



Rice University's Baker Institute for Public Policy

The Future of Oilfield Services

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With

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Neither United States (“US”) nor global oil and gas operators of any size, public or private, can function without oilfield service (“OFS”) support. This form of industry organization is the result of a long evolution and repeated business cycles that have profoundly impacted how the oil and gas industry, on the whole, does business. In 2019, OFS suppliers were facing yet another period of adjustment as soft oil market conditions impacted operating company budgets and industry activity. Now, the harsh conditions associated with COVID-19 energy demand reduction, along with disarray among the large sovereign producers and exporters of oil and collapsing oil price, are intensifying pressure on OFS corporate management to respond with even deeper restructuring.

In this conversation with Andrew Gould, we explore the history and underlying dynamics for the OFS segment and future prospects.

Michelle Michot Foss (MMF): Ever since the “Big Re-Org” decades ago – major companies shutting down their internal drilling and seismic crews, offloading technology into the market, and so on – OFS has been the flea at the end of the dog tail. It is always reactionary; companies are never able to sustain cash reserves; and they really have no way to sit on unutilized capacity.

Andrew Gould (AG): Some reflection on history is always useful.

Prior to the oil shocks of the 1970’s many oil companies besides exploiting their assets also developed and deployed what would be thought of today as service company technology. They maintained their own service divisions and owned their own service equipment. This was particularly true outside North and South America as the service industry had an immature geographical presence in the eastern hemisphere.

As a result of the sustained explosion of E&P [Exploration and Production] activity following the oil price surge of 1973, the service industry began to invest in rapid worldwide expansion. Growth from 1973 to 1984 was phenomenal. By the end of the period, the service industry found itself with many new players, a deeper understanding of technology, and the wherewithal to deploy it worldwide.

MMF: It is always interesting to see reactions when people remember, or did not know, that oil companies as we know them today provided much of their service and support internally.

AG: It was one of the early, substantial cost-cutting responses by the operating companies. The age of oil companies having their own service operations was fast diminishing. Service companies began spending extensively on R&D to improve their relative competitive position, and operators substantially reduced their service arms.

Then the oil price collapsed in 1986 and, for the following decade, activity fell. The world steadily absorbed the excess production capacity established in the 1980s, prices remained depressed, and everyone began scrutinizing budgets. R&D became more focused on reducing finding and development costs, and operators recognized duplication between their own efforts and those of the service companies. Operators closed whole departments and even whole laboratories. They also sold off the last of their service assets – mostly the offshore rigs and seismic boats they had built a decade earlier to ensure they had supply – in a situation not dissimilar to what is occurring today.

The trend continued, with R&D spending by the major international oil companies, which although it increased rapidly, not matching the overall rate of increase of the service industry. Even through 2019, the large players in the service industry provide more than one quarter of the total spend. It is also interesting to note that despite the continual drop in overall industry R&D spending, E&P efficiency has held steady or improved largely through the benefits of technology and increased competition.

Low oil prices through the 1990s also led to massive consolidation in the service sector where the three major service companies expanded from small enterprises specializing in particular technologies to global organizations offering a wide spectrum of services and products. Backed by strong R&D and considerable training resources their range of competencies increased. They have at times been pushed in this direction by the operators themselves who looked for greater integration at the level of their suppliers to reduce cost. You may remember Shell's "Drilling in the Nineties" and BP's "Partners for Profit" both aimed at reducing drilling costs in the North Sea through greater integration of the service providers. For several years running in the 2000's PEMEX was by far Schlumberger's largest customer due to the appetite for fully integrated projects.

MMF: I was at Simmons & Company International when OFS consolidation got underway and the operator-service company integration was starting to happen. Those were rough days, but exciting.

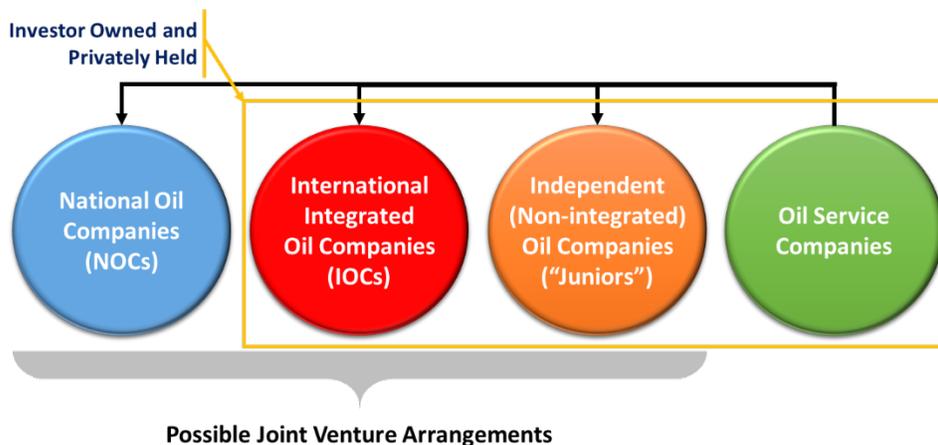
AG: So you have a feel for the times. As we entered this new century, well before 2019, before the oil market turmoil of 2014-2015, the industry was going through a period of almost unprecedented growth in activity. We had been trying to increase supply through intensive care of the existing production base while trying to engage new exploration and development at the same time. Before 2015, there were 50-100 new offshore rigs under construction per year – unprecedented since the early 1980s. New people were entering the industry in their thousands with the issues of safety, security, and efficiency that implies. Indeed, for much of the time, from the early 2000s until the most recent years, oil companies were challenged by new and difficult hydrocarbon

sources, changing fiscal terms, cost inflation, and a general decline in operational performance as the whole industry struggled to grow. In the four years prior to the 2008-2009 recession, E&P spending had more than doubled. Emergence of the US shale oil plays added \$200 billion a year just in domestic onshore industry spend. Prior to the current state of affairs, the IEA [International Energy Agency] estimated that spending in upstream oil E&P would still need to total more than \$500 billion per year between 2018 and 2030. And about \$400 billion dollars of investment would be needed for natural gas infrastructure and supply over the same period.

In all of this, if we look at other industries, notably the automotive and aerospace industries, we seem to have followed a remarkably similar pattern. In automotive, suppliers have become increasingly innovative to the point where much of their technology is provided to automobile manufacturers as a “black box”. A similar evolution is currently taking place in the aerospace industry where the advent of highly successful budget carriers coupled with rapid growth of air travel in the Middle East and Asia increased pressure on them to engineer a lower-cost product. In the electronics industry, the engagement of the supplier base in product design has been a feature of the industry since its inception.

MMF: Interesting to think about the analogies. Texas Railroad Commission member Ryan Sitton alluded to “autos” when discussing shale operations during a Tudor, Pickering & Holt Close of Business webinar April 21. And your landscape was shifting rapidly in terms of the OFS “customer.” In fact, I have a visual that we used for many years. The world looked something like this (Figure 1)?

Figure 1: Worldwide Industry Organization



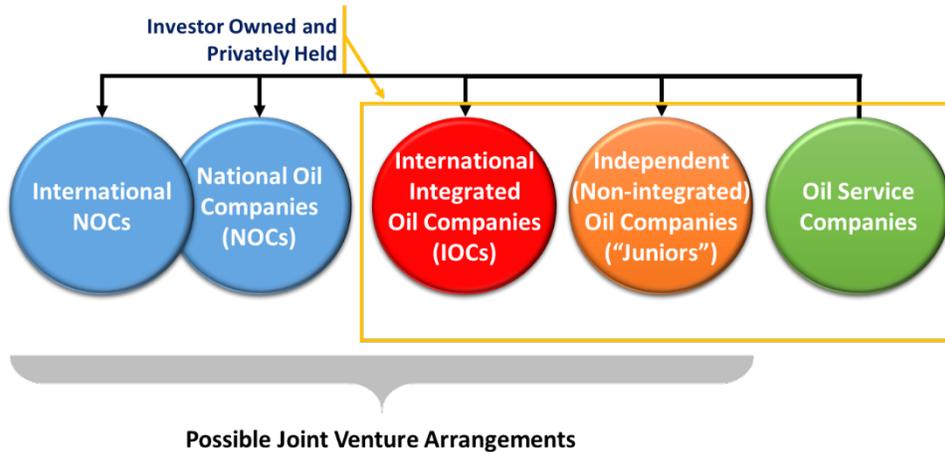
Source: Michelle Foss, Rice University’s Baker Institute (2020).

AG: I made a speech at a national oil company [“NOC”] conference in 2008, which gave my views on that [shifting customer landscape]. The customer base that the service

industry supports expanded dramatically. While I was at Schlumberger, from roughly 2003-2008 we added over 800 new customers. We changed our client designation from the traditional three (IOC [international oil company], NOC, independent) to add a fourth category, the “INOC,” or international national oil company. With the entry of INOCs, our management and account management structure had to be adjusted.

MMF: So, perhaps, this view (Figure 2), in reality.

Figure 2: Worldwide Industry Organization



Source: Michelle Foss, Rice University’s Baker Institute (2020).

AG: I can make several observations about differences among customers and trends that were prevalent. For one, the willingness to exploit the R&D capability of the service industry is much more advanced among NOCs than it is among IOCs. Statoil, now Equinor, Saudi Aramco, Petronas and Petrobras were stand out leaders. Second, it became insufficient to develop projects at laboratories located in the traditional areas of R&D in the OECD countries. There is a real desire to expand the host nation technical capacity. Third, there is a remarkable increase in the outsourcing of parts of the E&P process to the supplier base. Countries who adopt the outsourced process model see it as a way to accelerate their access to the technology learning curve. For them, observation of the work process, training of their personnel, and learning new methods are extremely important parts of the decision to outsource. Two other trends are important for service companies to build successful relationships with host governments and NOCs. The first is the need to maximize the creation of local employment. The rise of the national oil companies also led to an extraordinary thirst for the education and training needed to create a large enough body of skilled E&P professionals and local sources of supply. The Petrobras local content initiative and the Saudi Arabian IKTVA [In Kingdom Value Added] program are perhaps the most advanced examples of all these trends.

How quickly times change.

MMF: But I suspect that these driving forces and trends would not change much as the industry recovers. So, thinking about recovery, has anyone given thought to new financial models for OFS?

AG: Michelle, there are three basic ways that OFS has made good margins in the past and only one of them proved sustainable, at least it was until the recently departed CEO of SLB [Schlumberger] decided to indebt the company to invest in E&P.

Method 1: Periods when short-term demand for OFS exceeded supply and services were rationed to customers through pricing

It happened twice in my career. The first time was post the Shah's departure from Iran I was working in Asia and the sudden increase in activity led to a period of three years where we were short of equipment, short of engineers and we rationed mercilessly through price. The second time was in 2005-2006 when post the acceleration of demand in China Saudi launched their wave of mega-projects and E&P investment generally increased. Customers were fearful of a supply shortage and rushed to tie up equipment and people. Again, we allocated equipment to some extent through price, though we did increasingly take into account customer quality and perceived loyalty.

Method 2: Early mover in geographical presence and political risk taking

Here, there are two chapters in my experience that stand out. The first was again in Asia post the Shah. At the time, the only real service presence in the Far East was SLB and HAL [Halliburton]. At the time both companies dominated their respective core product lines and commanded huge market shares and therefore to an extent price. The broader US service industry had not yet moved out of North America. In the ensuing period, particularly from 1982 onwards, the smaller US service companies began to expand internationally and inevitably gained market share and eroded the margins that the incumbents had enjoyed. BJ and Gerhart Owen were fierce competitors. The Middle East markets opened at this time. It was, of course followed by a period of consolidation after the oil price collapse of 1986 and the big service companies increased their offerings and capitalized on their infrastructure investments to operate at lower cost.

The other example was the opening of the Soviet Union. In 1997, the ruble collapsed and the expropriation of state oil and gas assets by the first generation of Oligarchs took place. They turned to the western service industry to try to improve performance. Mikhail Khodorkovsky of Yukos turned to Schlumberger and Halliburton and requested that we advance him \$200 million of services, which he would reimburse us at the end of the first year. We went ahead. Twelve years later SLB had a \$2.0 billion business in Russia which remains today one of the most profitable geographies in the company. Khodorkovsky did pay after one year with a little friendly persuasion.

Method 3: Sustained technology lead and creating value for the industry

There are, in fact, very few products or product lines in oilfield services that contain technology that can make material differences to the oil company performance. Much of what OFS does can be equated to fairly complex civil engineering or industrial construction. This is certainly true for the EPC [Engineering, Procurement and Construction] contractors, much of well construction and surface equipment, pipelines and tank storage etc.

The only product lines that add true value are those that enable the oil companies to find, understand, plan and ensure that the maximum of the discovered hydrocarbon is extracted from the subsurface. Some seismic, open hole wireline logging, directional drilling combined with logging-while-drilling, geosteering and rock and fluid analysis are the obvious examples. Certain subsea equipment that must have the same reliability as space travel due to the lack of access is another. They are also the technologies that require the most extensive R&D and where the construction of the tools that are used is the most complex and difficult. I could give you many examples of where physical measurements commonly used in medicine in or around the human body are adapted to use in the subsurface at pressures and temperatures that can reach 15,000 psi and 300°C. These are complex engineering problems that are not easy to solve. The value of these services increases with the cost of exploitation of the hydrocarbon source. Deep and hot, offshore, particularly deep water are markets where the knowledge these services bring is so vital they have relative price elasticity. They are also essential to optimize recovery and therefore are extensively used in countries where long term recovery is a priority, notably the Middle East NOCs. This was the model on which the Schlumberger brothers built their company and it proved resilient through several downturns.

MMF: Looks like one or all three of the profitability methods might still apply to the provinces you mention (hot and deep, offshore and deep water). But let us turn to the topic of extreme interest these days, the US shale plays. This is a particularly acute US problem. "Real time" shale, or at least more responsiveness in domestic operations and production, hinges on availability of OFS. "Frac" [fractionation] spreads need to show up. This has been so expensive, and so detrimental to OFS margins.

AG: If I belabored the points above, it is to draw the contrast with shale, a poor rock with very low recovery rates, which was undertaken with a completely different method of exploitation.

MMF: During a meeting we attended years ago in Washington, D.C., a friend of ours, Bobby Ryan [retired Vice President of Global Exploration, Chevron] once called it "crummy rock."

AG: I like Bobby Ryan's rock description.

Shale does not lend itself to traditional methods of reservoir description and recovery. The industry quickly realized that the sophisticated methods used in conventional exploitation would be too expensive and would not necessarily advance the problem. They therefore turned to a much cruder but nonetheless effective method of production, which was blasting open the rock on the basis of geometrical patterns with hydraulic fracturing ["fracking"]. This led to the horizontal drilling and massive fracturing paradigm for geometric completions of increasing numbers of stages. Once this was embedded, productivity improvements came quickly. "Super fracs" made individual wells more productive. Pad drilling enabled the logistics that got all the equipment, personnel, and consumables to multiple wellheads more efficiently. Pad drilling permitted "zipper fracs" and "24x7" operations. Finally, drilling and completion engineers got better at drilling and fracking in the basins they work in - as they always do in this industry.

I described this process on a conference call in about 2009 as "brute force and ignorance" where the result was obtained but at the cost of huge waste. Since then the methods of using hydraulic fracturing have improved and considerable efficiencies have been achieved but the underlying problem remains the same. Poor rock opened with fracturing, subject to rapid pressure depletion leads to very rapid production declines. None of the classic means of maintaining pressure or re-pressurizing the rock was available. This meant that to sustain production new injections of capital were constantly necessary. The business remained extremely price sensitive, and as the last six years have shown, oil price fluctuations have meant that oil companies have to rapidly adapt to market conditions. Also, the poor returns and the need for constant capital injection have meant that shareholders have seen no, or very little, return on their money. This began to change in 2019 with shareholders finally realizing they were getting no return and were not likely to as long as the shale companies managements objectives remained production growth.

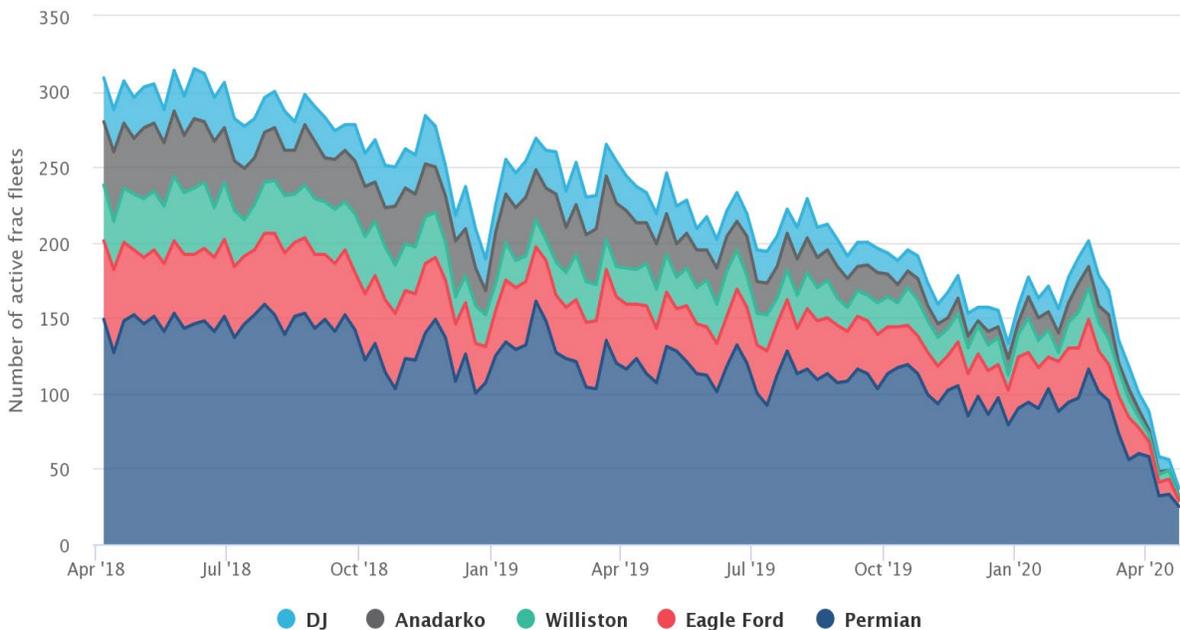
The change led to shareholders demanding FCF [free cash flow] and return of capital in the form of dividends or buybacks. These demands quickly revealed that at prevailing oil prices the shale industry could not grow and generate shareholder returns simultaneously. The weakening of demand exacerbated the problem and the failure of OPEC quota renewal coupled with the steep decline in demand caused by Covid-19 lockdowns has delivered a final blow. For oilfield services, the whole shale operation has been a fool's errand. If you relate it to my three methods on making money in OFS above none of the conditions were fulfilled on a continuing basis.

Most importantly, the method of exploitation required very little technology, let alone unique technology. I am amused when horizontal drilling and long laterals are held out

as examples of new technology. Long horizontal laterals at record distances were a technology that was perfected in the late 1990's and early 2000's. The Troll Field Oil rim in Norway, the North Dome Oil rim in Qatar and Exxon's use of the technology offshore Sakhalin are examples from those times. It was used extensively in Russia to access by-passed oil. All that has occurred is that as the technology matured the market shrank the price came down. Equally, there was nothing new about the use of hydraulic fracturing, what changed was the scale and size of the frac operations that were undertaken and its application to very low permeability rocks. Improvements in the process since the beginning of shale have largely been incremental in improving the efficiency and reducing the cost (slick water) of frac operations. Finally, the use of super-spec drilling rigs was largely enabled by equipment improvements made by the suppliers to the drilling contractors to whom the rent accrued. The drilling contractors were able to remunerate the additional investment but not to make substantial profits.

The advantage of geographical presence was extremely limited in shale. Some contractors profited from concentrations of activity in certain basins or from size, but the US OFS equipment is so mobile that this type of advantage was normally quickly eroded. There was no geopolitical risk taking involved in US shale.

Finally, short-term demand exceeding supply is not a viable strategy in a market where the necessary OFS is low technology and cheap money coupled with reckless lending to herd instincts ensures that any lack of supply is quickly eliminated by new market entrants acquiring the appropriate equipment with debt financing. The financial model for shale adopted by the E&Ps was also adopted by the service contractors, and as the barrier to entry was low, new companies proliferated largely debt financed. As a result the carnage that is going to be wrought in North American Shale OFS will be even worse than in the Shale E&Ps. As an operator, if you have production you always have some cash flow. As a service company, if you have no contracts you have no cash flow. The debt pile for service companies may not be as big as for E&Ps but it is that much more difficult to service in a collapsing market. To give you an idea of the scale of the disaster the chart below shows now active frac fleets in the five principal shale basins have declined from 300 to less than a 100 over a period of two years and have declined very rapidly recently. Some of the initial decline is due to improved efficiency but most is excess capacity.

Figure 3: Active Frac Fleets Across the Key Tight Oil Basins as of April 24, 2020

Source: Kayrros, <https://www.kayrros.com/>.

The North American Shale “revolution” has not yet achieved a level of operational and financial stability that will allow it to be a responsible part of the world supply system. It will remain volatile until the necessary elimination of the marginal players and accumulation of debt has taken place. What is true of the operators is true for the service industry, and in the next phase of shale, the use of technology and the concentration of more responsible operators will lead to improved market conditions for the remaining service players. In the meantime, we will see production declines and financial distress again.

MMF: And the margins issue?

AG: I should have said in the context of North America that in the deep water GoM [Gulf of Mexico], the OFS technology usage and profit margins were the same as, if not better than, the other deep water basins around the world. It really is about the rock and the method of exploitation in US land and the prevalence of cost reduction as key to well profitability.

MMF: What about technology, when we think about recovery and new financial models?

AG: You raised the point that maybe new start-ups are needed to provide specialty services. This is true and the digital age has made the cost of exploiting new ideas, particularly in software and web-based applications available to entrepreneurs with

little capital. It happened that I recently did a little work for one of the analysts on how SLB and HAL built their software businesses. This is not a model for the future but does give some indication of how new technology gets absorbed into OFS.

You make the point that a competitive threat (to traditional OFS) comes from the proliferation of start-up companies who will develop individual Apps or software routines. This is true but the creation of Schlumberger Information systems and Halliburton's Landmark is instructive and, I suspect, a model that will repeat itself. I observed the growth of Landmark but lived the creation of SIS.

In the early [19]90s, Schlumberger's exposure to technical data processing was through two internal organizations: the seismic data processing of WesternGeco and the data processing of wireline and testing. Both these revenue streams had for principal activity the bulk processing of raw data but each had started to have specific interpretation capabilities. Seismic was obvious and log data processing was evolving to the combined interpretation of multiple measurements and specialized routines such as formation dip and dynamic reservoir testing.

The company had no workstation or system where it could present the offering to the customer in a uniform manner. The acquisition of GeoQuest gave it an entry to the seismic workstation market and a platform on which to build further integration. While much was done internally, the most successful additions were through acquisitions. Reservoir Simulation came through ECL [Exploration Consultants Limited] with Eclipse. Modelling and the ability to combine data sets in a single earth model came through Petrel. If I mention these two, it is because they are examples where the seller recognized that to access the market for their product they needed a global footprint and to be part of a broader platform. There were many other acquisitions notably Techsia whose founder said at the time of acquisition "Accessing the Schlumberger Global sales and business development organization will directly allow Techlog to achieve greater market penetration and accelerate the realization of integrated workflows from the well bore to the reservoir to change the game for reservoir management".

I suspect that in terms of financial ratios Petrel was the best acquisition Schlumberger ever made with Eclipse not far behind. I think that this model of extending capability through acquisitions will continue. There are two caveats. The success in this market was also due to the need for new products to have proper support and the ability of the large service companies to do that locally was a key part of the success. There is now a new generation of petroleum and reservoir engineers who are much more used to obtaining support through online tools. The second caveat is that the large oil companies have started hiring their own software engineers and data scientists who may not require the same level of support as the previous generation. Overall, I suspect

the business model will remain largely the same and the best start-ups will be acquired by the oil companies or large service companies.

Another parallel with the initial growth of SIS and Landmark that you mention and which was very prevalent in the 1990's 2000's is the desire of the technology companies to go beyond providing storage and compute power and to enter the application domain. In the build-out of WesternGeco and SIS, the principal competitors who tried to enter the market were IBM (access to seismic data management) and Accenture (Petro technical consulting) both failed because they could not acquire sufficient domain knowledge to convince the customers. I suspect it will be the same this time around. There will be a market for niche providers in North America unconventional but the consolidation amongst the shale operators will limit its size. Looking at the current crop of start-ups it seems to me that the most promising are those that have application across different verticals, SparkCognition being the most obvious.

MMF: Still, there has to be a better way!

AG: OFS companies can only survive the cycle with fortress balance sheets. A position that, as refugees from the Franco-Prussian war of 1870 and as Protestants in a Catholic country, the Schlumberger family knew well. It served the Schlumberger company well through all the downturns until this one when as I said at the beginning my successor indebted the company to adventure into the E&P space.

MMF: But, is my search for a "better way," then, the "fortress balance sheets"? That seems the bottom line. Thinking back to the salvage efforts in 89-90 when I was at Simmons & Co, I thought it was all about building better balance sheets. Yet, here we are. We could chalk it up to the unusual conditions except that I think we all knew this was coming down the pike, in some form - a reckoning in our shale patch, the domino effects to OPEC+ players. Perhaps not as severe, but certainly a reality check.

AG: There has never been a shortage of supply, only dislocations in its availability. The Industry has never learned that what goes up in cyclical business will come down and has never properly protected itself against its own eternal optimism.