

They say necessity is the mother of invention, and no one in the oilfield understands necessity better than the operators themselves.

Today, tight oil is at the technological forefront of the oil and gas industry. Exploiting low permeability, heterogeneous rock at \$50 oil makes invention and innovation a requisite not a luxury.

In fact, demand for subsurface technology progression has never been greater in the oil industry's history than it is today. But how? Finding practical ideas that work to solve real-time shale problems at scale is not easy. Fostering the new tech is not easy. And optimizing the tech is not easy either.

## Four Primary Innovation Models

The way we see it, operators have four primary innovation models to choose from in shale. Each has pros and cons.

**1. Let The Big Oilfield Service Firms To Do It.** The large customer bases of diversified oilfield service firms put them in an active feedback loop, which is conducive to incubating innovation. Inquiries from diverse customers inform a comprehensive to-do list of problems to solve and tech to develop. As a group, OFS firms have spent billions on R&D. And many have pumped millions of dollars into branding themselves as innovation engines. But their tech motivations don't necessarily align with their customers – they are in it to make a buck and will focus primarily on technologies that can be effectively commercialized and deliver contribution margin.

Moreover, bureaucratic inefficiencies can kill innovation, and then there is the temptation to innovate for innovation's sake

**2. Partner With A Growing Field Of Tiny Start-ups.** Behaving more like partners than B2B counter-parties, 5-man shops and billion-dollar companies are diving into problems together because they can find solutions faster together. Through a highly iterative process between giant operators and tiny start-ups, new solutions are being refined and optimized faster than ever before in shale. There is efficiency in small specialized teams focused on niche solutions. Relentless entrepreneurs focused on survival move faster than comfortable bureaucracies. But there are some inefficiencies in this model too, including i) operators may have to go down many rabbit holes to find one good idea, ii) good ideas can wither and die if they don't get sponsored, and iii) the lack of established communication channels can result in wasted efforts – how does the field of startups know what problems are most pressing for operators day-to-day?

**3. Establish Internal Tech Venture Capital Groups.** For years, the oil majors have invested directly in 3rd party upstarts – supporting innovative O&G tech pioneers. For example, [Chevron Technology Ventures](#) has been a conduit for early adoption of emerging technologies since 1999. Repsol's group is a more recent arrival. As shale demands more elegant solutions, this venture capital model is receiving serious consideration from the Independents. [Statoil Technology Invest](#) and [Hunt Energy Enterprises](#) have demonstrated success in applying the approach to US unconventional tech. Unconventional leaders like Pioneer and Marathon have formed internal groups to evaluate and source innovation, perhaps the first step towards more formal VC formation the Independent E&P level. The cons of this approach are similar to the tiny start-up model shortcomings listed in point 2 above.

**4. Develop E&P Tech In House & Carve It Out.** In some cases, tech carve-outs arise as a result of the efforts of the internal tech venture capital groups described above. In other cases, the tech carve-out innovation process starts out a bit more homespun and organic – born of necessity. Although internal operator R&D was downsized in the downturn, it still drives meaningful technological discovery. Small teams within operators are developing scalable and adaptive solutions to shale problems. If kept internal, new solutions are unlikely to realize their full potential. Instead of trying to keep a lid on new technology, we believe operators increasingly understand that promising new ideas can be choked out if kept strictly internal. This does not apply to completion recipes of course, but we believe it does increasingly apply to widgets and subsurface tech being developed in house. Niche subsurface solutions need to be refined by many operators across application in many wells and basins to reach full potential. So some operators are increasingly taking a build, implement, sell approach to R&D. Not everyone is ready to embrace this way of thinking just yet, but we sense a growing acceptance and awareness, especially among larger companies with greater R&D resources in house.

## **All Models Will Drive Shale Innovation, But Our Focus Today Is On 3 & 4**

For the foreseeable future, some combination of the four innovation models will drive oilfield innovation. But we started this update by saying that no one in the oilfield understands necessity better than the operators themselves. And that turns the spotlight on models 3 & 4: internal tech VC and tech carve-outs.

The idea with both of these is that the innovation starts with the operator who understands their challenges better than anyone.

However, because a single operator does not have the scale of work necessary to optimize the technology for every possible use case, both these models give emerging solutions access to the broader market.

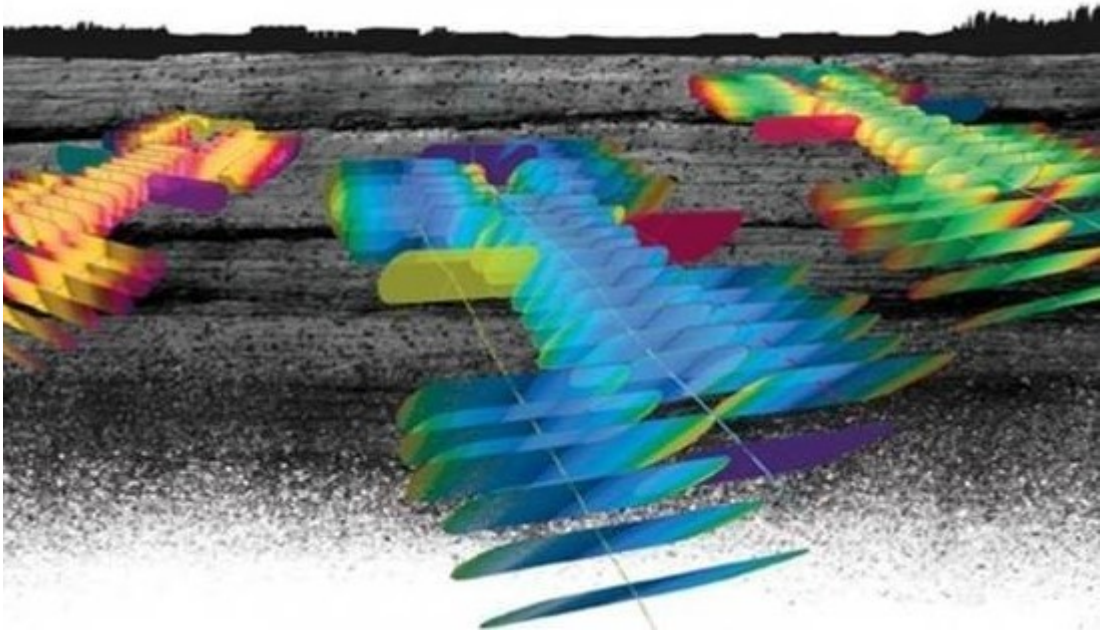
While structural unbundling is not a new concept in E&P, the idea of technology disaggregation (innovation born and incubated in E&P offices is later spun-off to stand-alone) seems to be gaining traction. In spinning off the tech to stand alone, operators benefit from a) better returns on R&D investment and b) better solutions in the field.

Remember Helmerich & Payne's [acquisition](#) of drilling technology company MOTIVE back in May? The target of that deal was born inside an operator – Hunt Energy Enterprises, a venture startup incubator within Hunt Consolidated – to address challenges in horizontally drilling unconventional plays. Rather than keep the tech internal, Hunt spun it off to stand-alone. And rather than build it themselves, H&P let the operator forge a solution they will now deliver to a large customer base.

Another example is Statoil's fracture mapping technology that became the foundation for spin-out [Reveal Energy Services](#). We had a chance to speak with Sudhendu Kashikar, Reveal Energy Services' CEO, not too long ago. We came away with a firsthand feel for how powerful the tech carve-out model can be.

## Revealing The Power Of Tech Carve-outs

If you were one of the 2,500 attendees at URTeC this year, you may have seen Reveal Energy Services' product launch presentation in person. At the oilfield tech confab, the company unveiled IMAGE Frac 2.0.



*IMAGE Frac mapping of hydraulic fractures; photo courtesy of Reveal Energy Services*

IMAGE Frac technology is a new approach to mapping hydraulic fractures. It enables operators to work with factory mode consistency to increase reservoir contact by confirming whether a stimulation treatment is producing the planned fracture dimensions. IMAGE Frac's brilliance lies in its simplicity – using only a common surface pressure gauge, extensive frac data is generated in relevant time.

The idea was born of necessity within Statoil. One of the challenges with unconventional well diagnostics is that many older technologies are cost-prohibitive.

As Statoil developed more heterogeneous shale reservoirs, they looked for a solution that went beyond sample well data and after searching the market, they found nothing available that was scalable at the field level. “Statoil asked what technology can give us simple, accurate, and affordable answers on every single well in the field?” Sudhendu Kashikar said. “That was the driver behind our technology.”

The technology provides similar answers as legacy technology, but at 10% of the cost, making it scalable to entire fields not just science wells.



*Sudhendu Kashikar, CEO Reveal Energy Services*

The company was conceived in 2014 within Statoil’s unconventional R&D group. During 2015, tech pioneers within Statoil created the IMAGE Frac solution while working on the operator’s Bakken completions program.

In early 2016, Statoil set up Reveal Energy Services as a stand-alone entity with an exclusive license to fine tune the technology to meet Statoil's requirements – the idea being that the company would eventually become a larger operation and build more extensive product offerings around the initial tech.

In 2017, Reveal Energy Services was funded with capital from Lime Rock Partners.

Today, the technology is field proven in 1,200 stages across 6 key US unconventional basins – a track record that would have been impossible to establish had Statoil kept the tech strictly internal.

The core technology uses a standard surface pressure gauge as a primary sensor. That's it as far as field presence goes. Super-simple – no field operations, no boots on the ground, no workflow change, no installation downtime, no equipment at the wellhead (other than the bridge plug). The software resolves the fracture geometry created during hydraulic fracturing, all based from precise surface pressure data recorded on nearby offset wells.

The surface pressure gauge data powers a suite of hydraulic fracturing mapping outputs that are provided to the operator in relevant time for each completion in their program.

“The whole idea that guides everything we do is that it is simple, accurate, and affordable – key characteristics for application in E&P factory mode workflows,”

Kashikar told Infill Thinking.

Looking at the Reveal Energy Services' output suite comprised of five service offerings, we can see that their product logic addresses many trends / challenges we've been writing about here at Infill Thinking this year: frac hits, proppant intensity and placement, and reservoir stimulation to name a few.

To us, the way the company's product service offerings are set up shows a clear understanding of what operators really need in shale today. The kind of thought that went into this product line-up would be impossible to develop without close collaboration with an E&P in our view. In this case, operator collaboration was about as close as it can possibly get.

Life at the bleeding edge of technological change is hard. Could the commercial success and thoughtful product line of Reveal Energy Services have been achieved independent of operator sponsorship? Perhaps. But in this Darwinian US shale tech start-up landscape, the company's origin is a distinct competitive advantage. Operator collaboration with technologists is more critical than ever before given the complexity of today's challenges – and there's no closer collaboration than building in house to carve out.

Many technologies fail not because they don't work, but because they don't scale up quickly. Others fail because while well intended they simply aren't what operators require. We believe the simple and effective product service line of Reveal Energy Services demonstrates the power of the E&P tech carve-out model in shale.



Operators that spin out widgets and apps benefit from accelerated optimization and enjoy better returns on R&D spend. And for the technologists, the collaboration and sponsorship can drastically accelerate both optimization and adoption cycles. Statoil and Reveal Energy Services are both enjoying these benefits now.

While all four innovation models have their place, it's hard for us to imagine a purer form of shale innovation than E&P tech carve-outs, and IMAGE Frac's story provides a good case study of how to do it right in our view.