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THE ITF AGM & MEMBERS MEETING FORUM REPORT

FACILITATING COLLABORATIVE TECHNOLOGY DEVELOPMENT & DEPLOYMENT

ABU DHABI APRIL 22, 2014

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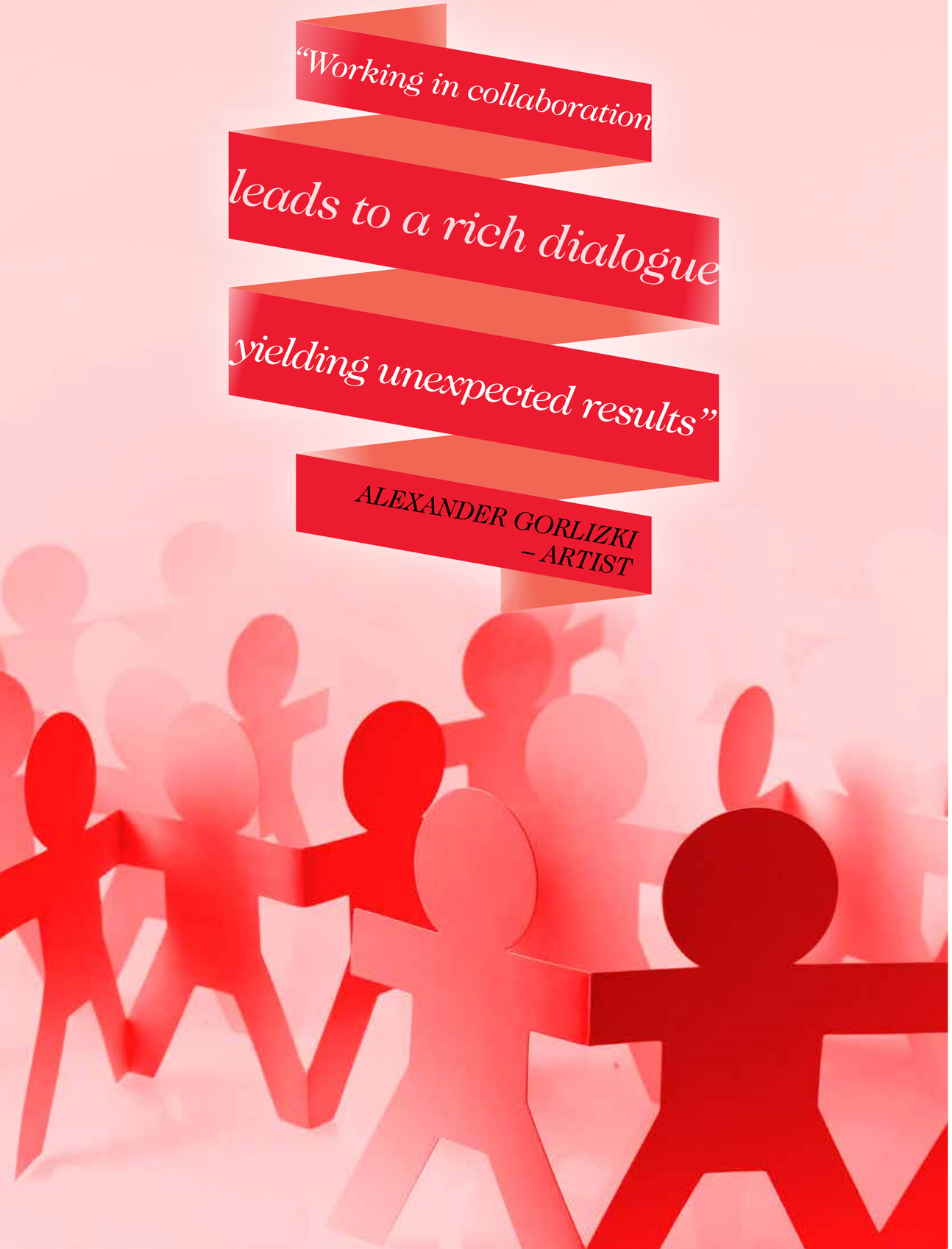


INTRODUCTION

The ITF Members Meeting & AGM was held outside Europe for the first time in its history on April 22-23, being hosted in Abu Dhabi. Sponsored by Abu Dhabi National Oil Company (ADNOC) subsidiary ADMA-OPCO, the event brought to the UAE leading global practitioners of energy R&D and offered a great opportunity for the ADNOC R&D Oil & Gas Sub-Committee and all its stakeholders to exchange and garner knowledge on how to collaborate in building a world class ecosystem for harvesting breakthrough applied research.

The forum opened with a keynote speech by Mr. Ali Bin Harib Al-Muhairy, Senior Vice President at ADMA-OPCO, focusing on ADNOC's Gateway to New Frontiers strategy that lays out the state oil company's R&D ambitions and targets. The keynote was followed by presentations from ITF CEO Dr. Patrick O'Brian; Total E&P UK Ltd. Head of Technology Innovation Jeremy Cutler; and ITF Regional Director for the Middle East and Australasia Ryan McPherson.

The theme of collaboration was also carried through to the following panel debate. Moderated by Gulf Intelligence, participants in the 40-minute debate were:

- Dr. Wafik B. Beydoun, Manager, R&D Division, E&P Directorate, ADNOC
- Dr. Nasser S. Al-Mohannadi, Research & Technology Center Manager, Qatar Petroleum
- Jeremy Cutler, Head of Technology Innovation, Total E&P UK Ltd.
- Dr. Patrick O'Brien, CEO, ITF

Complemented by a series of surveys conducted among panelists and audience, the debate produced valuable insights into what measures and initiatives the industry may want to take in order to address the energy challenges of tomorrow through enhanced collaboration among all key stakeholders.

There was a sense of consensus among panelists that the industry will have to enter a phase of deeper collaboration—whether between IOCs and NOCs, governments and industry, or industry and academia—in order to ensure that it is prepared to take on challenges in the form of meeting rising world energy demand, advance technologies, and attract new talent into the industry. ■

WHITEPAPER

Facilitating Collaborative Technology Development and Deployment

THE NEED FOR COLLABORATION

Collaboration sits at the core of any innovation ecosystem. Creating an environment conducive to and incentivizing collaboration is particularly critical for relative innovation newcomers such as the UAE and other Gulf Cooperation Council (GCC) states as they seek to realize their ambitions to build and develop domestic research and development (R&D) capabilities and capacities as part of their broader strategies to reduce their dependence on hydrocarbons and transition into knowledge economies over the next 10-20 years.

Collaboration supports the establishment of innovation ecosystems, in which—ideally—science meets commercial vision and entrepreneurial efforts; where large investments are being channeled into human capital; and in which governments put in place the required policies, regulations and incentives. None of this will be possible without the key stakeholders from academia, industry and government coming together. With this in mind, a high degree of collaboration within and among GCC states will be essential to meet their ambitious R&D targets in the long term, in particular in light of the region's focus on energy R&D.

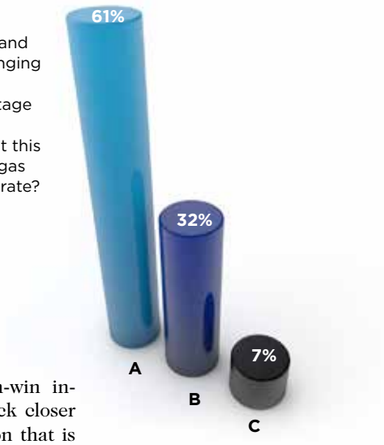
"In the oil and gas sector, collaboration is especially important due to the high cost and long lead times associated with oil and gas advancements. Joint projects between oil majors/super majors, oil field service operators and strategic partners, suppliers or universities are becoming the norm rather than the exception," according to a report on innovation in the industry published by consulting firm PwC in 2013 .

INCENTIVES

A survey carried out at the two-day ITF Members Meeting & AGM in Abu Dhabi in April 2014 showed that oil and gas companies generally have the desire to collaborate in critical energy R&D on technologies such as enhanced oil recovery (EOR). However, the survey also indicated that the absence of clear win-win incentives tends to hold back closer cross-industry collaboration that is considered essential to the development of key technologies aimed at reducing costs, accelerating production and increasing overall output.

QUESTION 1
Collaborative R&D in the oil and gas industry can be a challenging aspect at the best of times. With the competitive advantage potentially offered by EOR technologies do you feel that this is an area where the oil and gas community wants to collaborate?

A. Yes
B. No
C. Don't Know



According to the survey, almost two thirds of respondents comprising senior national and international oil industry executives and academics expressed the view that EOR specifically is an area that the regional oil and gas community wants to cooperate in.

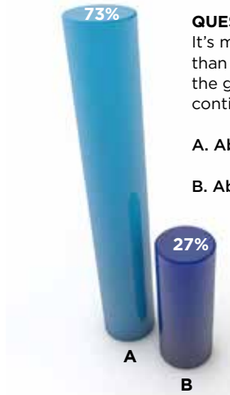
ADNOC has identified R&D as one of the grand challenges for the UAE to be addressed through R&D, being well aware that the time of easy oil is coming to an end, also in the Gulf region.

"The implementation of efficient EOR methods is a key to unlocking additional reserves," said Ali Bin Harib Al-Muhairy, Senior Vice President at ADMA-OPCO, speaking at the ITF forum.

But while a majority of respondents believes the interest among industry stakeholders to collaborate in EOR exists, the survey also showed that almost three quarters of those surveyed thought that the absence of obvious win-win incentives was an obstacle to industry collaboration – rather than a lack of common critical problems, which only 27 percent cited as the main obstacle for collaboration.

"In the oil and gas sector, collaboration is especially important due to the high cost and long lead times associated with oil and gas advancements. Joint projects between oil majors/super majors, oil field service operators and strategic partners, suppliers or universities are becoming the norm rather than the exception," according to a report on innovation in the industry published by consulting firm PwC in 2013.

According to Dr. Nasser Al Mohannadi, Qatar Petroleum Research and Technology Manager, the reality at the moment is that the energy companies with research centers at Qatar Science and Technology Park (QSTP) focus on non-core areas when it comes to collaboration among each other. Away from industry-to-industry collaboration, however, energy companies do focus on R&D in core areas that's also relevant to Qatar, he said.
"As [far as] collaboration, I see this is what's happening," Al Mohannadi said at the forum.



QUESTION 2
It's much easier to talk about the need for collaboration than to implement it – which of the following is the greater obstacle to industry collaboration that continues to hold it back?

A. Absence of obvious win-win incentives

B. Absence of common critical problems to solve

The need to deepen and intensify collaboration in R&D between national and international energy industry stakeholders in the UAE and in other GCC countries therefore requires the provision of clear win-win incentives. This is of particular relevance if research related to companies' core businesses is set to be addressed.

In oil and gas, peer-to-peer collaborations in R&D are often considered to be challenging to implement if core business is involved – due to concerns over sharing proprietary knowledge and technologies or sensitive data, for example related to national resources. As a result, energy industry research involving international and national oil companies in the Gulf region often tends to focus on non-core business such as water sustainability, desalination or solar power.

According to Dr. Nasser Al Mohannadi, Qatar Petroleum Research and Technology Manager, the reality at the moment is that the energy companies with research centers at Qatar Science and Technology Park (QSTP) focus on non-core areas when it comes to collaboration among each other. Away from industry-to-industry collaboration, however, energy companies do focus on R&D in core areas that's also relevant to Qatar, he said.

"As [far as] collaboration, I see this is what's happening," Al Mohannadi said at the forum.

For R&D mandates to be effective and successful in the long term, dedicated platforms will need to be created that help identify the areas where collaboration for joint industry projects is most feasible and promising in terms of producing locally-relevant results. At the same time, collaboration agreements will have to be covered and protected by clear policies and regulatory frameworks that address issues including intellectual property rights (IPRs) and the commercialization of research among others.

Against this backdrop, it may not be a surprise that a slight majority (53 percent) of survey respondents thought the R&D focus on non-core business areas was to be expected in today's competitive business environment, in which companies often are reluctant to enter research projects with their competitors. However, 47 percent of those surveyed said collaboration in general would happen once governments provide leadership and sound legal and regulatory frameworks governing the protection of IPRs among other issues.

There is consensus that governments have a role to play in R&D but survey respondents were split over what their main priority should be, with 47 percent saying that they should focus on the creation of physical and regulatory infrastructure that facilitates research. The same percentage of respondents thought that governments' priority should be to engage actively with industry and academia in driving R&D activities, while only 6 percent thought the direction of R&D should be left to the market to decide.

Whatever way this is being looked at, however, providing a robust legal framework is a key requirement for any GCC state with R&D ambitions because it provides the very foundations for and may facilitate companies' decision-making processes to enter into collaborations.

"We believe that if we had a clear IP policy in ADNOC that can protect our partners, then working together on challenging problems will happen. We can get IOCs and NOCs work together. But I under-

QUESTION 3
Getting IOCs to collaborate in joint R&D projects may not always be feasible because of concerns over sharing proprietary technologies or sensitive data – Does that mean collaboration can only happen in non-core areas where the oil industry has a common interest in developing knowledge, for example in environmental or water issues?

A. Yes, In reality, that's what's going to happen

B. No, all it takes is a sound legal environment and Government leadership

QUESTION 4
In R&D, the government has some role to play – generally speaking, which of the following should be the biggest priority for the role of Government?

A. Create physical and regulatory infrastructure that facilitates R&D

B. Actively engage with industry and academia in driving R&D activities

C. Let the market drive the direction of R&D activities

stand the reality: it's true that it's quite a challenge," Dr. Wafik Beydoun, Head of R&D at ADNOC, said.

"I guess if the IOCs have a joint interest in developing something in a joint venture together then you're going to see more sharing. They have a shared interest, which is the value created by the product," added Jeremy Cutler, Head of Technology Innovation, Total E&P UK.

THE OIL AND GAS SECTOR

With oil and gas production diversifying, strategies shifting to the unconventional and deep offshore, and the global—and regional—energy demand curve pointing up, R&D will play a crucial role in the longevity of the oil and gas industry; no more so than in the Middle East where the era of 'easy oil' has come to an end and capacity building in local knowledge capital is as critical to the development of the socio-economic fabric of the region as it is to national oil companies (NOCs) seeking to develop and deploy new technologies to extract more hydrocarbon resources in the most efficient manner.

Going forward, continued strides in technological innovations that ensure energy security will require significant R&D investments to develop and produce both an increasing and increasingly secure supply of energy, while using the safest and most cost-effective methods.

Moreover, as global energy demand continues to rise and more water-intensive methods are being applied to extract unconventional hydrocarbons such as oil sands, effectively managing the overall use of local energy and water resources through new and advanced technologies is becoming seminal.

Indeed, the world's water and energy needs are so closely linked that, going forward, they can't be separated from each other. As a result, water and energy—together with food security and climate change—have become the critical issues topping today's global policy agendas.

Finding solutions to these increasingly complex technical problems and meeting economic challenges that demand major R&D investments and capital projects will only be achievable through collaboration among all key stakeholders – industry, academia and governments.

What is needed will be continued—and increased—innovation in technology areas such as exploration, drilling and production as well as industrial water reuse and desalination, and in developing a network of highly-skilled individuals to develop and deploy them.

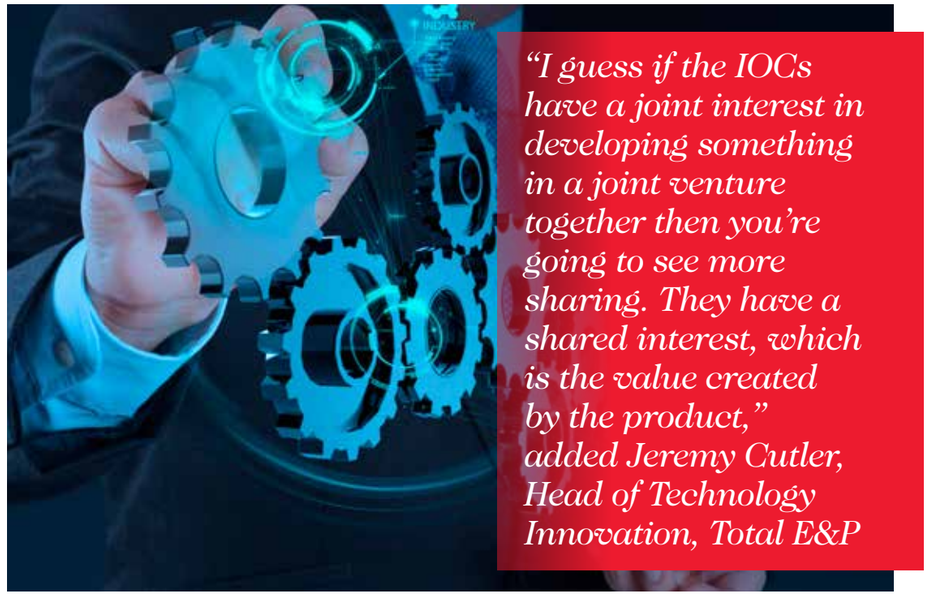
Although the list of challenges is long, the overall sentiment among those surveyed at the ITF forum was that the next 10 years will produce technological innovations that will have a similar impact on the global oil and gas industry as the breakthroughs that triggered North America's shale revolution.

"We believe that if we had a clear IP policy in ADNOC that can protect our partners, then working together on challenging problems will happen. We can get IOCs and NOCs work together. But I understand the reality: it's true that it's quite a challenge," Dr. Wafik Beydoun, Head of R&D at ADNOC, said.

QUESTION 5
The past 10 years have seen advances in technology that have triggered a transformation of the global oil industry - Will the next decade bring similar R&D breakthroughs that will allow balancing the water-energy-food nexus on the one hand and accessing harder-to-access hydrocarbon resources on the other?

A. Yes, of course, as technologies trigger change, not follow it

B. No chance, profit and sustainability are on collision course



"I guess if the IOCs have a joint interest in developing something in a joint venture together then you're going to see more sharing. They have a shared interest, which is the value created by the product," added Jeremy Cutler, Head of Technology Innovation, Total E&P

The vast majority of survey respondents (85 percent) expressed the view that the next decade will bring R&D breakthroughs that will help manage the global water-energy-food nexus and at the same time allow accessing harder-to-reach hydrocarbon resources .

COLLABORATION IN UKCS

The UK's oil and gas sector is among those that will require technological innovation and a much greater level of collaboration among industry and government stakeholders to meet the challenges it is presently being faced with.

The UK Continental Shelf (UKCS), which holds the vast majority of the UK's hydrocarbon reserves and accounts for the bulk of domestic oil production, is an area faced with a mix of falling production and investments, rising cost, reduced exploration drilling and smaller discoveries.

In a bid to stem the challenge, the UK Secretary of State for Energy and Climate Change last year appointed Sir Ian Wood to review the regulation of the UK offshore oil and gas industry and outline sector strategies and implementation plans to maximize the economic recovery from the UKCS.

Among the six main reasons explicitly stated by the Wood Review for being responsible for the decline in output from UKCS are 'lack of collaboration between operators'; 'lack of focus on maximizing economic recovery for the UK, as operators have pursued individual commercial objectives in isolation with limited shared commitments'; and 'lack of government stewardship due to an under-resourced upstream regulator'.

"Cross-industry collaboration will be essential to develop and promote key technologies to reduce costs, accelerate production and increase overall production recovery if the UKCS is to capture the 12 billion-24 billion of barrel oil equivalent (boe) reserves estimated to be left in the North Sea," Total E&P UK's Cutler said.

THE GULF REGION

The UAE, like most of its Gulf neighbors, sits at the heart of the global energy industry, being a major producer and exporter of oil and gas. Building on these foundations by developing R&D centers is a logical extension of the Gulf states' existing capabilities.

The UKCS experience can provide some guidance as to what a model for deeper and broader collaboration among key stakeholders may look like, in particular at a time when the region is entering the era of post-easy oil.

Bolstering stakeholder collaboration and developing R&D capabilities and capacities will have to go hand in hand with a string of initiatives aimed at building national capacity in Gulf countries. This includes providing incentives for researchers to commit to a country for the long term and instilling interest in science among the young as part of wider reforms to the local education system aimed at ensuring the creation of relevant skills and a pipeline of local talent – all of which are needed to sustain local research plans in the future and to support the transformation into knowledge economies.

It also includes university-industry partnerships, which are generally being looked at as offer-

ing potential win-wins for both sides. Deeper collaboration between industry and universities provides academia with a better understanding of what energy companies' needs are, while at the same time offering industry an opportunity to provide input on university curricula. For industry it may also be a way to accelerate time-to-market for new products and services; while for universities it could provide an additional or alternative source of funding.

Capacity building at regional NOCs is another area of importance given the skills shortage that the industry in- and outside the region is faced with.

"Since the beginning of petroleum production, research and development has been the key to increasing recoverable reserves. Other than the economic benefits of fostering new technology, NOCs in the region are motivated by a number of other factors," Deloitte said in a report published earlier this year on technology in the energy sector .

"With the region's NOCs looking to continuously diversify across the value chain to transform into fully-integrated energy companies, there is an increasing need for specialist skills. These skills have traditionally been brought in from abroad and through IOCs. Nevertheless, in recent years we have seen the creation of specialist research and training centers across the region to somewhat counter this importing of skills."

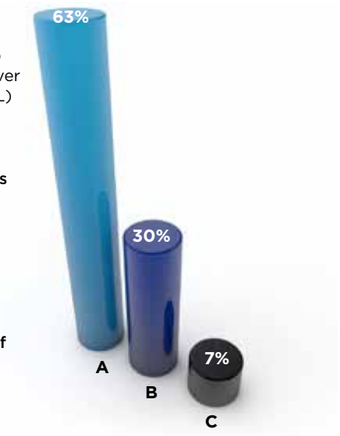
Against this backdrop, 51 percent of the ITF survey respondents held the view that building national education capacity should be the biggest priority for the UAE and other Gulf states to advance their R&D ambitions in the short to medium term . The remaining 49 percent expressed the view that the priority should be the introduction of IPRs.

QUESTION 6
What is the best strategy to pursue to get academia in the UAE and across the Gulf to develop its scientific research base and deliver low technology readiness level (TRL) solutions to meet the Oil & Gas industry's challenges?

A. Have industry contract universities to carry out the relevant specific applied research

B. Have universities pitch sector-relevant R&D to industry

C. Govt. should decree national universities to serve the interest of the national energy industry



Given the oil and gas industry's size and importance in the hydrocarbon-rich Gulf region in particular, regional academia is well placed to delivering low technology readiness level (TRL) solutions—the level at which scientific research begins to be translated into applied R&D—to the industry to tackle relevant local challenges going forward.

According to the survey, 63 percent of respondents thought that the best strategy to getting academia in the UAE and elsewhere in the Gulf to develop its scientific research base and deliver solutions to the oil and gas industry would be to have industry contract universities to carry out specific applied research work. ■

CONCLUSION

GOVERNMENTS AROUND the globe have recognized the need to step up R&D efforts and seek stakeholder collaboration. Brazil is a case in point. The government is making billions of dollars of funding available to help promote research that will spur offshore oil exploration – about 25 percent of the country's oil production comes from deepwater fields.

In addition, regulations have been introduced for companies bidding on highly productive oil and gas contracts that require operators to reinvest 1 percent of gross revenues into local R&D, both internally and externally at local universities, a portion of which funds scholarships within oil and gas-related studies. In Norway, the innovation system is based on a high degree of collaboration between suppliers of technology solutions and their customers, the operators.

The importance of greater collaboration among all stakeholders involved in building innovation ecosystems in the Gulf region is equally important. ITF, whose key objectives are to identify technology needs, foster innovation and facilitate the development and implementation of new technologies, has the potential to play an increasingly important role in facilitating this type of collaboration.

The reason is clear. ITF has the ability to engage with industry and facilitate work on new technology developments on an international platform. Developing technology through ITF allows its members to spread the risk and cost of R&D, enabling expenditure to be allocated more effectively and expertise and knowledge to be shared, globally and in the Gulf region.

QUESTION 7
Which of the following should be the biggest priority for the UAE and other Gulf States to adopt in order to advance its R&D ambitions in the short to medium term?

A. Regulatory – the introduction of Intellectual Property Rights

B. Build national education capacity

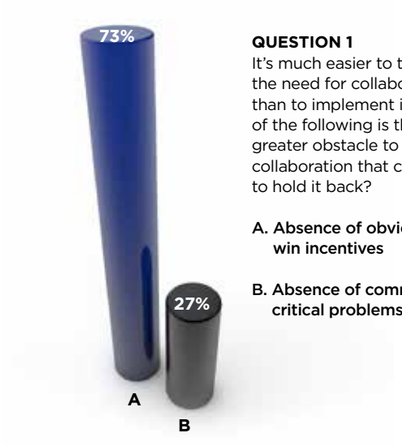
The Panel Discussion

~ Dr. Wafik Beydoun, ADNOC
~ Dr. Nasser Al Mohannadi, Qatar Petroleum
~ Jeremy Cutler, TOTAL
~ Dr. Patrick O'Brien, ITF
Moderated by Sean Evers, Gulf Intelligence

SEAN EVERS (SE) *Good morning. If we might just take this question – which of the following is the greater obstacle to industry collaboration that continues to hold it back? Is it 1), Absence of obvious win-win incentives; or, 2) absence of common critical problems to solve?*

And 73% say the absence of obvious win-win incentives for collaboration. Dr. Wafik, you come from Houston, Texas, so you obviously come from the outside into this ecosystem. How do you see your challenge and priorities in the area of collaboration?

DR. WAFIK BEYDOUN: For an international oil company (IOC) and a national oil company (NOC) to work together, you have to understand that the key IOCs have say about 50-plus years of experience in research and development (R&D). And NOCs, except for two that I won't name, have about 10-plus years of experience. Drivers or incentives for the 50-year person with experience to collaborate with a person with 10 years of experience are not the same as the two parties having the same maturity in R&D. As NOC, we want to accelerate these 10 years and grow faster than reaching 50 years. That's our intention. Information exchange in such collaboration is very different. You want to attract certain technology rather than just collaborate per se.



QUESTION 1
It's much easier to talk about the need for collaboration than to implement it – which of the following is the greater obstacle to industry collaboration that continues to hold it back?

A. Absence of obvious win-win incentives

B. Absence of common critical problems to solve

SE *There is an expectation that the 50 year will deliver some technology transference?*

DR. WAFIK BEYDOUN That's right. But the win-win is important, you need to have it. You also need to have incentives, of course. There are different mechanisms for incentives, but I think beside that point, we need to have the kinds of teams on both sides that are willing to exchange.

SE *When you come into this ecosystem, now you're just less than a year in your current post, what do you identify as the priority in terms of collaboration and developing the ecosystem? Is it industry-industry, international-national oil companies, or is it industry-academia, the development of that relationship?*

DR. WAFIK BEYDOUN Right now, the priority is to solve the critical problems and make industry abroad aware of these kinds of challenges, i.e. the priority of increasing the recovery efficiency (IOR-EOR)… If we can address first, industry-NOC collaboration industry-academia should follow.

SE *Dr. Nasser, what are your thoughts on where Qatar is at this time in terms of the level of collaboration, in particular Qatar Petroleum's position on collaboration?*

DR. NASSER AL MOHANNADI We find that collaboration is important, but the first question to answer is what are the challenges that we need to solve? We have business needs so have to look at the challenges that face the business. In the case of R&D, we have many players. There are universities, research institutes, IOCs and also the national companies. Each player has different objectives or mandates. Based on the challenge, if it is something fundamental, then we'll go to the universities; if it's something that's more applied, we might go to a research institute. In Qatar, QP and other operators such as IOC's still operate the fields. As a research center, we focus on the fields that QP operates directly and look at its challenges, then we look at the other operators, for example the IOCs. If we share the same challenge, that's where we come to collaborate.

> *"Frankly enough, I voted for B. Certainly a goal for ITF is to make sure we put out those common challenges, because we focus our efforts on working these challenges. So if we can clearly articulate the common challenge and opportunities then that provides a good base for collaboration."*
>
> *DR. PATRICK O'BRIEN*

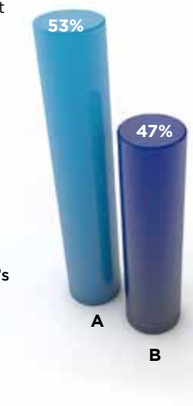
> *"There are two interesting things: One of the things certainly in the UK is that it's not just government leadership, but it's industry working together with government through an oil and gas industry council mechanism. So it is government supporting what industry needs, and that's what happened there."*
>
> *DR. PATRICK O'BRIEN*

SE *Dr. Wafik, you come from an IOC background into your NOC position. Should there be greater obligation on the IOC to collaborate even when it's of more strategic importance to the national holder of the resource and not to hoard?*

DR. WAFIK BEYDOUN I won't use the word 'obligation' for R&D. In operations you may have obligations. But in R&D, particularly, the research/basic science part (low TRL), you need to have people who get along in the collaboration. You cannot build a research team if they don't like to work together... So, if you oblige them, they can sit together but it'll be counterproductive. Once you move over to the development stage, to the technology that's more mature (TRL5+), you have an obligation to deliver and people are more willing to collaborate and work to jointly deliver a project.

SE *Paddy, if you just give us your views on the results here.*

DR. PATRICK O'BRIEN Frankly enough, I voted for B. Certainly a goal for ITF is to make sure we put out those common challenges, because we focus our efforts on working these challenges. So if we can clearly articulate the common challenge and opportunities then that provides a good base for collaboration.



QUESTION 2
Getting IOCs to collaborate in joint R&D projects may not always be feasible because of concerns over sharing proprietary technologies or sensitive data – Does that mean collaboration can only happen in non-core areas where the oil industry has a common interest in developing knowledge, for example in environmental or water issues?

A. Yes, In reality, that's what's going to happen

B. No, all it takes is a sound legal environment and Government leadership

SE *We'll take the second question, which is getting IOCs to collaborate to join R&D projects may not always be feasible because of concerns over sharing proprietary technology. Does that mean collaboration can only happen in non-core areas where the oil industry has a common interest in developing knowledge?*

Let's see what the answers are – there's a bit of a division in the room. It's good to see that not everybody's on the same side on this. Dr. Wafik, your thoughts?

DR. WAFIK BEYDOUN You have the realistic and the optimistic! If we have a clear intellectual property guideline in ADNOC that can protect our partners, then working together on challenging problems will be facilitated. We can expect IOCs and NOCs work together. But currently it is indeed quite a challenge to share proprietary technologies.

DR. NASSER AL MOHANNADI I voted 'A' because I believe that every institute or player in the research field—NOC or IOC; service company; or university—they all have different objectives.

Sean Evers: "Paddy, if this question was put for the other parts of the world, all the places that you operate, do you think the answers would be different?"

Dr. Patrick O'Brien: "The answer will likely vary. For example, in Brazil and Norway they have very strong policies in terms of investment and basic R&D which provides an opportunity for innovation and strengthening the education base. There must be a great opportunity then for universities to collaborate across the world. Typically while universities tend to see each others as competitors within their own country, they are more likely to form partnerships with universities in other countries – this is a great opportunity for universities to build their capability.

You cannot get to come together and work on a sensitive topic together unless there is a value out of that research.

SE *Are you currently seeing in Qatar that 'A' is the reality at the moment? There are 10 or 12 international energy companies with research centers at Qatar Science and Technology Park (QSTP). They seem to be doing 'A'.*

DR. NASSER AL MOHANNADI Between each other – yes. Individually – I can see that there's some research that's relevant to the country. But as collaboration, I see this is what's happening.

JEREMY CUTLER I guess if the IOCs have a joint interest in developing something in a joint venture together then you're going to see more sharing. They have a shared interest which is the value created by the product.

DR. PATRICK O'BRIEN There are two interesting things: One of the things certainly in the UK is that it's not just government leadership, but it's industry working together with government through an oil and gas industry council mechanism. So it is government supporting what industry needs, and that's what happened there.

AUDIENCE MEMBER — James McCallum We're talking in this section around elements of guidance coming from the North Sea; one of the words that's missing from the drive in collaboration in the UK side is materiality.

Materiality is what has driven collaboration in the UK. And I pick up on Paddy's point; government-industry collaboration, this is what has driven much of this and certainly was what brought about the creation of the industry technology facility that came out of a joint government-industry initiative, which, at that time, was driven by the crisis of $12 oil. It is interesting to note that the crisis, which the UK sector faces with oil, is actually going to be taken forward not by the people who developed it through the early exploration of the fields.

It's going to be taken forward by the smaller independent oil and gas companies who moved into the UK sector over the course of the last two decades and principally the last decade. If you look up the UKCS [UK Continental Shelf] today, the small independents are dominant in terms of the activity and the investment cycle. Now, it is interesting to note therefore that those small independents may be driven to collaborate much more than the IOCs, because the concept of materiality in that changing pace in cycle is of more importance to their investment than it is for the IOCs. So I think I would just put to the panel this issue of addressing the issue of R&D collaboration might be driven by materiality to the companies that are involved.

JEREMY CUTLER I think it's a very good point and what is going to reinforce that idea of the smaller companies who tend to collaborate more is that many of them don't have their own R&D centers. So they've actually got less to lose in that they have to go out if they need to buy R&D. They don't have to get R&D, they'll buy it. So they won't have as much at stake because they haven't got very established research centers. They'll hire. So collaboration between them is perhaps more likely.

SE *Dr. Nasser, I just wanted to pick up on the other point that James made, that a crisis compels collaboration, $10 oil compelled and now we have the decline in the North Sea compelling maybe another episode of collaboration. We've seen it to a certain extent in Oman, because they have faced the crisis. Do you think that ends create solutions; that we should develop bespoke EOR R&D here for mature fields rather than simply look to adopt technology from outside?*

QUESTION 3
Which of the following should be the biggest priority for the UAE and other Gulf States to adopt in order to advance its R&D ambitions in the short to medium term?

A. Regulatory – the introduction of Intellectual Property Rights

B. Build national education capacity

DR. NASSER AL MOHANNADI We should look for solutions for EOR but the question is how are we going to do it? If the subject that's needed is long term and is fundamental, we would go with the university. And if something needs field testing or prototype, then we might go into research institutes to choose; if it's lab. testing or something that's mature then we might engage with other operators or IOCs.

SE *Should you as an NOC look to develop your own technology solution even if you can go buy it off the shelf from someone else, should you still go look to develop your own capacity?*

DR. NASSER AL MOHANNADI Yeah, we should develop our capacity. We support these activities.

SE *Let's go to the next question. Which of the following should be the biggest priority for the UAE and other Gulf states to adopt in order to advance its R&D ambitions in the short to medium term? 'A': Regulatory, the introduction of intellectual property rights; or 'B': build national education capacity.*

AUDIENCE MEMBER — Sheikha Nasser Al-Akhzami from Sultan Qaboos University in Oman. I voted for 'B' because we really suffer from the capacity. If you would like to build a collaborative effort in the industry, you need to build the R&D at the institutes as well as the industry. But when you try to find the people, you cannot find them. They're not available. What is happening in education is that we produce engineers and they're just being taken up by the industry. So there's no one left; it's a void for R&D.

SE *Paddy, if this question was put for the other parts of the world, all the places that you operate, do you think the answers would be different?*

DR. PATRICK O'BRIEN The answer will likely vary. For example, in Brazil and Norway they have very strong policies in terms of investment and basic R&D which provides an opportunity for innovation and strengthening the education base. There must be a great opportunity then for universities to collaborate across the world. Typically while universities tend to see each others as competitors within their own country, they are more likely to form partnerships with universities in other countries – this is a great opportunity for universities to build their capability.

AUDIENCE MEMBER — Unknown Female I'm from Oman. I voted for 'A'. As the question asked for priority, priority, in my opinion, is to have the education platform. That will actually lead to everything else. ■

ITF Members Forum Survey Results

OPENING SURVEY

QUESTION 1
The past 10 years have seen advances in technology that have triggered a transformation of the global oil industry - Will the next decade bring similar R&D breakthroughs that will allow balancing the water-energy-food nexus on the one hand and accessing harder-to-access hydrocarbon resources on the other?

A. Yes, of course, as technologies trigger change, not follow it

B. No chance, profit and sustainability are on collision course

QUESTION 2
In R&D, the government has some role to play – generally speaking, which of the following should be the biggest priority for the role of Government?

A. Create physical and regulatory infrastructure that facilitates R&D

B. Actively engage with industry and academia in driving R&D activities

C. Let the market drive the direction of R&D activities

QUESTION 3
Is it possible to import R&D collaboration best practices -- IOC-NOC / Industry-Academia -- from one region of the world to another?

A. Yes

B. No

QUESTION 4
Do NOCs need IOCs in implementing EOR projects or will regional R&D become a technology game changer giving National companies greater independence to deliver bespoke solutions?

A. NOCs will need IOCs for at least for another 10 years

B. Regional R&D will put NOCs in pole position on EOR

QUESTION 5
How much of a threat is the shortage of drilling engineers, among others, to the energy industry's capacity to meet future demand growth?

A. Significant threat

B. Minor issue

SURVEY A

QUESTION 1
It's much easier to talk about the need for collaboration than to implement it – which of the following is the greater obstacle to industry collaboration that continues to hold it back?

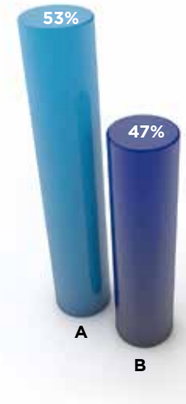
A. Absence of obvious win-win incentives

B. Absence of common critical problems to solve

QUESTION 2
Getting IOCs to collaborate in joint R&D projects may not always be feasible because of concerns over sharing proprietary technologies or sensitive data – Does that mean collaboration can only happen in non-core areas where the oil industry has a common interest in developing knowledge, for example in environmental or water issues?

A. Yes, In reality, that's what's going to happen

B. No, all it takes is a sound legal environment and Government leadership



QUESTION 3
Which of the following should be the biggest priority for the UAE and other Gulf States to adopt in order to advance its R&D ambitions in the short to medium term?

A. Regulatory – the introduction of Intellectual Property Rights

B. Build national education capacity

QUESTION 4
What is the best strategy to pursue to get academia in the UAE and across the Gulf to develop its scientific research base and deliver low technology readiness level (TRL) solutions to meet the Oil & Gas industry's challenges?

A. Have industry contract universities to carry out the relevant specific applied research

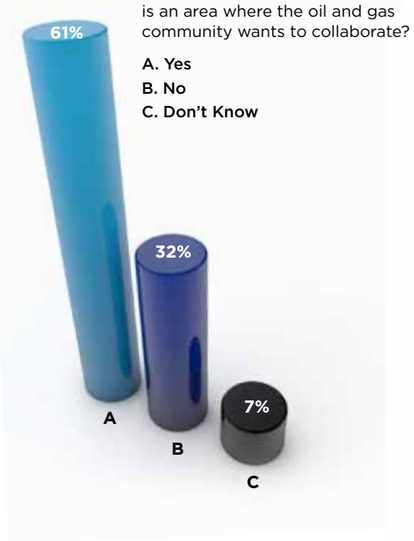
B. Have universities pitch sector-relevant R&D to industry

C. Govt. should decree national universities to serve the interest of the national energy industry

SURVEY B

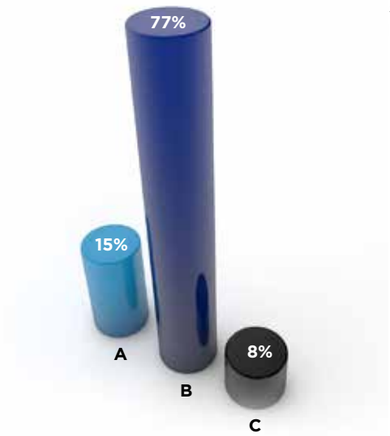
QUESTION 1
Collaborative R&D in the oil and gas industry can be a challenging aspect at the best of times. With the competitive advantage potentially offered by EOR technologies do you feel that this is an area where the oil and gas community wants to collaborate?

A. Yes
B. No
C. Don't Know



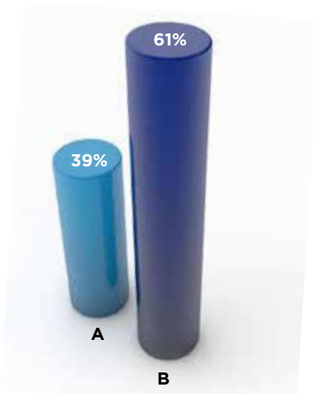
QUESTION 2
There are a number of initiatives underway in the area of EOR. Do you feel that you and the industry at large have a good awareness of which initiatives are running?

A. Yes
B. No
C. Don't Know



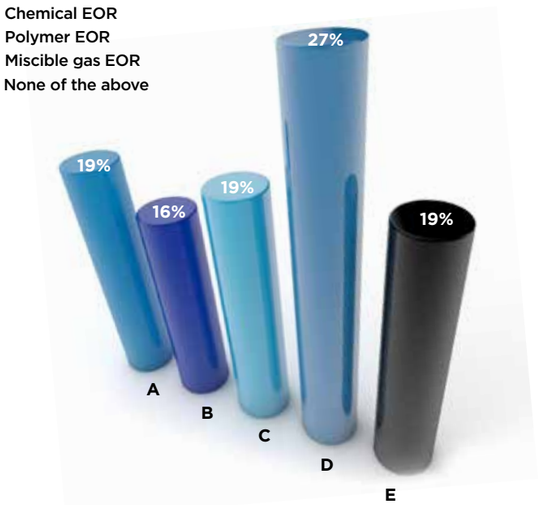
QUESTION 3
Do you think Sheldon Gorell's (RPS Knowledge Reservoir) presentation identified a specific EOR / IOR technology that is ripe for collaborative development?

A. Yes
B. No



QUESTION 4
There are a number of EOR technology areas that have shown potential for increasing recovery factor. Which do you feel offers most potential?

A. Low salinity EOR
B. Chemical EOR
C. Polymer EOR
D. Miscible gas EOR
E. None of the above



QUESTION 5
Given a choice to collaborate on projects relating to EOR and IOR, which of the two technologies would you prefer to collaborate on...

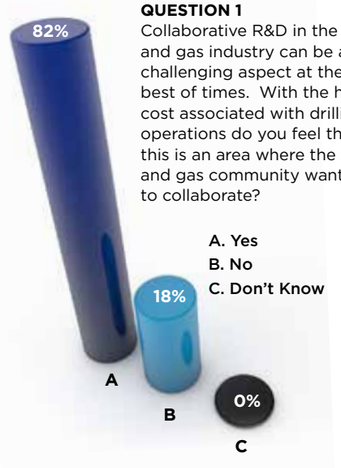
A. Enhanced Oil Recovery (EOR) technology

B. Drilling Technology for Increased Oil Recovery (IOR)

SURVEY C

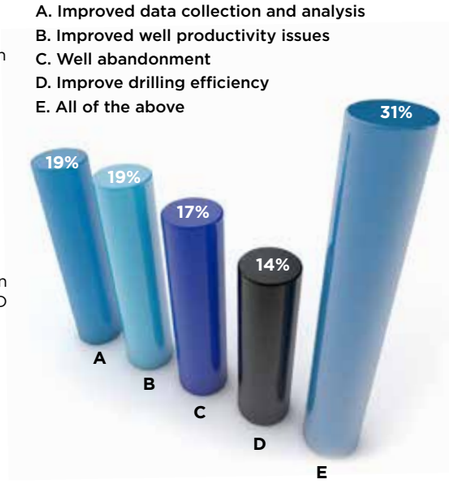
QUESTION 1
Collaborative R&D in the oil and gas industry can be a challenging aspect at the best of times. With the high cost associated with drilling operations do you feel that this is an area where the oil and gas community wants to collaborate?

A. Yes
B. No
C. Don't Know



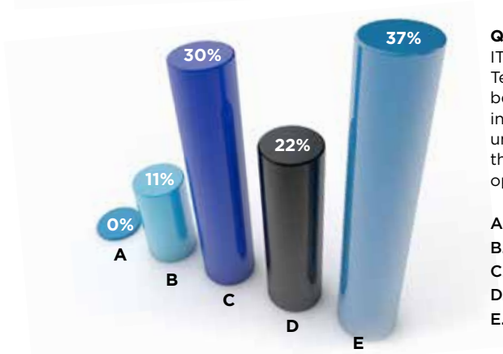
QUESTION 2
Technology plays an important role in drilling and completion of wells with the ultimate objective to reduce well counts, improve drilled footage/day, minimise the unit technical cost, increase well production/injection, etc. What do you feel is the area that would gain most participation from collaborative R&D funding?

A. Improved data collection and analysis
B. Improved well productivity issues
C. Well abandonment
D. Improve drilling efficiency
E. All of the above



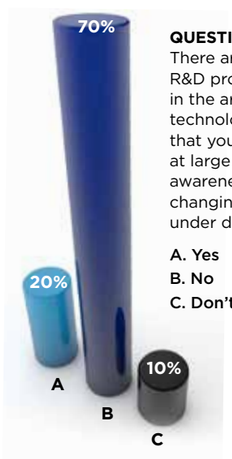
QUESTION 3
ITF has identified Improved Well Productivity Techniques as an area for collaboration that would be suitable to go straight to a Call for Proposals in one or more topic areas as there is a good understanding of the requirement. Which of these do you feel is the area where there is most opportunity for immediate action?

A. Alternative to Gravel packs
B. Improved perforating systems
C. Drilling reservoir with non-damaging brines
D. Advances in Managed Pressure or Underbalanced Drilling
E. MWD techniques to improve the placement of the wellbore



QUESTION 4
There are a number of R&D projects underway in the area of drilling technologies. Do you feel that you and the industry at large have a good awareness of which game-changing technologies are under development?

A. Yes
B. No
C. Don't Know



QUESTION 5
Well abandonment has long been identified as an area that has a requirement for new technology advances and development. ITF is running a decommissioning and abandonment workshop in May – which of the following areas do you feel requires the most attention?

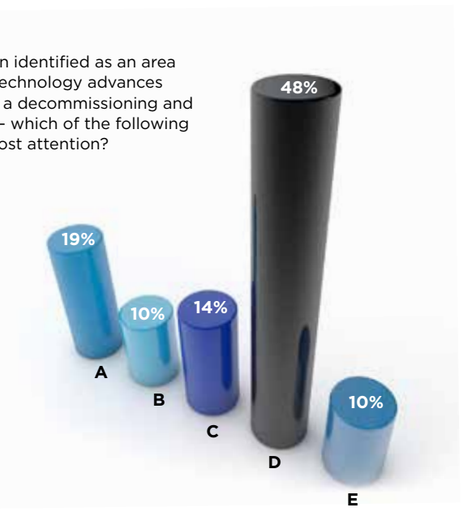
A. Alternatives to cement plugs

B. Methods for addressing cables during plugging operations

C. New technologies for cutting casing

D. Low-cost rigs for abandonment campaigns

E. New tubing pulling systems



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