

# Turning data into dollars: Synthesizing business architecture and optimizing operations in the age of digitization

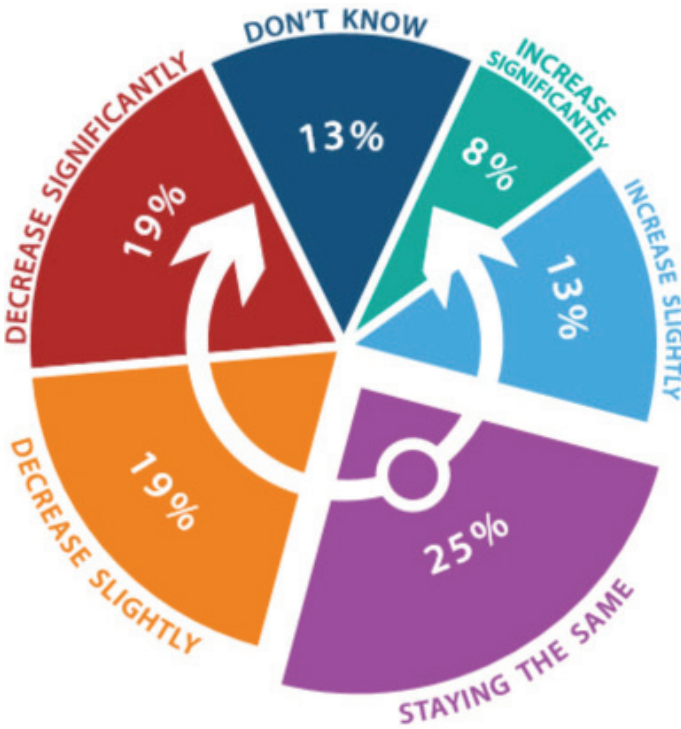


This report has been produced in collaboration with the **3rd Annual Data Driven Production Conference (6-7 June 2017, Houston)**. Bringing together 250+ of the most influential decision makers in the data space, this meeting is designed to help you increase production and efficiency by transitioning from standard data collection to advanced analytics, visualization and IOT.

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In 2016, Upstream Intelligence's *Data Driven Oilfields: Challenges and Opportunities Survey*, identified that more operators anticipated organizational spend on data and analytics products and services to increase or remain unchanged over the course of the year than those who indicated investment retraction. This sits against the context of decline in global upstream Exploration and Production (E&P) spending across 2015 and 2016, the first consecutive annual cuts in 40 years according to the International Energy Agency (IEA). The IEA reported in September 2016 a 24 percent annual decline in industry expenditure to US \$450 billion, a downward revision of more than 17 percent on earlier forecasts for 2016, and a fair distance away from the average annual 12 percent rise in capital spending witnessed during the heady days of 2000-2014 (IEA, *Oil Market Report 2016*).

### For 2016 how is your company's spend on data and analytics products and services changing?



Source: Upstream Intelligence Data Driven Oilfields: Challenges and Opportunities Survey, 2016

Of course, a low oil price climate may well represent the optimum time to carve out processes and deploy technologies which facilitate cost reductions and optimize efficiencies. As Joseph 'Joe' Perino, President & CEO of PERTEX Management and Technology Consulting LLC told Upstream Intelligence, "the good thing about the downturn is that it is forcing a lean sigma on companies and hopefully that becomes a permanent condition." Tony Edwards, CEO of Stepchange Global, has said that for some companies the downturn has forced "a realization that if they don't engage with digital approaches they will go out of business. They're having to really think about this because of the downturn."

That's not to say that there are no negative correlations between capital expenditure tightening and digital investment in upstream O&G, as we shall see for example, it is shaping which operators are investing most heavily and which most conservatively, which assets and activities are featuring prominently on the digital agenda and which are not.

Complexities involved in quantifying industry-level Big Data investment make it hard to know whether the investments we are seeing are enough, are happening quickly enough and with enough direct impact on operator bottom lines. "It's hard to quantify numbers because investments are going to be split between so many units, between CAPEX and OPEX, and buried in IT costs," says Jess B. Kozman, Regional Representative – Asia Pacific, Professional Petroleum Data Management (PPDM) Association. "In fact, this is a microcosm of the issue we have with Big Data Management (BDM), it's very hard to quantify your true cost."

In any case, a more indicative metric might be identifying precisely where commitments are being directed.

- Level 1:** Field work instrumentation and process control network
- Level 2:** First mile connectivity; global enterprise and supply chain network
- Level 3:** Real-time production and reliability surveillance
- Level 4:** Data foundation
- Level 5:** Integration framework
- Level 6:** Data access portal (search, presentation and reporting)
- Level 7:** Geoscience and petro-technical applications environment
- Level 8:** Collaboration platform and decision environments
- Level 9:** Analytics platform (modeling, simulation and optimisation)

Source: Upstream Intelligence, Offshore Digital Services Report: Well Integrity and Production Optimization

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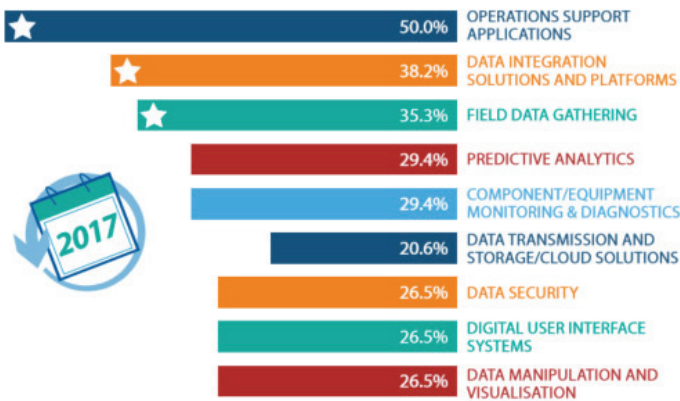
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The same survey revealed that for 2017, operators were planning to invest most frequently in **operations support applications followed by data integration solutions and platforms**. This highlights an evolution from the acquisition of data which had characterized the earlier Digital Oilfield (DO) rollout towards the interoperability of data to drive business decisions, which in the case of integrated approaches refer to enterprise-wide decisions with data-connected architecture connecting units from the back office to the field. Such decisions in this climate need to ultimately identify and drive the quickest cost reductions, optimization gains and reliability breakthroughs.

### What digital solutions, services and/or products is your team investing in the next 12 months?



Source: Upstream Intelligence Data Driven Oilfields: Challenges and Opportunities Survey, 2016

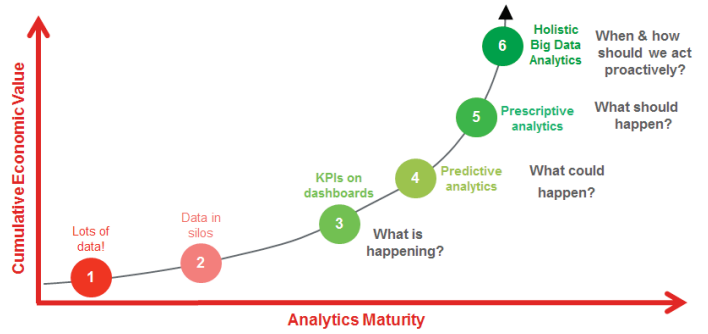
The industry appears to be targeting the more advanced levels of O&G Digitization. It is these stages you need to reach “to get the decision information to get the return,” Perino notes. “There’s not much of a return in just collecting it all.” Integrated platforms enable the move from what Jim Crompton, MD of Reflections Data Consulting LLC and Chevron Fellow, terms as “functional siloed solutions” to “cross-functional solutions.... this is where the next really big challenge is, and big data is either an enabler or barrier.”

### From acquisition in the age of the Digital Oilfield to execution in the age of Digitization

Data capture and storage has evolved from an organic by-product of operations to a more strategic pursuit, facilitated by a marked fall in the price of sensors, increased sensor functionalities, and the advent of advanced wireless and Cloud computing networks.

“In Upstream production we have gone from being under-instrumented and under-sensored, to a place where through the DO campaign sensors are now everywhere,” explains Perino. “Whilst the offshore industry is more instrumented, the onshore industry is also putting a lot of more economical instruments in; you can now get a sensor for US\$ 100 rather than US\$2000.” At Upstream Intelligence’s 2016 Data Driven Production Conference in Houston, Steve Schmarzo, Chief Technology Officer (CTO) at EMC told the delegation

### Big data the 'force' for E&P digital transformation



Source: ©2017 Dr Priyadarshy, Halliburton

how “it’s 20 to 50 times cheaper to store, manage and analyse data than it was just a couple of years ago using traditional technologies. That’s the equivalent of going from the abacus to a laptop.”

Yet this deluge in data brings its own challenges. Back in 2013 the International Data Centre forecasted an O&G digital universe of up to 2.7 zettabytes. “I guess the biggest driver we are seeing in the move towards BDM rollout is pressure on existing systems and solutions from the volumes of data,” Kozman notes. “There is a clear recognition at this moment that the volumes are overwhelming the systems that are in place.” Volume does not instinctively equate to value, and in this context it can obstruct it. Many operators already house the data they need to make data-driven business decisions across their organization. But to be able to adequately respond to the downturn by mobilizing said data to make asset-specific or even enterprise wide efficiency improvements is another matter.

“Digitalization represents the next step of what to do with that data we got from the DO,” explains Perino. “...where all this Big Data is used to transform the way we connect and work, and of the course the connection part here is the Internet of Things (IoT).”

### Defining the value creation path in data-driven operations: From a resource to a production focus

#### Digitization vs. Digitalization – What’s The Difference, If Any?

The Wikipedia definition for Digitization is distinct: “...the representation of an object, image, sound, document or signal (usually an analog signal) by generating a series of numbers that describe a discrete set of its points or samples... strictly speaking, digitizing simply means the conversion of analog source material into a numerical format.” DO initiatives indeed delivered a lot of Digitization.

Gartner goes a good step further in assigning meaning. It defines Digitalization as “the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.” DO did some of this, but now with Big Data, Analytics and IoT, we have stepped up to Digitalization, allowing the taking of now automated processes and digital bits and pieces and apply gathered data and metrics to optimize business outcomes. And that’s what counts.

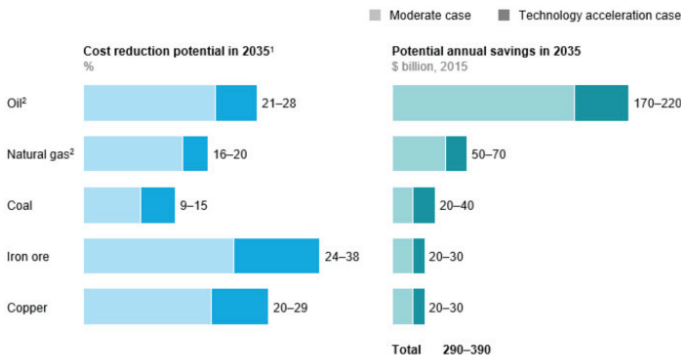
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## Technology could unlock up to \$400 billion in annual value for resource producers by 2035



<sup>1</sup> Difference between total cost per output unit (tonne, barrel) in 2035 and 2015.  
<sup>2</sup> Only upstream operations considered.  
 NOTE: Numbers may not sum due to rounding.

Source: McKinsey Global Institute

McKinsey Global Institute has recently estimated that under an aggressive data technology acceleration scenario – whereby technologies are adopted wherever it makes financial, operational, and geological sense –by 2035 producers could reap a 21-28 percent cost reduction in total cost per barrel produced for Upstream oil on 2015 levels, and an industry-level production annual saving of between US\$ 170-220 billion. For natural gas activities, this has been calculated as a 16-20 percent unit cost reduction and a US\$ 50-70 billion industry saving (McKinsey, *Beyond the Supercycle: How Technology is Reshaping Resources*, 2017).

Where exactly are these gains likely to come from? The downturn has forced a shift from a sub-surface and resource focus to a production and maintenance focus. As Crompton notes, “it has shifted from just producing more O&G to ensuring that you are producing more profitable O&G.” This has translated into Integrated Operations (IO) driven by value creation in efficiency gains over quantity gains. So, whilst in the DO you sought to produce as much oil as you possibly can, now as Crompton continues, “you can produce oil and lose money on every barrel because your operating costs are too high.”

Perino concurs. “Whilst it’s a cold climate, the focus on cost control and production – which would include drilling and completions to an extent – have received funding because anything you can do to increase the cash cow, which is production, is good.” This is about the margins that can be squeezed out on total production cost per barrel in the US\$ 50-barrel climate. “Once you have existing assets in the ground or water where the cost is sunk, your marginal cost of production isn’t \$US 65 or \$US 80 dollars a barrel, it may be \$US 15 to \$US 30 dollars per barrel so \$US 50 a barrel still makes you money so you want to make every incremental barrel you can because that’s the case you need to stay alive.”

Kozman has observed the same shift from greenfield to brownfield over the past 18 months, “to the point where we are even seeing data management staff being recast from working with subsurface

geology and geophysics data being asked to apply those same practices to facilities and engineering data.” The impact of the commodity price downturn has been “a real focus on existing assets where the ROI is going to be seen quicker.” As well as facilitating the technologies required to optimize these efficiency gains, an integrated platform can provide you with that critical data you need to calculate profitability. “It’s not just about the operational real-time data but as real-time as possible your cost data,” says Crompton.

### Key areas of Operations Support Applications

Digital operation support applications have the potential to permeate vertically across businesses units to steer functionalities from accounting and finance to executive management and HR. In these early days, however, and given the current focus on quick and deep returns, the expansion of Digitization has been firmly rooted horizontally across operations and engineering units.

Within this, production is winning out in terms of investment over exploration. “Exploration is at a several decades low, it has been starved during this three-year cycle and it’s not recovering very fast,” explains Crompton. But there are initiatives underway to readdress this balance. Halliburton have a newly formed exploration team who “are working hard to generate insight from exploration data,” Dr. Priyadarshy, Chief Data Scientist at Halliburton told Upstream Intelligence. “We are working on some very interesting areas in exploration digitization, next year we will be able to tell you the details around this.”

### Operations Deep-Dive: Maintenance and the move towards predictive and automated technologies

Digitalization is driving the shift in maintenance processes and cultures we are seeing from reactive to predictive, from scheduled-based to condition-based responses. Underpinned by the pursuit of quick gains on existing assets, this space is likely to see further traction as operator assets continue to age.

This is about reducing Non-Productive Time (NPT) by ensuring critical equipment is operating for more of the time. “Unreliability is the number one enemy of production because downtime is more important than optimization,” explains Perino. “If the well is running at 90 percent and you can optimize to get 2 percent more than that’s great, but if the well is running at 80 percent that 2 percent doesn’t make up for the fact that the well is not running great.”

Anything which reduces downtime for repairs by predicting failure before breakage, enabling repairs during planned downtimes or turnarounds (especially offshore) and lowers equipment and labor costs through known and repeat supply cycles is going to bring gains. Areas we are seeing predictive maintenance roll-out include electric submersible pumps (ESPs), compressors and haulage fleets. If you consider that ESPs are active in securing 60 percent of global oil production and that when failure occurs it is estimated that a single pump failure can cost between \$100,000 - \$300,000 per day in lost production, predicting failure can avoid significant lost production costs (Junewarren-Nickle’s Energy Group, *Digital Oilfield Outlook Report*, 2017).

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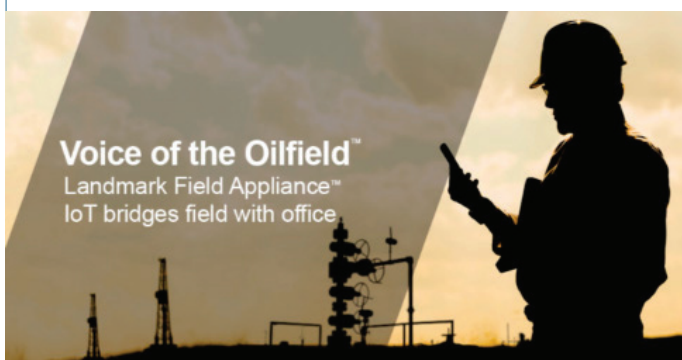
### Predictive Maintenance Case-Study: Halliburton's Voice of the Oilfield™

Launched in late-2016, Halliburton's Voice of the Oilfield™ leverages IoT networks or devices to bridge the field and the office. One of the key features is its potential to reduce the time latency currently experienced in maintenance and repair decisions and directives by facilitating the addressing of the oilfield and oilfield challenges in real-time. Ultimately leading to cost reductions and production optimizations.

"We have a sensor integrated into the field which sends a signal and the signal is analyzed in real-time or near real-time and then an actionable insight back to the person in the field so the person can take the action that is needed immediately," explains Dr. Priyadarshy.

"Traditionally, if something goes wrong it takes a couple of days to get the repairs implemented. But by connecting this tech to a pressure sensor, for example, provides feedback as soon as the value falls outside the normal range it sends a message to the back office and at the same time sends a signal to the pressure sensor to do A, B or C. So, this is about two-way communication."

**"Future Outlook:** I think the future of the industry is in this enabled through IoT and then the next level will be machine-to-machine communication, breaking it down slowly to sensor-to-sensor communication. So, at some point we should have sensors fix themselves so that we can reduce the NPT."



The next steps here are connected to automation, the first of which we are already seeing early adoption of in the field; remote maintenance. Facilitated through centralized operations centers and executed through integrated data technologies including smart video surveillance, X-ray, self-navigating drones and satellites alongside sensor data, these applications have the potential to change the way assets are monitored, which will have growing appeal as new projects target increasingly remote and/or hazardous locations. SkyWave have identified seven assets which are particularly receptive to remote monitoring in terms of the efficiency and cost gains; compressors, tanks, LACT meters, rectifiers, test points, PIGs and gas meters.

BP is already using drone technology to inspect pipelines at its remote Prudhoe Bay field in Alaska, while GE is currently developing a drone called Raven, which can sniff for methane emissions at well-sites as proven during a trial run in July 2016.

The next innovation area here is likely to be Artificial Intelligence (AI) facilitating the automation or semi-automation of maintenance workflows. Just as predicting failure does not mean preventing failure, being digitized or automated does not mean being smart, and in the case of maintenance you want technologies which allow for both the prevention and the repair. This is where AI comes in as Shahab D. Mohaghegh, professor at West Virginia University and founder of consultancy company Intelligent Solutions, Inc. has noted:

"There is a misconception in our industry today that equates automation with intelligence. Just because an operation is automated does not mean that it is smart. Without AI, you may have automated fields, but you will not have smart fields. An automated field may provide the brain, but AI provides the mind. AI is the language of intelligence; it is what makes the hardware smart. To fully realize this, one must subscribe to a complete paradigm shift" (*Society of Petroleum Engineers Journal*).

This is exactly what Perino is referring to when he says the next challenge for the industry is to integrate all the data and technologies to move from data-driven decisions executed by humans to data-driven decisions executed automatically. "You forecast a deterioration in a pump or compressor and you say OK there's a 90% probability with a 90% confidence that this compressor is going to fail in 30 days. That's good but what do you do with that information? Most people playing with the tools are at that point and then they say OK now I need human to do all this work... I might have a prescription where it says you can do A, B or C, but someone needs to say OK I'm going to do B. Do I need to do that manually or can I close the loop on the actions and have the work automated, or semi-automate the work where you have points of human intervention to make sure you always have approval of what you are doing? I predict my pump to fail so I want to schedule my technician to go to the well two weeks before it and take a look at it. That could be automated now. Right now I don't see people integrating the systems to do that but can we do it from an IT perspective, yes."

Tony Edwards agrees that we should be targeting these ambitions. "Certainly we see that data driven decision making and automated or semi-automated workflows is the way to go. But most of the highly valuable workflows are those which require people in the loop, so collaboration is needed. Close looping those operations is very difficult, its technically feasible, but nobody has done it."

Crompton talks about this in terms of moving AI from a tool to a co-worker. "As the data sciences begin to figure out untraditional ways of bringing the data together and broader insight into what is happening then you code those up into algorithms and the algorithm is the AI as your co-worker." For Crompton, this shift is intrinsic to the demographic changes we have witnessed in recent years – both the natural retreat from the industry as the first generation of O&G workers retire, and the depletion of c. 350,000 people because of the downturn squeeze – the subsequent collective lowering of industry expertise, and the systematic push for production optimization. "The radical change here would be to produce more oil with less people ....so your robotic co-worker needs to be just or even more productive than the old-school guy who left before who run more on experience than data."

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The benefits associated with automated-centric tech are almost as far-reaching as their potential technological capabilities. One of the metrics often overshadowed by productivity gains is that of risk mitigation, both in terms of safety and security through reducing the human footprint within operations. Indeed, Jess B. Kozman has worked on projects where they've justified the cost of the data management component from the reduced risk of putting people out in the field. "You get the QSHE department to pay for the data management project because their insurance rates go down when they've got less guys driving around in a truck in the desert, it's pretty easy to justify the cost of a BDM project if you look at those kind of numbers."

### The Vendor Landscape: A changing services apparatus

Integrated, end-to-end solution platforms form the basis of the commercial architecture needed to facilitate production efficiency initiatives across workflows, with 32.8 percent of surveyed operators indicating they will be investing in such frameworks during 2017.

As Perino observes, "first you have to go out and buy the databases." The Big Data technologies we are seeing in O&G are essentially based on the Apache™Hadoop® project, an open-source software framework which allows for reliable, scalable, distributed computing (Hadoop, 2013). "The biggest thing we have seen come into the space in the last 10 years to deal with the different structures and dimensions of data in O&G has been Hadoop," Perino explains. NoSQL databases have also emerged within the last decade. Most operators now have Hadoop, or a version of it, and are at the experimental stages of usage through applications or pouring the data into it.

Most software innovation has been coming out of a small ecosystem of O&G contracting companies; Halliburton, Schlumberger, GE Oil & Gas and Weatherford, who have expanded into the digital space from their non-digital core competencies. The big IT providers include Microsoft, IBM and Oracle. But the vendor ecosystem is expanding at pace. "I've got a spreadsheet with 14 start-ups in O&G analytics," notes Perino. The numbers of non-O&G specific analytics companies

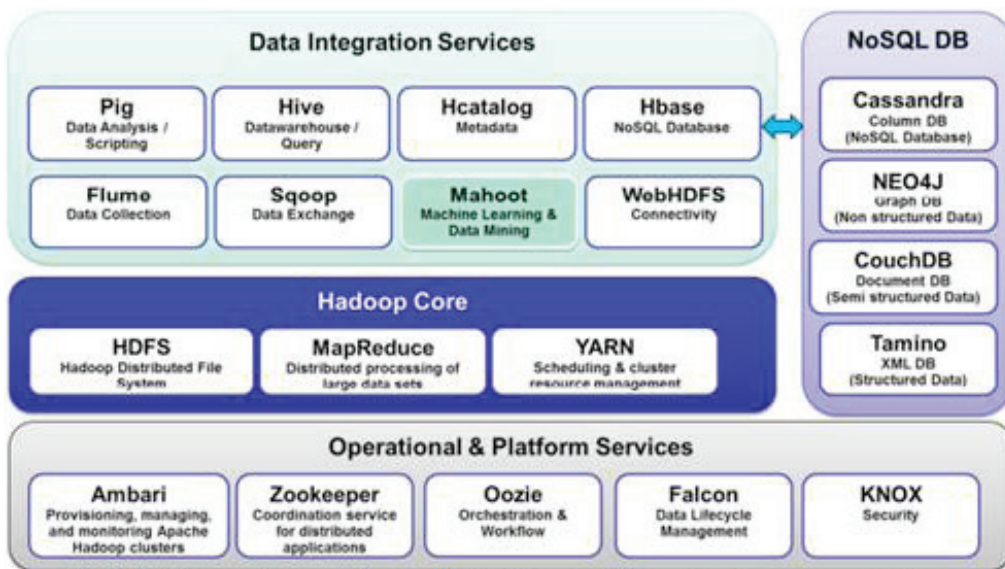


**"An integration framework is the enabling technology suite that allows the seamless transfer of information from collection, to analysis and modelling. The purpose of an integration framework is to enable the transfer of information between various applications, according to a defined workflow and the presentation of information in such a way to facilitate decision making. In a word, this is about interoperability."**

*Upstream Intelligence, Offshore Digital Services Report: Well Integrity and Production Optimization*

will be over ten-fold that number. Kozman has similar observations; "we are seeing the O&G market being bombarded now primarily by software providers saying look we've got tools that can help you do the big data audits you need to be doing."

It's a bit of a chicken and egg situation. Is an acceleration in operator appetite driving vendors now to tap into the O&G potential returns? Dr. Priyadarshy notes how Halliburton have significantly invested in this space and now have the fastest growing data science team in the industry." Or, as Kozman poses, is it a case "the awareness that big technologies are out there having caught up with the industry now and operators are now saying OK where do we get this." It's probably a bit of both.



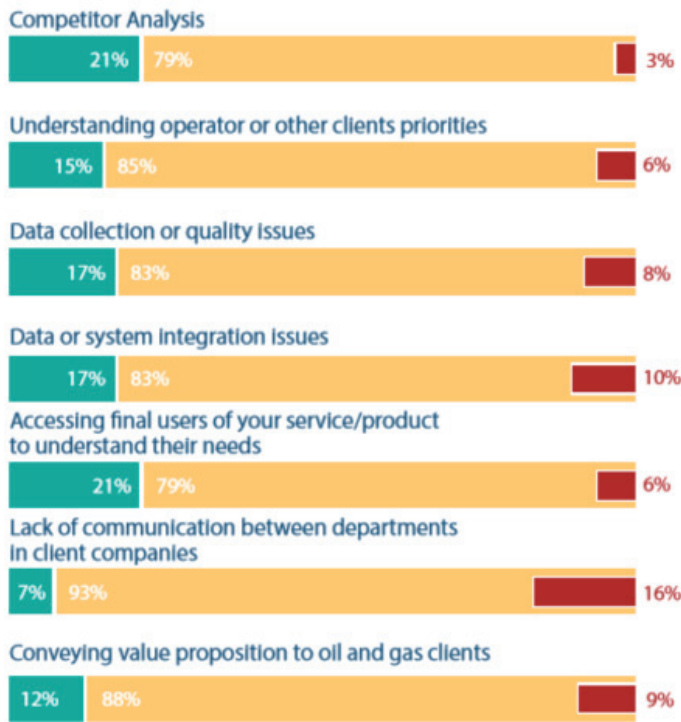
Source: Hadoop Ecosystem

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## What are the main challenges you face?



**% Not a Challenge**  
**% Is a Challenge of which % is Extremely Challenging**



Source: Upstream Intelligence Data Driven Oilfields: Challenges and Opportunities Survey, 2016

Concurrent to their investments, Halliburton have experienced a U-turn in operator interest in BDM and their DecisionSpace® integrated platform over the space of the past six months. As Dr. Priyadarshy explains, “three years back no operator was talking about this when we were at the US\$ 100 barrel. When it started falling even then they were not really talking about it. Now in the past six months we are seeing the same operators who I have been going out and meeting over the last two-to-three years approach us and asking how Halliburton can help them.”

Importantly, the changes we are seeing in the vendor landscape are not just confined to numbers. A significant regrouping in the non-O&G specialist analytics sector is taking hold, as Kozman explains. “What software and solution providers are finding is that having worked with data first companies – the Amazons, Facebooks, and insurance companies – they survey who else has a lot of data which leads them

to O&G and they think ‘OK that ought to be easy.’ Wrong. “They find themselves mired in all the silos and 40 years of legacy data on existing brownfields,” continues Kozman, “so now you’ve got regrouping of the vendors who are coming back and saying ‘now we’ve got subject matter experts in petroleum engineering’ .... they have learnt they need to speak in a language targeted towards the industry.”

There is also a diversification taking place on the data acquisition side of the service apparatus. “In the US market, we are seeing, particularly among small independent operators, the contracting of companies like ZEDI, Seven Lakes Technologies, PetroCloud and WellAware, to do all the field wiring, cutting data and putting into the Cloud,” Perino notes. “This is growing quite a lot, especially with operators that don’t want to have field operations.”

Again, quantifying the value proposition at the BDM project or platform level is complex. “When you go to the Big Data domain you are dealing with an exponential rise in the total economic value,” explains Dr. Priyadarshy. “It’s not like you can say here is a US\$ 1 million investment and you are going to get a return of US\$ 1.5 million because you cannot know how quickly the value is going to rise until the complexities of the challenge are known.”

Currently we are seeing upwards calculations around specific applications or point solutions over top down ROI calculations from rolling out a Hadoop, for example. “I think that will continue to be the case until it becomes evident that there are mature platforms that you just go and buy and it’s obvious to everybody what you can do with it and what the return is, but we are not there yet,” observes Perino.

Gaps in the service offering landscape persist. While Halliburton is engaged in pulling actionable insights in various areas including exploration, drilling, production, etc. the challenges in areas are diverse, for example in exploration “the challenge comes from a compute point of view.” The focus in production over exploration is not just a driven by the market but by the fundamentals of technology. As Perino notes, “exploration is a specialty data management area which means Hadoop cannot be utilized here owing to the type and scale of databases required.” To illustrate that point, in mid-February 2017, Exxon Mobil announced a breakthrough in reservoir simulation, when in conjunction with the National Center for Supercomputing Applications (NCSA) they run a parallel simulation which used 716,800 processors, the equivalent of harnessing the power of 22,400 computers with 32 processes per computer (World Oil).

Diversification in service offerings are also required to reflect the vast disparities in operator budgets across the board. “You need a dozen or so vendors that can offer platforms that can scale for small producers as well as the BPs of the world,” observes Perino.

There is also a challenge occurring between the technology world and operational O&G world, which could be hindering the pace of IO maturity. As Crompton explains, “the potential for digitization to change the O&G workflow in a radical way does exist, there just aren’t very many companies or people trying to change in a very revolution way.” With the focus firmly on incremental, evolutionary gains, “there is the risk that the technology world pushes the O&G world way down their list of adoption priorities because of the reputation as slow, conservative, risk adverse adopters.”

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A DNV GL survey in late-2015 revealed that only one in five O&G operators considered themselves digitized enough (DNV GL, A New Reality: The Outlook for the O&G Industry in 2016). Kozman agrees that “operator uptake has been slow to sluggish,” while Perino has noted that although “they are not going hog wild they are not cutting spend off whereas they have in other areas like staffing... I think it will pick up more and more as they see the results.” That final point really gets to the heart of things here; uptake is dependent upon proven or provable technologies with a business case built around them. “There is a need for a cultural shift,” notes Dr. Priyadarshy, “but I can tell you that once people understand the value of it they are quickly converted to this new culture of doing business. That number of people is still small, but it is growing, and given all the market conditions has probably grown at the right speed.”

As Edwards points out, there remains some engrained barriers to adoption. “Firstly, you still have companies in a state of semi-denial that the price of oil will go up and everything will OK. While that’s a diminishing number of companies it does hinder digital rollout.” Conversely, you get other companies who acknowledge this climate is here to stay so they need to do something different to navigate it. “But when you look at what they’re doing,” Edwards continues, “they’re just pulling all the traditional levers, like laying off people and trying to streamline. That might get you a 15 percent, 20 percent, or even a 25 percent reduction in cost but it’s not going to get you a 50 percent reduction. If you want a 50 percent reduction in cost, especially across the board you’ve got to really come up with a completely different operating model, which is enabled by analytics.”

One way to think about uptake is through the lens of operator class, whilst recognizing there will be exceptions within this. “If you organize operators into three classes you get a better reflection of what’s happening out there, and why or why not as the case may be,” explains Crompton.

It is the mid-tier, large independents who Crompton sees as leading this space in terms of front line activity. “It’s the Devons, Chesapeake, EOGs, Pioneers, who are really trying to make analytics work for them and to be smarter, more data driven.” This is a practical campaign rather than academic strategizing. “They’re setting up centers of analytics excellence which include attempts to manage all of this data and operationalize it through use of the new technologies to drive quick decisions like where is the best place to drill and what is the best technique to drill with.”

By contrast the losses recorded by global Integrated Oil Companies (IOCs) over 2016 is delaying the commercial rollout of BDM until a return to cashflow neutral or positive is achieved, Crompton contends. “Their major driver right now is return to profitability ... they don’t have a BDM rollout program because their focus is on reducing cost.... There’s no question that they are capturing data, there’s no questions around appetite to use it, it’s just been on a piloting basis.”

And in terms of the smaller operators? Well, as is common practice across their activities outsourcing to 3rd party providers appear the most common approach. “They are very quick and agile and are spending a lot of money, but when it comes to Big Data they are wanting to buy that as a service from their drilling contractor or maintenance facilities contractor rather than build an internal data

lake.” What this means in terms of feasibility around achieving ‘cross-functional solutions’ in this segment remains unclear. With small operators drilling most of the wells in the Permian Basin, and with the Permian accounting for c. 50 percent of all wells being drilled in the US, there is a big opportunity here for 3rd party vendors.

Perino added, “Consider the fact that we have 600,000 wells here in the US alone, and according to World Oil’s 2017 Forecast, we will drill another 18,000 this year ... there is no way companies can keep up organizationally with this growth, especially if the oil price rises. They don’t have enough qualified people and in today’s price environment, their cost structures won’t support mid-to-long term linear build up, so leveraging technology is the only way to handle it – this is a major forcing function in favor of BDM.”

## How to optimize the efficiency of a data integration platform

An integrated data platform can positively impact upon production optimization in two key ways:

- 1) **Reconciling legacy of productivity loss**
- 2) **Productivity enhancement through interoperability**

### *Reconciling legacy of productivity loss*

Before you get to the point where interoperability can occur you need your integrated framework to enable streamlined, coherent and accessible data environments to the right people, in an efficient manner. The legacy of siloed workflows and ad hoc data management cultures means that there is a lot of work to do just to clean-up the data and facilitate continuous processing into a platform.

The impact of this on productivity should not be underestimated. “Today, especially with regards to trying to access data, the workforce has been suffering poor productivity now for a decade,” Crompton observes. “All of the data which is collected is not being used efficiently and it still takes most your time looking for the right data, including correct formatting and level of quality.” Teradata have estimated that the upstream industry loses US\$ 8 billion per year in NPT as engineers spend 70% of their time searching for and manipulating data.

These issues concur with PPDM observations across BDM projects, as Kozman explains. “Invariably the first thing that happens in any of these projects is that in the initial run of trying to use the data it is revealed how disparate the data is, how much lack of standards there are... The way that shows up they’ve usually scoped the project and they discover that 60-70% of their project is spent on data clean up before the get to the analytics part, and that figure is very consistent no matter size or structure or location of organization it’s the same story.” That impacts project costings and deliverables in the first instance, but can also limit the ability to reach interoperability. “They often discover that they just haven’t been collecting the data either to a high enough quality or they haven’t been collecting it long enough with consistency in quality to build up the model that they need to use that data to support a business decision,” explains Kozman.

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### Productivity enhancement through interoperability

In 2015, McKinsey calculated that “less than 1 percent of all data from an oil rig reaches the decision makers” (McKinsey, *The Internet of Things: Mapping the Value Beyond the Hype*). That utilization rate is exactly what operators are seeking to enhance when investing in an integrated data platform and holistic approach to BDM. To do this there are several organizational and cultural shifts taking a required on both operator and vendor side.

## 1) Vendors: Target the right business units and decision makers

“It needs to be business driven, we always say that but it’s true,” explains Perino. In the current climate, business is focusing on production, and more specifically on operational efficiencies. Vendors need to make their value propositions resonate with the units and stakeholders leading this charge, which means broadening out from their traditional IT client base to asset management teams. “It is a challenge for the software companies,” remarks Crompton. “They know how to do IT speak but now they need to translate this to how will this new technology help me to produce more O&G at a cheaper cost, more safely and with less environmental impact.... And they have a hard time telling that story.”

This is about who they are sitting round the table with now. “The typical engagement that I see in the past 12-18 months,” Kozman notes, “is a subject matter expert from the discipline – so the end-user of the data – and that’s most likely to be a facilities engineer or production analyst today over a geophysicist or geologist because of the move in focus from exploration to surface operations.” IT is not out of the picture completely, but their role has been redefined to facilitator rather than business driver. Kozman continues, “there is always someone from IT at the table, they need to understand the architecture, bandwidth and connectivity required by the project.” The third component here signals a bridge between IT and operations. “These are the sensor and instrument guys that really understand the nuts and bolts of how things are connected from the field to the operation center.”

Halliburton are witnessing a similar shift. “Most of the drivers come from the business side, whether you call them asset managers or operational managers, those are certainly our key customers today,” notes Dr. Priyadarshy. They are also seeing HSE as a growth area which will no doubt require another linguistic expansion, and investment from some operators in data-specific roles like Digital Officers and Chief Analytics Officers. “It’s not the same as what we did a few years back with DO so you have to think very carefully about these new challenges prompted by Digitization,” Dr. Priyadarshy comments. Indeed, Perino contends that one of barriers to DO rollout was the focus on IT. “It was very IT driven which might be why it didn’t get very far at least initially.”

And at the highest level, the sponsors of these integrated data initiatives are the Chief Operations Officers (COOs) not the Chief Information Officers (CIOs). “They are the ones who bring together operations, maintenance and now even finance with the emphasis on cost,” observes Crompton. “This is where ‘they are changing the business architecture.’”

## 2) Operators: Expose your workforce to a cross-discipline culture

Organizational restructuring is taking place within operating companies to ensure that the key decision makers are gaining exposure to the core business elements they need to conceptualize and execute a truly integrated, enterprise-wide approach to BDM. “You will see more people in IT with an engineering background, for a career stop at least,” notes Perino, “and senior engineering managers take a role as head of IT for a period to get familiar with that side of the business.” Crompton concurs, “people pinpointed early on to be a potential CEO or VP are now given an IT stop somewhere in their career”. So, this isn’t about a departure from IT, it’s about structural change which promotes integration between disciplines which have traditionally been isolated from one another. “I’ve seen organizations fail to adapt and suffer subsequently through value extracted from data,” Perino continues.

As Edwards explains, “at Stepchange Global we’ve done quite a lot of work with defense contractors and they say things like the first wave of transformation is a technological wave, the second one is an organizational wave. And we’re only part way through the technological one and some companies are only just realizing there is an organizational problem to tackle.”

## 3) Operators: Engender and embed a data management culture

“Understanding how to leverage the data analytics is a process by itself and I don’t think the industry currently has the right caliber of people to address that,” contends Dr. Priyadarshy. The problems are broad. We are working against a culture of historic in-house mistrust of data compounded by fragmentation of data sources and staffing cuts reducing overall expertise levels. This means getting the value of the big data proposition is inevitably going to be a very complex process.

“We’ve been working in digital oil for 15 years now,” notes Edwards, and whether you call it analytics, Big data or data visualization we always see the same problem, how do you get people to make a different decision and action of the back of it?” For Edwards, the issue isn’t in the analytics or technologies, “the problem is integrating them into your day-to-day operations and getting the workforce to believe the output and actually do something different based upon that.”

Halliburton believe a paradigm shift is required in how data is approached to extract business decisions. “It’s about looking at the answers from the data and then asking the right questions.” As Dr. Priyadarshy explains, that goes against the traditional way of business intelligence, where the data is used to get answers for a question they have. “It then very slowly boils down to operational level questions and then to the technical level, so people have to learn how to ask the second and third level questions.” Integrating data using E&P platform technology is gaining investment ground, corresponding investment on getting value back out of it is falling behind.

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#### 4) Operators: Treat data as a corporate asset through standards, standardization and governance

To a resource focused industry, treating something as abstract as data as a corporate asset, especially when the value proposition is not always quantifiable and clear, is a big ask. At the in-house level a push towards carving out processes for standards and governance will be central to moving into the terrain of data as an asset, whilst simultaneously boosting the value coming out of your analytics and data-driven operations.

This isn't going to be a straightforward task. Firstly, as Crompton recognizes, there is a real challenge here. "Data governance. It gets to the heart of the question every company needs to answer and that's who owns data? Is it a corporate asset or individual asset? Does it belong to the business or to IT?" Crompton fears data is currently falling between a crack between being a personal and business asset. "I think data should be considered more as an enterprise business asset, but that requires a cultural shift for a lot of O&G companies who have come to see data as a personal asset, managed and consumed as a part-time job by the engineers and their shadow IT systems and these things are difficult if not impossible to integrate in an IOC environment." The gap emerges when IT takes management of the infrastructure which houses the data, but the engineers are reluctant to manage the data themselves. The solution is establishing independent units within organizations that deal with data governance, but that's not currently being seen in O&G. "You can go to high-tech social media sort of organizations and you will find a CDO, but an O&G company would say what the hell do we need that for?"

Kozman agrees on the value of in-house governance. "Internally they need a data governance process which recognizes data ownership and data validation from the subject matter experts within their own organization and then they are ready to adopt industry standards for things like naming conventions and format." This should be treated as a process not a project warns Kozman, something not currently embedded in the industry. "So they say OK we'll clean up all the data and what they fail to realize is that during this time they are spending six months cleaning up you've got new types of sensors connected, collection frequency is ramping up every 18 months, new technologies coming on-board, new types of measurements," The key here, Kozman continues, is to put in a data management process which "is at a high enough level and with broad enough granularity that my best practices around data governance will apply to the new data types as they come in; that is the only way to manage your data asset."

There are some cautionary notes here, as Edwards points out. "If you standardize on industry standards that could be a bad thing because you are accepting the status quo. It's an unusual stance, but the really interesting stuff we are seeing people do with analytics they are not doing it as an industry standard approach, they are really way out in front of that."

#### Concluding Remarks

At the outset, we established how investment in BDM was happening not in spite of the downturn but because of the very pressures it has been placing on operators bottom lines. Specifically, the downturn has focused attention towards the most advanced stages of BDM in the pursuit of extracting quick and production-focused gains based upon data-driven business decisions. With the IEA forecasting further downward industry spend for 2017, BDM is likely to continue featuring as an important mechanism within the drive for production efficiencies.

Concurrently, the downturn is hindering the universalness of rollout across the industry and the maturity of the approaches being carved out. As we have seen, for example, many IOC's are taking a conservative approach to BDM in this pre-return to profitability climate, with minimal front-line execution in favor of conservative monitoring of technologies and backroom strategizing.

"Is it being used uniformly?" asks Perino, "no, we haven't jumped the Crossing the Chasm gap yet, people are still migrating across it. There is a lot of testing and they don't yet see a clear vision across this fog of services and products floating in front of them."

Quick point solutions still appear to be winning out over truly integrated, 'cross-functional solutions'. So, for example as Kozman observes, "going into this year people are looking at their budgets and saying 'OK we are living with this commodity price for the next 18-months where do we get a big hit?' So, we are seeing a lot of retrofit through upgrading sensors so they can feed that data to the new technologies." The concept of integrated data platforms specific to O&G functionality is still in a relative state of infancy, so this is not a simple case of industry conservatism but a chasm within the service space persists. "The only person out there who probably has a platform with a bunch of services to it which have gone through pretty well is GE," contends Perino. "There are other platforms out there but they are not O&G orientated."

If the 'Holy Grail' here is "optimization of asset performance through its whole lifecycle," as Crompton notes, then an integrated data platform vertically and horizontally connecting units to drive through timely, quantifiable and proven business decisions can unlock this.

One of the earliest signs we may have on BDM's success in lowering production costs is coming out of the Permian Basin, where breakthroughs in extraction of unconventional is showing up in profitable operating costs. "One of the successes of the Permian's US\$53 per barrel is operating costs of US \$35, so they are making money," explains Crompton. "It does show up on bottom line in terms of cash flow. It does turn up on looking at those who have lower OPEX. You can quantify in those kinds of ways but it is kind of behind that – the data driven part of it is the enabler of these results."

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