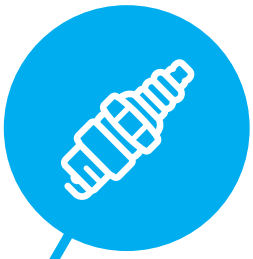


1. HOW DOES YOUR ASSET STRATEGY FIT WITH YOUR ASSET'S LIFE STAGE?

E&P companies rarely look at asset strategies in operational excellence programmes. This is a missed opportunity. Clean-slate asset strategies help operators make deliberate choices on which fields to grow, operate as mature, swap with others, abandon or divest. A Western European operator with mature operations realised that half the fields in its portfolio would generate 95 per cent of its future cash flows. Consolidating the portfolio would free up scarce capital and talent for its most productive assets with material remaining reserves. Moreover, legacy ownership structures concealed bottlenecks in third-party infrastructure: this restricted current operating capacity and the ability to mature reserves through production. Redrawing portfolios in line with which operator controlled critical processing capacity and evacuation routes – swapping assets and acreage with contiguous operators, for instance – could improve the basin's future economics and simplify day-to-day operations for individual parties.

A regular discipline of considering clean-slate asset strategies – commonly in an annual cycle – helps revisit field development plans and improve recovery rates. An African client with a portfolio of 800 closed-in wells concluded that intervening in a mere 5 per cent of the closed-in well stock could add 30 kboe/d in the first year, with payback also within the same period. It made wells and reservoir management a top priority in capital allocation and operational plans across its upstream portfolio[3].

More than all else, clean-slate asset strategies enable customisation of our remaining four drivers based on whether an asset is going through growth or decline. Operators commit to building and maintaining additional capacity, such as capital-intensive facilities improvement programmes, only where there are remaining reserves and future value potential, or they eliminate expensive optionality wherever the asset's maturity makes it irrelevant to future value creation.

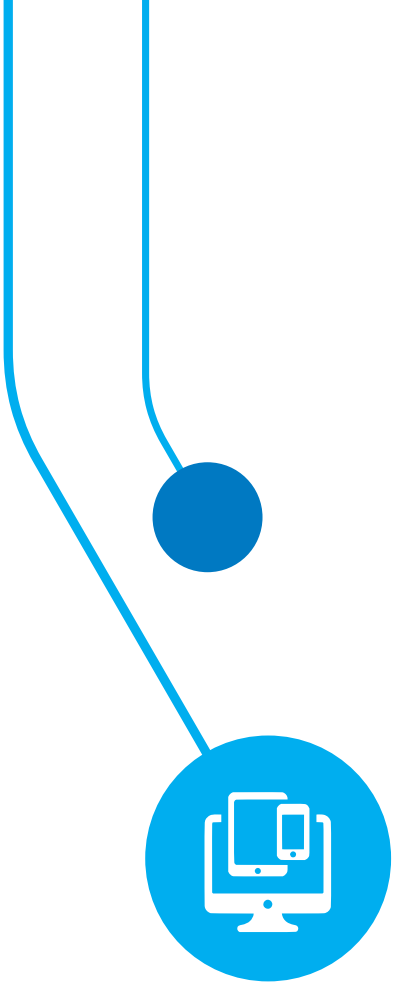


2. WHAT IS THE LEANEST PHYSICAL FOOTPRINT FOR YOUR ASSET?

The physical footprint of an asset has always been a major driver of project economics. With increasingly small and stranded reserves and limited discretionary spending, it has become the single largest factor in project break-evens. Additionally, the physical footprint shapes operational processes, and determines the structural limits of operating cost optimisation across asset lifecycles. Examples of these limits include deck space, number and type of crane, storage and layout, and redundancy in installed equipment. We recommend that operators consider the total value of owning their physical footprint – in design and in operations.

For new builds, considering the total value of owning their physical footprint may lead to smaller, modular, unmanned or energy self-sufficient designs. A North Sea independent used a standard platform design to shorten the engineering process and achieve first gas within 18 months versus industry averages of 30 to 36 months. The standard topsides – developed for two marginal fields – were useable in other fields within a comparable range of gas throughput. The modular jacket was suitable for similar shallow water resources. Solar and wind power generation with battery storage reduced air emissions and offered energy self-sufficiency. Standardisation and modularity rationalised maintenance costs just as much as FEED capital. As routines were replicable across the portfolio, a standard campaign-based maintenance approach yielded material synergies in engineering, work preparation and spares management.

[3] An analytical approach to maximizing reservoir production: Francesco Verre, Otto van der Molen, and Anton Maximenko explore the recent impact they have had by applying deeper analytics to subsurface optimisation



For mature assets, standard subsea design and equipment improves the economic attractiveness of brownfield expansions. Besides, obsolescence, fatigue or corrosion issues can all serve as triggers to make the asset easier and more economic to maintain. One operator in West Africa replaced traditional flowlines with thermoplastic ones. With better corrosion resistance, higher asset integrity and longer life, these new materials drastically extended schedules for inspections and maintenance routines. In a different example, a North Sea late-life asset systematically challenged the equipment in place to reduce surplus capacity in power generation, compression and storage vessels. The lower physical footprint eliminated 25 per cent of required maintenance hours and allowed redeployment of the maintenance team to more pressing pre-Cessation-of-Production imperatives. With a total value of ownership approach, this operator tackled the growing divergence of needs from means in its initial operating envelopes, and structurally reduced its operating cost base.

3. HOW CAN YOU COMPRESS YOUR WORKLOAD?

In asset turnarounds, we commonly encounter over-reliance on time-driven maintenance philosophies. Equipment strategies are set to standard specifications and adapted marginally as assets move through steady-state production into decline. The outcome is inflated workloads and costs, combined with an operations and maintenance plan that does not adapt adequately to emerging reliability or integrity challenges. Our proprietary maintenance benchmarks indicate that there can be a 5 to 10 percentage point differential in production efficiency and 20 to 30 percentage point differential in maintenance costs between top quartile operators and the also-rans.

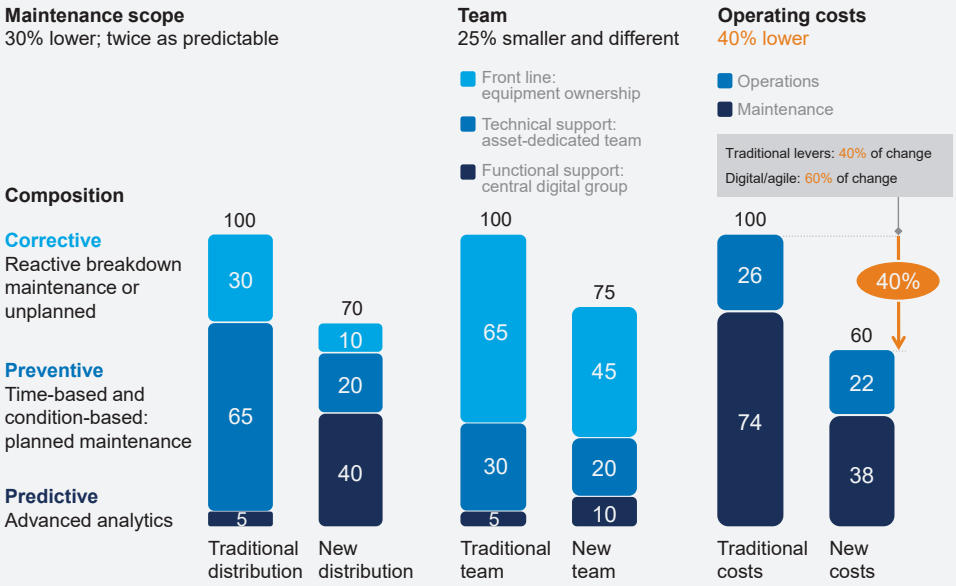
Success cases exercise both traditional and digital levers to optimise the overall operations and maintenance workload. Traditional choices include stepping away from a 100 per cent inspection approach to risk-based strategies in mid-life assets or run-to-failure for late life ones. However, next-generation operations and maintenance is centred on equipment sensors for performance data, advanced analytics and machine learning to predict and avoid failures, with maintenance or replacement on an as-needed basis. This end-to-end digitally enabled system makes activity workloads smaller and more predictable, feeds into more efficient and economic management of materials and people, and levels the operational risk-return profile of an oil and gas business towards the steadier profile of a manufacturing one.

A mature asset operator makes timely interventions through failure prediction to reduce asset downtime. Predictive maintenance incorporates sensor data and condition monitoring results in a machine-learning algorithm, which recognises patterns associated with different failure modes on a specific machine. As no two machines are alike, the learning algorithm can customise trigger points for failures on each individual piece of equipment, thus allowing maintenance teams to plan better, reduce the incidence and severity of failures, and compress the time to recovery. The operator has reduced downtime on critical machines by as much as 30 to 50 per cent.

Most significantly, predictive techniques are redefining the scope and composition of maintenance activities, enabling organisations to have smaller maintenance teams and lower operating costs. Exhibit 2 shows the expected future impact for this mature asset operator.

Exhibit 2

Illustrative example – a full scale-up is expected to transform maintenance scope, efficiency and costs



Predictive techniques are relevant regardless of the life stage of an asset. However, operators may choose to match upfront investment with the remaining life of their assets. While an overhaul of multiple systems into a single platform may have a positive business case at an early-life asset, a mature asset may better use an integrated platform that consolidates scattered data from legacy systems and rapidly digitises key operational workflows.

4. HOW CAN YOU MULTIPLY THE WORK HOURS YOU OBTAIN?

Upstream operators consistently appear middle of the pack in time-in-motion studies, reporting an average of 20 to 30 per cent of a shift as productive. However, world-class process-based industries and leading upstream operators can extract 7 hours of value-added work in a 12-hour shift; in some cases, particularly in campaign-based interventions, they can achieve 8 to 10 hours of useful work per shift.

Lean tools continue to be the mainstay of improving productivity. In addition, the vision for next-generation operations and maintenance is to put the employee at the core, flipping the model from 'thinking like the manager' to 'thinking like the technician'. This means that anything in the way of the technician's doing value-added work must be minimised, or where possible, automated.

At an offshore asset, we shadowed technicians to uncover their pain points. Three pain points emerged at the top:

- A manual and substantial data reporting burden that went beyond industry compliance requirements: this trapped the Offshore Installation Manager and supervisors at their desktops.

- A time-based schedule and planned loading approach in compliance with company maintenance execution standards: often this imposed twice as many work orders and doubled the time per work order relative to actual execution data. While the asset was plan compliant, the maintenance teams had effective surplus capacity.

- Focus on a process rather than equipment or systems: this prompted compliance with complex process steps and reporting to relevant technical authorities over equipment care and ownership.

Addressing technician pain points along the maintenance execution process was the main lever for improving productivity. The operator reacted with three innovations:

- Digitisation of key workflows had the secondary benefit of allowing most compliance data to be tracked autonomously and routed to a secure site for reporting to the parent company or regulator. This freed up offshore supervision capacity. Gradual deployment of IoT and mobile devices over the next two years was expected to provide further relief through real-time reporting.

- Time-based scheduling and plan loading was replaced with the use of actual execution data captured in digital work tracking systems. Surplus capacity in maintenance teams could be redeployed to liquidate maintenance backlogs or better utilised for standby work. The operator was beginning to implement next-generation control of work, with increased automation in integrated planning, permit-to-work processing and work notifications.

- Process simplification liberated front-line time and capacity. Simple engineering was delegated to an offshore engineer who supervised 'find and fix' and accelerated simple jobs without routing them back to a central team or contractor.

But front-line equipment care and ownership required organisational refinements. This brings us to the fifth driver of next-generation operating models.

5. WHAT IS THE MINIMUM ORGANISATION YOU NEED TO ACHIEVE YOUR BUSINESS GOALS?

Upstream companies typically start and end reorganisations with the organisation itself. Notwithstanding its limited impact on resourcing levels, this approach constrains companies' abilities to visualise how they might adopt new technologies, such as digital tools, or introduce organisational agility, a premium functionality in our world of relentless change[4].

Building a next-generation operations and maintenance team begins with drafting the minimum capabilities required for steady-state operations. At its most elemental, an operator takes a zero-based budgeting approach: desktop analyses and cross-functional scrums help set the size and shape of the smallest team with the skills to conduct the asset's baseload activity set, and add incremental capacity only if there is a strong business case for it. So, while an early-life asset operator might aim for equipment familiarity through

[4] The oil and gas organization of the future; Christopher Handscomb, Scott Sharabura and Jannik Woxholth talk about five ideas that can help organisations adapt as technological and political trends reshape the industry

hands-on commissioning, a late-life asset operator would accommodate capacity to address integrity challenges. Even with this minimalist mindset, it is easy to rationalise why additional technicians should be on standby for unanticipated trips.

We have seen assets operating with teams less than half the prevailing norm, and specific activities, such as routine well interventions for reservoir data acquisition, run with team sizes of around 25 per cent of what is typical. Three choices facilitate flexible access to the required capabilities:

- **Fluid teaming.** Multi-skilling through a second service role, combined operations and maintenance roles or a secondary competence is more talked of than implemented. Many technicians often have broader competences than trades-based staffing models allow. In next-generation operations and maintenance teams, we go further towards an agile organisational structure, designed around equipment ownership. For instance, an equipment improvement team is cross-functional with representation from challenge areas, such as engineering, maintenance or supply chain. It is self-managing and has end-to-end accountability for the reliability of its equipment. Each team sets out with a performance target associated with its equipment and has compensation tied to the results achieved.

- **Redefining skill requirements.** As operators increasingly deploy digital technologies – improving work-scope predictability – unmanned operations become more feasible. An integrated remote operations centre staffed with data scientists and operations-skilled digital translators – who marshal advanced analytics models for production optimisation – is no longer inconceivable.

- **Use of innovative partnerships for non-core and peak load activities.** Contracting is the traditional option for flexible access to skills. In a 21st-century organisation, this might look more like a risk-sharing partnership. In a recent example, a large upstream oil and gas company established a long-term contract with two asset management contractors to increase production in a mature field. While reserves continued to be owned by the upstream company, the contractors operated under a cost recovery model with a bonus for how quickly they increased unit cash flows. Tailored alliances across the sector, with distinct contributions from participating upstream companies, can go beyond supply chain relationships. A recent merger of two operators combined the operational excellence of a leaner independent with a larger incumbent's superior basin expertise. In the year following the transaction, the new entity nearly doubled production, providing greater financial robustness and a platform for long-term growth to both partners.

Ultimately, reorganisations must ensure access to the right talent within the asset's business context. Organisational agility can achieve this without compromising process and personnel safety. Even with fluid teaming, the roles of the Offshore Installation Manager or the Site Supervisor as safety custodian remain intact.

Achieving a continually evolving operating model will require new approaches to operational transformations, skill sets and ways of working among the people who will make it happen. While the traditional transformation roadmap to arrive at well-defined goals is still relevant, an agile development and implementation process will be needed to accommodate greater collaboration and learning on the go. Multi-functional teams will work together on end-to-end processes to create new solutions, using shorter sprints to design minimum viable products, and being happy to fail fast as long as they learn in the process. This will put front-line teams and middle management at the heart of the transformation. And operators will have to invest in building both their belief in the value potential and their capability to deliver the required changes.

None of this will be easy, but it will be necessary if oil and gas operators are to attain the next wave of structural improvements amid the uncertainties of an ever-evolving industry.

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