Crossing the Technology Chasm: Managed Pressure Drilling

Accelerating Technology Acceptance

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Editor's note: This is the first installment of a multipart series examining key upstream technology challenges facing the oil and gas industry and the reasons for the lack of accelerated acceptance of technologies needed to expand the frontiers of exploration and production.

Managed pressure drilling services have been offered for almost a decade and, while some believe it has the potential to be a widely used technology in the future, thus far it has been met with relatively limited acceptance by oil companies. The evaluation of this emerging technology and its acceptance involved a worldwide survey among approximately 600 SPE members who completed an e-mail questionnaire.

In an effort to determine what was important to the participants, the first question asked was: "What are the main value propositions you see for managed pressure drilling services?" As shown in **Fig. 1,** the most important value proposition cited for MPD is that it allows operators to "walk the line between pore pressure and the fracture gradient." This capability confirms an important benefit of MPD, and was further substantiated by the second most frequently mentioned value proposition of MPD—that it allows an operator to drill wells not possible otherwise. There were no significant differences in responses to this question between technology providers and users.

The survey results were discussed with both operators and service companies familiar with the technology. Don Hannegan, director of emerging technologies, Controlled Pressure Drilling and Testing Services, with Weatherford International, stated: "In addition to such drilling hazard mitigation applications, a growing amount of today's MPD applications are for HSE benefits and 'insurance against a blowout' on prospects that may be technically drillable with conventional open-to-atmosphere circulating fluid systems. Perhaps one of the more significant impacts of the technology has been that of increasing the amount of reserves deemed recoverable by drilling prospects previously thought to be economically or technically undrillable." This last benefit would appear to be the ultimate value proposition for MPD.

Lance Cook, vice president of Wells Technology Deployment and Tech Services for Shell, believes that operators and service providers may be looking at the technology differently. "Shell achieves value from the constant bottomhole pressure and the ability to keep the well in balance downhole and, thus, reducing mud cost and avoiding other issues such as stuck pipe," he says. "Most MPD service suppliers market this constant bottomhole pressure as the primary value from MPD, but they often assume operating companies know more about the subsurface than we actually do. In Shell, we obtain higher value from safely using MPD practices to routinely determine what our pore pressure to leak off gradient is real time with short duration decreases or increases to applied annular back pressure. As most of our MPD operations are on high temperature/high pressure wells, they inherently come with high pressure uncertainty. We also introduce drilling window uncertainty with routine borehole strengthening operations. By eliminating the drilling window uncertainty with MPD 'fingerprinting,' we are then able to control the constant bottomhole pressure to what is known to be the optimum bottomhole

About this Series

The petroleum industry has a proud history of developing technology capable of exploiting reserves in increasingly harsh surface and downhole environments. Despite these considerable accomplishments, it has been documented that the speed of technology acceptance is slower in the petroleum sector than in a number of other industries. As exploration continues to focus on even more challenging environments (e.g., high pressures, high temperatures, deep water, and extended reach applications), the need for advanced technology to successfully exploit hydrocarbons will only escalate. *JPT* and Decision Strategies, an oil and gas management consulting firm, have teamed up to examine these key upstream challenges, the potential technology solutions, and the reasons for a relatively low acceptance rate of some new technologies in the industry.

To start this market analysis, a worldwide survey of SPE members was conducted to identify specific technologies that represent real benefit to end users. The initial survey asked one question: "What do you believe are the most important upstream technologies that will be needed in the coming years?" Respondents supplied more than 1,000 suggestions, with no single technology mentioned with dominant frequency. However, several products and services were identified by both users and service providers as being important technologies for the future. Some of the technologies identified as having significant potential were managed pressure drilling (MPD), seismic while drilling, and permanent downhole monitoring.

A second, more detailed survey among SPE members was conducted to identify the value propositions for MPD, determine why MPD is not more widely used, and to analyze its potential if these obstacles to technology acceptance are addressed. Results were then shared with representatives of technology providers and users to further explore the issues surrounding the benefits possible with the uptake of this technology. Similar surveys are being conducted for other technologies identified in the initial survey with the results to be explored in future issues of *JPT.*

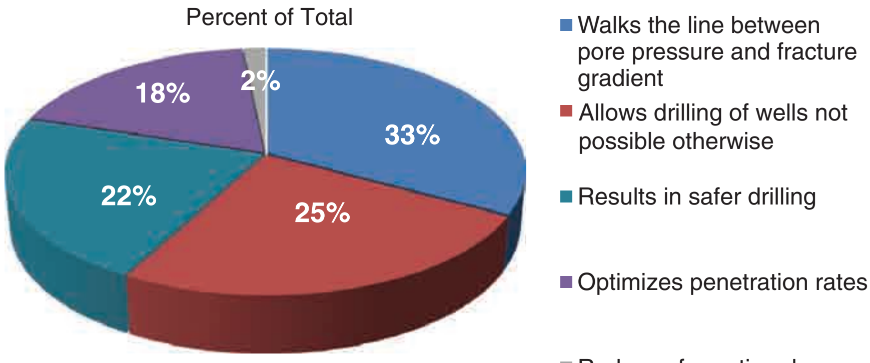

Fig. 1—The Value of MPD.

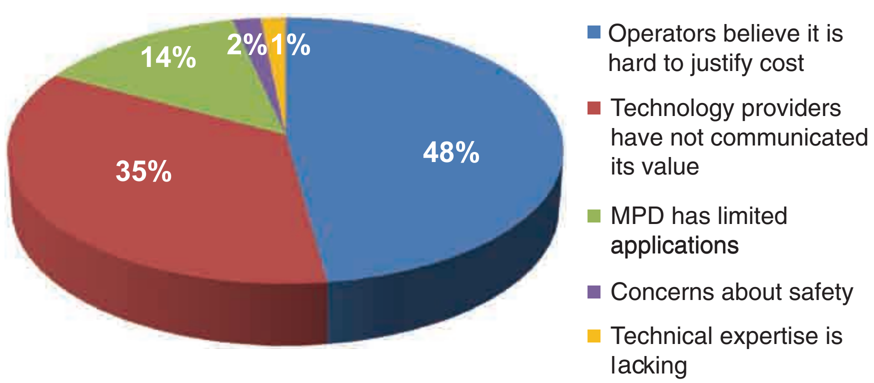

Fig. 2—Why MPD has not been more quickly accepted by operators.

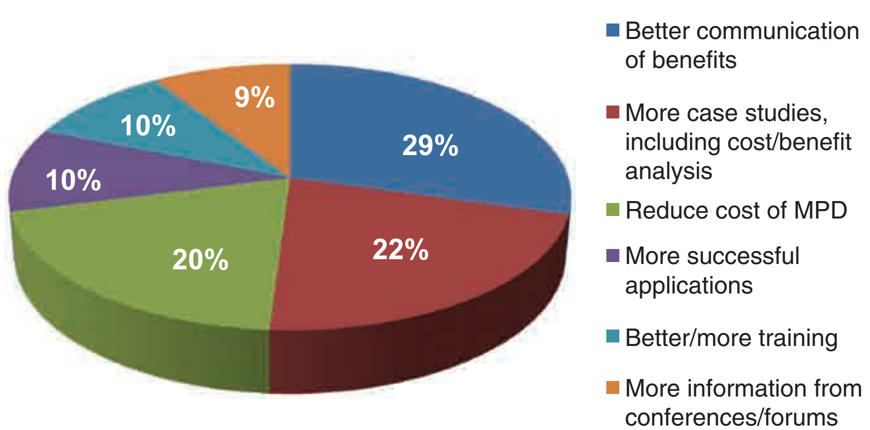

Fig. 3—Steps to accelerated MPD acceptance.

pressure, not relying on pore pressure and fracture gradient predictions."

A follow-up question in the survey asked participants to state the reasons why they thought MPD has not been accepted more rapidly by operators. Operators said they believe it is difficult to justify the cost of MPD **(Fig. 2).** This is a common finding in many emerging technology market assessments conducted over the years, some of which have concluded that it is hard for operators to justify the price of a new technology if they do not have a comprehensive understanding or appreciation of its benefits. Half of all operators in the survey—whether from international oil companies, national oil companies, or independents—stated that technology providers have not adequately communicated the value of MPD. According to one operator: "MPD applications are not very well defined by suppliers and, in some cases, MPD is being represented as a cure-all instead of being presented as application-specific."

Some operators also believe that there are limited applications for MPD. Often, in the early years of a new technology introduction, applicability is low—in some cases because operators do not view the emerging product or service as a viable alternative to conventional techniques and practices. As part of the product development process, service companies frequently modify or expand their emerging technology in response to both interaction with and resistance from oil company buyers. This situation was characterized by John Samuell, president of Schlumberger At Balance, a leading MPD service provider: "It is more about the customization of the system to the applications rather than taking the full blown system out and saying this is what the operator needs. We are trying to custom design the solutions to address the problems on the well."

Steps to Accelerated Technology Acceptance

An additional survey question attempted to determine what steps operators and technology providers might take to accelerate the rate of acceptance of MPD **(Fig. 3).** Answers were received from more than 570 individuals, with more than half citing better communication of the benefits of the technology, including more detailed case studies and cost/benefit analyses. According to one operator: "(We need) publication of MPD successes. It would seem that the larger operators would readily accept this as they have the resources and are usually more open to using advanced technology. Some of the smaller operators appear apprehensive when it comes to the use of new technology and methods. Perhaps this is due to the cost and/or being set in their habits. Published results on the successes of MPD may overcome these obstacles."

However, the speed of technology uptake is not necessarily determined by the size of the oil company. Some of the fastest adopters of new technology have been independents or select national oil companies that have seen benefit in working with technology providers in the development and testing of new products and services that provide solutions to drilling and production problems.

Another important perspective of operators was voiced by Shell's Cook: "I believe many operators are still very uncomfortable taking influx all the time. Managed pressure drilling is also a complex, multidisciplinary activity and requires the right skills and resources throughout the process, ensuring proper project engineering, integrated skills management, HSE management, and effective project management."

While operators in the survey also suggested reducing the cost of MPD services, a comparatively small percentage of service company personnel saw this as a viable solution to higher technology acceptance. Said Weatherford's Hannegan, a recognized expert on the development of MPD technology and an SPE Distinguished Lecturer on the topic: "This is not surprising at this juncture in the evolution of industry acceptance," he said. "It depends considerably upon the prospects the operator has in mind and where he places his value proposition. Service companies have applied some self-restraint to avoid MPD applications where the cost-benefit is unfavorable, in part to avoid giving MPD a bad name. An International Association of Drilling Contractors' committee has emphasized MPD Candidate Selection Guidelines for this reason. Most strive to participate in it being applied where the cost benefit is most favorable, for example, on wells where offsets have experienced the types of drilling-related nonproductive time, mud loss excesses, and/or well control scenarios that MPD has proven to be capable of addressing safely and effectively," he said.

"MPD is a complex, multidisciplinary activity and requires proper project engineering, integrated skills management, HSE management, and effective project management."

"For operators, the single most effective way MPD acceptance can be accelerated would be for their business units to cross-pollinate their experience with MPD applications," said Hannegan. "There appears to be a chronic disconnect between business units of the same operator in this regard, a phenomenon difficult to explain. Operators often apply the technology on specific and often one-off prospects where 'nothing else works.' Operators' business units and technology providers should work more closely together toward multiwell MPD drilling programs that are conducive to technology transference with staying power."

Application of MPD may be complex or simple, as the technique has several variations and application possibilities, says Charles "Rick" Stone, president of Signa Engineering, which has made MPD a cornerstone of the services it offers over the past decade. "It is important to understand that the *best* solution for every MPD application is typically the *simplest* solution," he said. "Drillers should analyze their project and determine the level of complexity that is needed to reach the prospect, and then select the proper tools and procedures. Otherwise, technological understanding of the process will be low and the application runs a high risk of failure. In addition, the company's long-term acceptance of the technology will be hindered."

Confusion about MPD's application may contribute to its relatively low acceptance rate, Stone said. "In our observation, there is still some confusion between MPD and underbalanced drilling (UBD), which has led to misapplication of MPD technology and caused some operators to lose faith in its benefits. MPD and UBD are two distinctly different technologies, but because they utilize some of the same surface equipment, they are sometimes seen as the same technique. This confusion is evident in both service companies and operators," he said.

"The distinction between UBD and MPD is simple," he said. "UBD encourages flow of gas and liquids from permeable formations while MPD does not. A company that is unsure of the distinction between these two technologies will also be unsure regarding the solution."

One operator who participated in the survey addressed some of the "hidden

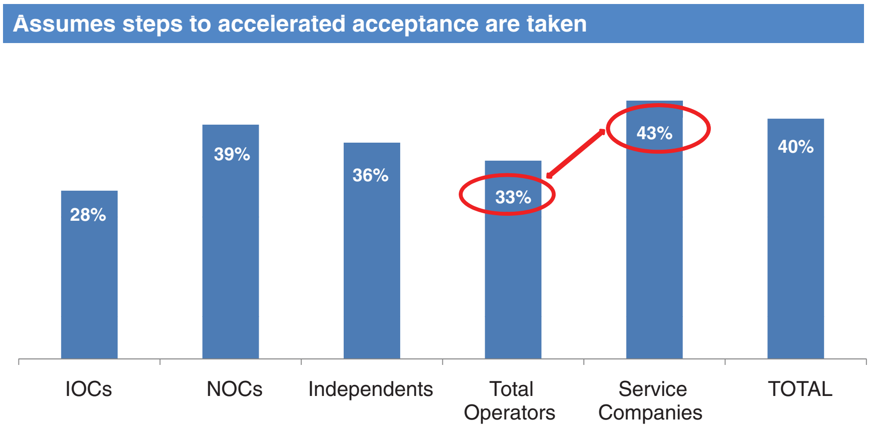

Fig. 4—Percent offshore wells using MPD in 5 years.

costs" that influence the acceptance rate for new technology, which can take the form of testing and evaluation, personnel training, and equipment maintenance and modification. "In areas where it has been used (service providers should) demonstrate the reasons the technology was applied, and the values gained," he said. "Discussions I have heard on MPD say, yes, we could use it but we do not really need it. There are fears that it is different than what the crews are used to; it is additional equipment to maintain. (Service providers) must clearly demonstrate that the safety advantages outweigh risks of equipment new to the crew. (They) must define what training should be in place to safely use the equipment and to give understanding to the rigsite personnel of the advantages of the technology."

Offshore Applications

Technology users and providers were next asked if steps were taken to accelerate industry acceptance of MPD, what percentage of all offshore wells would use MPD 5 years from now. As shown in **Fig. 4**, the question received a range of responses from operators and technology providers. Overall, respondents indicated that 40% of all offshore wells will use MPD in 2015 and beyond. Representatives of international oil companies were the least optimistic about the level of applicability of MPD, stating that they believe 28% of all offshore wells will utilize this technology in the future. One service provider optimistic on the technology's future made the following comment: "There are many forms of MPD technologies. However, the biggest prize lies in the floating drilling market. When drilling subsea wells, MPD technology must be applied as a mainstream technology to be used for the entire drilling operation. Now, MPD is basically a niche market where technology is used only when everything else fails."

Service companies see a compelling future for MPD offshore. "MPD's commendable onshore well control incident track record is being repeated on all types of offshore rigs," says Hannegan. "There has not been a reportable well control incident where the root cause has been attributed to failure of the technology to address a drilling hazard of interest or failure of MPD enabling equipment. Also, all operators' business units who practiced MPD for their first time have found enough benefit to not hesitate its application to future wells. Many of these first adopters of offshore MPD practiced the technology only on prospects previously thought to be economically or technically undrillable due to their challenging hydraulics, narrow mud windows, offset wells grossly exceeded AFEs, or well control problems."

Offshore use of MPD is showing robust signs of growth, said Deepak M. Gala, engineering lead for Drilling Hazard Mitigation at Weatherford and an instructor for SPE's MPD and UBD short courses. "Offshore acceptance of the technology appears to be on a faster track than its onshore roots' experienced," he said. "This is in part because the majority of 'easy prospects' have already been drilled. Additionally, MPD's ability to detect quick influxes/losses and minimize well control events enables it to meet requirements to drill in deeper water more efficiently."

Gala said he believes that the survey results predicting that more than a third of offshore wells could be using MPD in a few years are positive. "When one considers MPD is not a panacea solution or applicable in a cost vs. benefit fashion to all remaining offshore prospects, that is pretty impressive for an industry that has somewhat of a reputation for slow uptake on new technology, particularly one which requires a new way of drilling conventional wells," he said.

Samuell of Schlumberger At Balance is also optimistic. "I would say 75% of offshore wells 5 years from now will use MPD and, depending on pending government regulations, it could be that 100% of all offshore rigs will have some form of managed pressure drilling. Just to control the well and have the ability for advanced kick detection you basically need a rotating head, and where it is a closed system, the ability to monitor the pressure on the well at all times."

Summary

Several findings can be drawn from the survey and separate discussions held with MPD experts:

- Even technologies with strong value propositions often face slow uptake because of the cautious nature of operations personnel, the time required to thoroughly evaluate a product or service, and the potential risk involved. A disconnect sometimes exists between technology providers and operators about which technologies should be developed and introduced. (Over the years numerous market assessments have been conducted in which the emerging technology being evaluated was perceived by operators to have only moderate to low benefit, including some emerging technologies that eventually achieved mainstream acceptance.) The onus is on the technology providers to effectively communicate the value propositions of new technology to the operators.
- It is also apparent that some operators do not have an optimized program for technology transfer within their own organizations. This can make the acceptance cycle quite long for the service provider due to multiple efforts required for the technology to be accepted on an enterprise-wide basis within the operator.
- Also contributing to slow uptake is that some technologies are introduced before a reliable product/service has been created. This can make technology acceptance relatively unpalatable to oil company personnel because of the "pain and suffering" that must be endured during the process.
- Operators believe that service companies sometimes do not appreciate the "hidden costs" of training and evaluation that operators incur as they incorporate the use of emerging technologies.
- Pending government regulations will likely have an impact on the rate of technology acceptance. However, it is not clear at this time just what that impact will be. **JPT**