ECHO

SPE Suez University Student Chapter Annual Magazine

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Drilling Process Digitalization Using Advanced Machine Learning

The Technology Arm of Sustainability

Applying Artificial Intelligence to Optimize Oil and Gas Production

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Suez University Student Chapter

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Ahmed Haitham
ECHO Chairperson
& Chapter President

Human Mind; Factory of innovations

The human brain is the body's computer. Each great discovery begins as an idea, an unsystematic thought that popped into someone's head. It is perceived that discoveries were not made as much by those whose ideas were innately superior, but by those who had the passion and the confidence to follow through with their own ideas.

We all have ideas that pop into our heads unbidden. You neither decide to have an idea nor prevent ideas from flowing in your subconscious mind; it happens simultaneously. The key lies in what we do with our ideas once inspiration strikes!

Our subconscious mind is a potent tool. While we are busy working away on our quotidian chores, our subconscious mind is occupied with our future goals. Of course, this can happen only if we are clear about and regularly review our goals. Our subconscious mind is a fertile ground for generating ideas; we simply have to sow the seeds "Our goals" and then capture those ideas, appraise them, and proceed.

Who can innovate? Can any common person innovate, can you and I innovate?

The answer lies in the power of human imagination. It all starts with a single innovative thought in our conscious mind, which can transform into action with the right level of passion, and into an impactful outcome with the right level of effort.

Continuous practice of paying attention to the thoughts and ideas soon results in innovation being a habit of our sub-conscious mind, eventually becoming an innovative personality. Research indicates that an innovative mind is not necessarily born, it can be developed through techniques of observing and thinking. The authors of The Innovator's DNA, say that roughly **two-thirds of the innovation skills can be learned**.

So, **learning is a life-long process,** and we can learn to innovate at any age. But are we willing to learn and try new things once we are out of university? In universities, we learn a few subjects and score well in exams. But if we can learn to become an innovator, we will keep scoring well not only in exams and profession but overall in life.

All great leaders today acknowledge that innovation is a lifelong process and the key to excelling in life. So, it is significant to develop what we call our 'innovation quotient' of the human mind, to innovate lifelong.

"Innovation is the ability to see change as an opportunity – not a threat."- Steve jobs

Here is your copy of **ECHO 12** ; you will see how the human mind managed to facilitate the oil and gas industry and save the efforts and time on a large scale using different innovative technologies as Artificial Intelligence, Machine Learning, and Digitalization… etc, and how these technologies help keeping oil and gas industry sustainability. Therefore, read each page carefully and enjoy.

Now, I would like to thank everyone who does his best for the sake of helping others. Also, I appreciate everyone I worked with and taught me priceless things that has truly guided me to reshape my mindset and remodel my character to be a person of a real value to everyone I work with.

In this situation, I have to show gratitude to the chapter's high board members who are the reason behind our current status of brilliance and uniqueness. I cannot find a better occasion to mention their marvelous support throughout this season. Finally, allow me to proudly say **"Thank You!"** to ECHO Team; editors and designers for this magical and professional issue which you will enjoy its elegant interviews done with industry leaders and articles collected from industry pioneers.

Abdullah Sharaf
ECHO CEO
& Chapter Secretary

The True Meaning of Success

Some people spend their entire lives wondering how to be successful in life, but never figure it out. Everybody wants to be successful in life, but what this means will always differ from person to person. We all encounter individuals in our lives who by all appearances seem to "have it all," and yet struggle to fill their days with joy and fulfillment. On the opposite end, there are others of modest ambitions who lead lives of quiet contentment, and who savor the gifts of life's little pleasures.

Success is not comparing between our achievements to those of others, **"Success is a period of tranquility, inner peace, and harmony that a man lives"**. It is all about your vision. Highly effective people usually seek the grasp of their real value and discover their inner powers rather than realizing successful achievements. Identifying your real value will help you create your own future, leave an impact wherever you are, and inspire people to have the strength not to give up if they encounter obstacles on their way.

To be successful, you're going to have to adjust goals and occasionally abandon what you thought was a great idea. That doesn't mean that you failed at the original goal, it means that you were smart enough to redirect that energy in a positive manner. You might have realized it after listening to feedback, or you may have come up with it yourself. No matter how it happens, you constantly evolve to provide a better product — **that is success.**

The truth is that success comes from understanding and valuing who you are - not taking your cues from someone else. If you don't know yourself, you'll end up wasting time at jobs that aren't right for you. You'll lose momentum, and your career will stall. You'll be no closer to success than when you first started out.

"Try not to become a man of success. Rather become a man of value."-- Albert Einstein

Intelligent reaction is one of the most important components to being successful because it's realizing that you have to change, which doesn't always come easy to everyone. Intelligent reaction is not solely about change. You can't just make radical changes when you realize the original plan isn't working — it's about evaluating the situation and reacting to what's not working in a smart and intelligent way. While many people view success as having and achieving a goal, I believe it's more than that. By staying flexible and continuously innovating, you're always moving toward success.

So, we can summarize the meaning of success in 5 truths:

1. Hard Work
2. Listening to others
3. Life's lessons
4. Permanent insistence
5. Motivating yourself

In this **12 issue** of our magazine **"ECHO"**, you ll see the realistic success in making our work environment more accurate and comfortable through usage of different new technologies. You'll read articles about Artificial Intelligence, Machine Learning, Digitalization and how these new technologies made a huge revolution in petroleum industry.

Finally, I'd like to thank everyone who spend his time and effort helping others and I really present special thanks to all ECHO team; designers, editors and business developers. The release of this issue would not have been accomplished if we did not have such a competent team with their passion and loyalty.

Enjoy each page of your copy

2021 SPEI President

Tom Blasingame

By/ Mahmoud Ahmady

Tom Blasingame is a professor and holder of the Robert L. Whiting Professorship in the Department of Petroleum Engineering at Texas A&M University. His teaching and research activities focus on petro-physics, reservoir engineering, analysis and interpretation of well performance, exploitation of unconventional reservoirs, and technical mathematics.

As of February 2019, Blasingame has graduated 67 MS (thesis) students, 34 MEng (report, non-thesis) students, and 14 PhD students. He served as assistant department head of Petroleum Engineering graduate programs at Texas A&M from 1997 to 2003.

Blasingame was named an SPE Distinguished Member in 2000 and is the recipient of numerous SPE honors and awards. Also, he was the SPE Technical Director for Reservoir Description and Dynamics from 2015 to 2018. He has prepared approximately 160 technical articles and chaired numerous technical committees and technical meetings.

Blasingame holds bachelor's and master's degrees and a PhD from Texas A&M, all in petroleum engineering.

Q1. We are eager to know about your career experiences and your journey with SPE?

A1. This is a great starting question. I am very proud of my early work with students, and I do sincerely appreciate the venues that SPE provided for me to present and publish. In the early 1990s, I began my service work in SPE with some program committee work in education, in particular, the SPE Education Colloquia. I was amazed at how the older members not only treated me as an equal but gave me the chance to "drive".

Fast-forward to the early 2000s, and my SPE service career took off. I became involved in quite a few initiatives in North America, including numerous program committees for meetings in Canada, the US, and Mexico. I enjoyed my program committee work in Canada very much so that I joined the (now defunct) Petroleum Society within the Canadian Institute of Mining (this group voted to join SPE in the mid2000-s). Not only did I feel like I was contributing in my "neighborhood," but my work was very well-received in these venues.

In the late2000-s, I began being involved in most (if not all) of SPE's efforts in unconventional reservoirs. Starting in 2008, I led all of the SPE meetings on unconventionals, including the joint SPE/AAPG/SEG venture known as URTeC. I served as Technical Director for Reservoir from -2015 2018, and I will tell anyone that wants to hear it that these roles are real work! Lots of late nights, early mornings, and weekends.

Q2. What kind of challenges did you face during your career, and how did you overcome these challenges?

A2. Honestly, I have mostly created my own challenges, but I have no regrets. Several times, I was told to keep my mouth shut, but I didn't. Believe it or not, I have even been threatened a few times, but I don't let threats faze me. I even have been fired twice for insubordination! I think that you have to be honest and transparent and that you must stand for what you believe is right. In short, I chose to focus on where I thought I would do the most good. Today, it doesn't matter that I was "right," but it does matter that I was willing to speak up.

There were also a few strange "challenges" that I have encountered in my career. I have been offered at least three other leadership positions in academia along the way, and about 20 years ago, I was offered a truly unbelievable job in the industry. In the end, my wife made the final decision on all of these tough decisions. She said "no" and she was right every time!

Q3. What is your opinion in the industry of oil and gas during this downturn?

A3. This is an extraordinary question. The emotion comes from the loss of senior talent, the demotivation in a depressed job market, and the uncertainty of how or when things will improve. The inspiration comes from knowing that we have fewer people to do more (and more difficult) work; we need to improve our focus on technology and education. Evolving and future Petroleum Engineers will have to master at least two major sub-disciplines (e.g., completions and production, reservoir and production, etc.).

The motivation comes from the duty to serve an ever-increasing need for energy. In my opinion, we have done our jobs so well that we caused this downturn. The need for energy is essential for a global population of 7.7 billion people and growing that wants a continuously improving lifestyle. Also, we need hydrocarbons as raw materials for just about everything we use in daily life.

Q4. You said, "My stated goal as SPE President is to engage, enable, and inspire every SPE member to a higher level of technical and service performance." What are your goals and aspirations, and how do you plan to achieve these goals?

A4. Let me distinguish between "goals" and "aspirations" — goals are tangible; in short, these are "tasks" that one can state and then demonstrate mastery and completion. Aspirations are generally more intangible, but in my case, I would say that my aspirations are "inspirational", I want to use my time as SPE President to inspire to aspire.

Specifically, my goals as the 2021 SPE President are:

- To have the SPE Board of Directors focus on long-term issues relevant to the function and success of the SPE.
- To have the SPE staff focus on short and mid-term initiatives relative to publications, meetings, member engagement , protocols for improving the quality of our publications.
- To "go anywhere and everywhere» so I can listen, observe, engage, and encourage our members. I do believe I am a world-class motivator.
- To invite open and direct input from our SPE members on what they want and how they would commit to achieving a given desire.

Specifically, my aspirations as the 2021 SPE President are:

- Big picture: To be a faithful and industrious servant. I have no personal ambitions in the role, other than to create a vision of the future of energy for this planet.
- My Professional Aspiration: I believe that every SPE member has at least one truly outstanding and unique paper that currently resides only in their head. As SPE President, I want to encourage, challenge, beg, bribe, cajole those members who are ready to get that paper written in the next 12-18 months.
- My Personal Aspiration: I want to use this role to inspire people to engage to their maximum capabilities, and to enable others to do the same.

Q5. SPE Suez have achieved many regional and international awards like the outstanding and the golden standard status. So, what do you, as the faculty advisor for the Texas A&M SPE student chapter, advise us to keep moving forward?

A5. My wife says that my real day job is being the faculty advisor for the Texas A&M SPE student chapter or, as well call it TAMU-SPE. Let me be clear: Our goal is NOT to win awards. Our goal is to provide a vehicle for our students in learning, leadership, and service. Achieving this goal necessitates a very large organizational structure a very aggressive meeting and training agenda focused on industry presenters, and the prioritization of student engagement and participation.

TAMU-SPE is a professional (technical) society. But we also address social concerns, and we try to provide significant philanthropic contributions to the community and the department (to the scholarship fund). Our main goal is to provide a professional home for our students and let them do the driving as much as possible. They are dedicated to serve and deliver, and if you couldn"t tell, this is my favorite job.

Q6. You said, "It is important for me to help others because this is how I learn." Can you explain how you learn from helping others?

A6. I commend you as this may very well be the best question to gain insight into what truly makes me tick. My parents taught me never to go first, to be the last to leave, and to always help clean up. My mother had me make my bed from the time I was 4 or 5 years old. Sure, I wanted to take it easy, but my parents never took a vacation because they had a business to run.

This work ethic was pounded into me, and still is from beyond the grave. When I became an instructor in the mid1980-s, I realized that the only mechanism I have for teaching is to assess someone's needs and weaknesses and help them with that. When I became a professor in the early 1990s, I was extremely engaged with my research students, and to a lesser degree, with my classroom students.

The learning through service concept is really about seeing why a person has an issue and being as innovative as possible about solving it. Making myself available, both mentally and physically, to help others is the best learning tool I have.

"If you hold someone's hand too much, they won't learn to their fullest potential."

Q7. What do you think of our magazine ECHO?

A7. I admire the dedication from your chapter to regularly produce this publication in such a professional manner. Furthermore, I would love for TAMU-SPE to learn from ECHO for our student chapter publication "The Well Log." The Well Log has been a very good publication lately, but requires a similar steadfast attention from student leadership to achieve long-term consistency we are striving for. In short, ECHO is a strong publication, and you can bet that I will challenge our TAMU-SPE student chapter to produce a publication that matches its quality.

Q8. Please leave a message for senior students and fresh graduates who are about to join the industry in the near future?

A8. My message to students and recent graduates is that the world needs you — and yes, I know that sounds cliché, and yes, I know that the world doesn't know it needs you, but it does. I know that getting that first job is challenging. Still, my advice is to be the best student you can be, and once you land that job, but the absolute busiest, be the most productive petroleum engineer you can be.

If you can't land a job as a petroleum engineer, then take whatever works for you. I know of numerous cases where fresh graduates have started their careers as pumpers or technicians, and even a few that started in pipelines and logistics. The key to employment is to make the most of any opportunity and to demonstrate why your employer cannot live without you. You need to be able to self-study, and you absolutely must be self-motivated.

Mr. Hussam Abuseif

Director and General Manager - Egypt, Sudan and South Sudan at Baker Hughes

By/ Abdullah Sharaf - Mohamed El-Araby - AbdElrahman Eid

In the start of our interview, could you tell us about your background and the transition you made to your current role at Baker Hughes?

I have started my career immediately after I graduated from Mechanical Engineering. I joined SLB as a Field Engineer Trainee, worked in oil and gas field locations for 6 years during which I enjoyed knowing and learning day by day and enjoying problem solving, delivering success and learn from failures and finally knowing hard working people in such dynamic and critical sector. The other 7 years I spent in SLB were managerial development roles, including technology development. Joined Baker Hughes in 2010 till present, where I have learned even further different business startups, structure to growth and different merger and acquisition cases. Today I lead a wide portfolio of technologies that feeds in to our Upstream and Downstream customers as the Director and General Manager for Baker Hughes Egypt, East Africa.

How did you overcome your journey challenges to draw up your success and reach this high position?

Challenges are the core to build progression. I never stop hearing or facing challenges till our time and will continue. They come in different nature and intensity, rather than naming challenges; because conceptually it varies from one person to another. I believe facing those challenges and tackling them is the important aspect. Major tip to face challenges and tackle them is emotional control and calmness. If I would advise, at any time you face a challenge, take some time to analyze it, listen to your team and believe in your solution.

Mr. Hussam, you started your career with Baker Hughes in Iraq as the country director, till you held your current position in July 2017. What were your first impressions of the market here?

Egypt is a unique market with huge potentials for investment. The country gas story is impressive, directions to make Egypt as a gas hub for the Mediterranean is well thought of and will develop the country resources towards effective utilization. The market is so dynamic and the mix of oil companies and investors are wide which makes such oil & gas sector an ideal place for trainees and new hires to gain useful experience and to build on it for a better future.

Having met with many of your counterparts all around the world, we have heard that innovation is truly at the core of Baker Hughes. What innovations are you bringing to Egypt; last and upcoming?

Baker Hughes is a company that wants to take energy forward and we are known as Energy Technology Company. Therefore, you are right as it is in our core focus and direction. We have introduced several drilling technologies such as Echo, Track Family along with production technologies such as GeoForm and Transcoil. Moreover several downstream technologies in Refineries, Petrochemicals and Compression Complex. We are so excited about the future, when we took a mandate on our commitment to develop technologies that are suitable to be zero carbon emission sources. We are shaping and leading a future in such industry to help in creating safer, cleaner and more efficient energy to people and the planet.

Many of your global competitors are present in Egypt as well, and there are also many local oilfield service providers. In your point of view, which factor guarantee that Baker Hughes remains competitive?

Technology, Technology and Technology. Looking into future building on digital transformation and artificial intelligence would be a big differentiator.

How has Baker Hughes contributed to the human development within the oil and gas industry in Egypt?

We have been for years and years in the country. We even have more than two generations in the company. We have been a strong attraction to several talented new graduates from all universities in Egypt. We have contributed to several active organizations and community services. We will always have a duty to do more to raise the human capital resources and outcome.

In light of Baker Hughes' long history in Egypt, moving forward, how important will Egypt continue to be for the overall organization activities?

There is no doubt that Egypt will continue to be an important attraction for our company. The visibility of the gas hub and the attraction of foreign investment in the Oil & Gas sector will continue to be a solid venue for activities and involvement.

Could you tell us your feedback about ECHO magazine?

I enjoyed reading the last edition of the magazine. I like the structure and the content. I believe more of inspirational and motivational materials are needed for the audience of such magazine. More focus on Data analytics, Artificial intelligence and Alternative energy would be good technical material for several editions to come.

Finally, Could you please leave a message for the young professionals and undergraduates who are about to join the actual industry life.

It is time for you to roll up your sleeves and join one of the most dynamic business where price of a commodity changes daily and technology is a differentiator. I have enjoyed my days learning and progressing and I believe you will feel that from the first day you join. It needs effort and determination like any other job and mainly depends on a character that is willing to explore his inner qualities. I wish you all the best in your career and beyond.

Valuable words from Mr. Ahmed Hamouda

Country Sales & Commercial Director at Baker Hughes

Mr. Hamouda holds an Engineering Degree in Mechanical Engineering, He brings with him over 16 years' experience starting from DRS Field Operations and Service Coordination. Prior to his promotion to this role, he has held dual roles in Baker Hughes as Egypt's Drilling Services Sales Manager & Business Development Manager for the past 6 years, in which he worked with various product lines covering operations, sales , business development and management responsibilities related to his assigned customers. Currently, He is the Oil Field Services (OFS) Country Sales Leader for all product lines.

- **"Challenges are the one of main pathways to build a successful career bath every day I am facing a new challenge in my career and every day I learn more and more from these challenges, a lot of experience I gained from facing these challenges and it really have a huge contribution in building my current work personality. "**
- **"What I can see these day that there is a big focus on the young professional development, huge focus from the country leaders and the same focus I can see now transferred to oil & Gas sector, now a days we can see new younger generation leading some of the key positions in the Oil & Gas sector which encourage new generation to do more efforts to reach it faster."**

Ms. Alex Roberts

HSE manager at Schlumberger for Egypt and East Mediterranean

By/ Mohamed El-Araby - Abdelrahman Eid

A motivated, capable and versatile professional with 18 years Oil and Gas experience from Schlumberger including wireline field operations, new technology acceptance testing, resource management, quality improvement, product development, end to end supply chain, finance and business sytems. Able to integrate rapidly into multi-cultural, multi-functional teams having led teams across Europe, North America, Russia and Africa. Ready for the next adventure!

Could you introduce yourself for our readers?

I started working for Schlumberger straight after I graduated with a Masters in Materials Science and Engineering from Imperial College, London in January 2001. Like most Schlumberger managers, I was hired as a Field Engineer and got promoted after completing their fixed step training programs. I spent 6 years in the field running wireline jobs offshore for clients in the North Sea and the Gulf of Mexico. It was very rewarding work with a great deal of responsibility and enormous variety. I moved from rig to rig, met people from all over the world, operated ground breaking technology and even broke world records.

When I moved into managerial roles, my first remained within wireline but I subsequently transitioned to the supply chain function. I next worked for 5 years as a Product Owner designing solutions to enhance productivity through asset and material tracking devices, many linked to custom mobile applications. Geographically my career has also been diverse, starting in the North Sea, then living in Southern United States, moving back across the Atlantic to Nigeria where I covered a quality compliance role travelling all over Sub-Sahara Africa. The IT role I had gave me the opportunity for Global travel, I delivered training in Russia, South East Asia, Europe and North and South America.

Since August, I have been working here in Egypt as HSE manager for Egypt and East Mediterranean.

Through your long journey with SLB, could you tell us how SLB environment motivate the diversity and women role in energy?

Yes, that is one of the highlights of working for Schlumberger. They believe in equal opportunities; gender, nationality and religions are all respected and as long as you have talent, they will support you to achieve to the best of your capabilities. In fact, in the UK newspaper “The Times” there is an annual article: “The Times Top 50 Where Women Want to Work?”. This is a UK focused event and Schlumberger has been listed as one of the 50 companies for 4 years in a row – every year since the initiative was introduced!

I’m excited about all the steps being taken to reaching equivalent status here in Egypt. One of the key focus areas for Schlumberger in Egypt is to attract and retain more females into Field roles. Egypt universities are one of the sectors we engage with to encourage this including delivering HSE seminars with our Oil and Gas industry partners. I’m looking forward to EGYPS and participating in HSE Excellence awards, Women in Energy and Employer of the year championing inclusion and diversity panels. There watch this space to see the talent pool expanding as we offer more opportunities to women in Egypt.

Tell us what inspires you at the moment working in Egypt as HSE Manager?

The oil and gas industry of Egypt, led by the Ministry of Petroleum recognizes that a safe industry is a successful industry. They've been taking positive steps to improve safety awareness. I feel that I have arrived in Egypt at a pivotal time where we should soon see a step change in safety performance and that is very inspiring and exciting. I'll go into depth about one of the key items Schlumberger has been working on with the Ministry of Petroleum.

During 2018 a memorandum of understanding was signed between Schlumberger and the ministry to spread knowledge and promote HSE leadership and awareness. Since that initiative, the MOU steering committee team has collaborated on several initiatives to increase safety awareness in the Egyptian Oil and Gas industry.

"The important role of Leadership; how the leader should build positive safety culture".

Sounds great... Please tell us more about examples of collaboration in HSE within Oil and gas industry?

Schlumberger hosted a driving workshop in December because we recognize driving as our highest risk. Globally, we take it very seriously and have developed technology that helps us manage journeys.

The Driving Safety workshop started with an overview of how Schlumberger manages driving, reviewing the 7 elements of our driving policy and discussing each one with a focus on the technology we have implemented to manage journeys and influence driver's behavior.

The second part of the day was the actual workshop session. There was a very good turnout with over 150 delegates from more than 60 companies in attendance. The room of 150 delegates was split into 15 round tables of 10. The tables seated a diverse group of upstream and downstream executive men and women from companies in Egypt. Each table was given an open ended question to discuss and write a response. The open ended questions were thought provoking conversation starters, to encourage brainstorming and asking of further questions.

The teams came up with many ideas such as:

- How do we influence good driving habits?
- How do we increase safe behaviors and eliminate bad behaviors?
- How do we standardize training programs, monitoring systems, vehicle standards, pre-trip inspections, journey management?
- How can we influence the driving safety culture and improve it year on year?
- How can we make 2020 a safer year?

Once these ideas had been agreed on, each team summarized their ideas on their poster and then every group presented back to the room what they had come up with. The outcome has been incorporated into EGPC's safety plans for 2020.

The level of collaboration and teamwork that went into planning and executing of the workshop was exceptional.

The seat belt convincer was also onsite at the Sky resort. During 2020, Schlumberger are lending the seat belt convincer out so that seat belt awareness and culture can be improved amongst diverse communities across Egypt.

We gathered to improve our industry, and during that gathering everyone agreed that a safe industry is a successful industry and by working together, through knowledge sharing, through promoting safety leadership in all the elements of our business, we can put our people first, we can empower them to make safer decisions every day and we can improve the safety and the success of our industry…. Together.

" To enhance HSE performance and awareness in Egypt's Petroleum sector through leadership and commitment that shall drive the implementation of programs to develop our people and processes in line with the Modernization Strategy "

Mr. Sherif Foda

NESR Petroleum Company Chairman and CEO

By/ Ahmed Haitham

while SPE attending the International Petroleum Technology Conference «IPTC» in KSA

Could you introduce yourself to our leaders and tell us more about your career path?

My name is Sherif Foda, I am an electronics engineer, I was graduated from Ain Shams university 1991, I graduated from automatic control and computer science which has nothing to do with the oil field. I started my career working in information technology for two years and then I shifted and I went to Schlumberger and worked in the field, you know the majority of the field engineers are not petroleum engineers, I spent about 24 years with Schlumberger.

I started working in Egypt in the offshore fields of the Red Sea (Ras Shoquir& Abu-Rdis), then I moved to Germany, Eastern Europe, United States, The Gulf countries, Africa, Latin America, North America and until in the end I was the president for Schlumberger of Europe, Africa, Russia and the Caspian and then I was the group president for world-wide production. I was running the production of SLB world-wide, and then I left after being an advisor to the chairman and I started what we call SPACK (Special Purpose Acquisition Company) in New-York, we raised money from the investment in basically the US on the Nasdaq market. I Launched this company called NESR (National Energy Services Reunited) and I merged and fused to the largest two national companies in the Middle East which are NPS and Gulf Energy, put them together and now we are the largest national company in the Middle East and North Africa after Schlumberger.

What challenges have you faced in your journey towards management position and how have you tackled them?

One thing I have to give credit to my earlier life in Schlumberger, they appreciate you if you are what they call "Of high value" or one of people working much harder, doing more jobs, taking more actions and responsibilities than their current job and showing initiatives. They flag them as potentials for management and move them to a completely different environment to take a leadership role.

They did that with me and I would say -thank god- I managed to survive which was a very good way of getting around different fields and different business and that is how I kept going on management. All the jobs I did I was actually the manager or the leader or the top guy. At the end, I decided to try to be an entrepreneur and I found the company.

I have now 4000 employees and I try to do exactly the same thing that when I spot young talent in people I throw them as well in tougher jobs and see if they can survive. Usually, it is a bit tough; if you do not make I cannot send you to a managerial position, you actually go backwards. It is a different style for putting people into management and I enjoy it.

As Nesr is one of the leading companies in the industry service field, have you a presence in the Egyptian market?

No, we are working in fourteen countries except Egypt.
Today we do not have any presence, because the two companies that we acquired and merged together had the Middle East GCC countries, North Africa, Algeria and Libya only. We started to enter new countries, so we entered Chad, Yemen, Bahrain and we are considering Egypt, But we are not operating there yet.

So you have a plan for Egypt in the future ?

Yes, we are planning to enter the Egyptian market; it is a very competitive market, beside I am Egyptian and I will be very proud to be in Egypt.

Is there anything else you would like to share regarding your company?

I think what we would like to highlight is something I looked upon; being twenty years in the industry there are a lot of successful E&P companies operators from the region, we have the biggest resources in the world form oil and gas and we have very successful national oil companies operating, but we do not have at the same level a service company that is known worldwide. It is something that is very different and we had to do something and take the benefit of everything we learnt worldwide and how to make the local company very different so to be a local within the industry with international standards in everything we do.
In the governance, we are publicly listed, we are in the New York exchange, we are the only company from the Middle East on New york exchange, because you have to pass a lot of regulations to be there. Some people have this thought that if you are a local company you have lower standards which we are not we are of high standards and if we cannot do something we do not do it; we honestly say that we cannot operate in this. You should use Schlumberger or Baker for this because I do not have the technology needed, and I think this is honesty and transparency which are very important.
We also care about diversity; that is why we make sure there is women in leading rules in our company: so my corporate control is a woman, my GC (General Council) is a woman, my head of legal is a woman, my ESG director is a woman.

Compared to other countries you used to operate in KSA, what are the most advantages and disadvantages of operating here?

The key in Saudia Arabia is there is only one client which is Saudi Aramco, so the disadvantage is if you do not have a contract you do not exist. But the beauty of Saudi Aramco is they are very fair and they are very innovative in technology so if you deliver and always bring new ideas they will always work with you as partners, so they have this partnership approach and they know how they want you to be there for the long term. If they feel that you are not contributing, they cut you off because you are not bringing anything to them; but if you are, it would be very hard to leave. It is the biggest market in the world so you have to be here.

That is interesting how different the international markets are.

Yes, it is totally different like the US. In the US, they work with something called quotation; so you give a quotation and if it works you come and work, tomorrow you do not work and they can call you like they call Walmart, so it is a very dynamic. But in other countries like in our Middle East or Africa it is very regulated from a tendering and bedding perspective. There is bureaucracy as well in some part of its law, but once you are in you are in; but if you are not it takes very long so you have to be patient.

Could you please give a quick review about our magazine? And what would you recommend to raise its standards?

It is good and I think you managed to get to a lot of expert people which is positive. I think more international and outside Egypt will provide more diversity. So, it is good to have some stuff from outside Egypt.

Finally, could you please leave a message for young professionals and fresh graduates?

I would tell them: Be open, be ready to take the tougher jobs; there is a message or a feeling from the older crowd that you guys ,the younger generation, want to sit in the office and do not want to go to the field because they think the industry is 4.0 meaning that everything is going to be digital and you do not need to work. But I can tell you my four years doing that made a huge difference for me despite the fact that I was almost working for like an IBM type of work and I left that and got my hand dirty. you should get your hand dirty from the beginning and you should make sure to spend quality time in the field understanding what people do, because that what makes a difference for your managerial time in the future.
When you are a manager and you understand how a person take units apart and repack a pump or repack an engine or plungers, it makes a hell of a difference. So spend quality time in the field not just to observe but to work and get your hand dirty.

A final comment about the industry from your point of view, is it easy for the petroleum engineer to get involved with data analysis, machine learning and artificial intelligence?

No problem at all, I think people should not take this as a slogan. This is going to take much longer than what people think as the automation on the rig is going to take very long time; it is very costly. I think more of it is going to happen on the upstream office type of work which is like the data analysis of the oil companies where they are going to use a lot of the data that are coming to analyze it and do something about it. They will need a lot of petroleum engineers but you have better tools to take better decisions and you will learn it all, there is no rocket science here. And you are going to learn it in the job, do not get excited that this is new and you will not be part of it, NO. The key is to know your subject as you are not going to be an IT person, you are going to be the subject matter expert of the technology of the petroleum engineering itself and these are just IT tools that help you make better decisions, but at the end of the day we need petroleum engineers because robots are not going to run the oil field, it is a myth.

Vladimir Grechka

World-class expert with +30 years of experience in development and application of novel geophysical technologies for the estimation of seismic anisotropy, fracture characterization, and microseismic monitoring. Effective and confident technical communicator, both oral and written (co-authored over 400 technical papers and 4 books).

Microseismic Imaging of Unconventional Reservoirs

Abstract

Microseismic technology focuses on the characterization of seismic sources: the travel-times of direct waves and the recorded wave amplitudes providing information about the source dynamics.

Microseismic images found in the literature are often unsatisfactory, appearing artifact-laden and poorly focused. Here, we take the next logical step and post-process our migrated volumes to extract attributes, such as local dips, azimuths, and discontinuities useful for subsequent interpretation. We begin with discussion of challenges faced by micro-seismic imaging to help the reader appreciate the difficulties preventing wide-spread application of this familiar for geophysicists technology to unconventional reservoirs; then we proceed with detailed description of our Woodford and Bakken case studies, highlighting the choices that have been made and analyzing the geologic and reservoir stimulation.

Challenges of microseismic imaging

The first difficulty, well-documented in the literature of microseismic imaging, is irregular spatial distribution of natural passive sources and sparse distribution of downhole receivers as opposed to regular distribution of active sources and receivers in seismic reflection surveys, designed with a certain imaging objective in mind. We attenuate imaging artifacts, caused by the sparsity and irregularity of microseismic data, through post-processing of migrated volumes, aimed at enhancing the interpretable content of images.

The second challenge is the variability of focal mechanisms of microseismic events as opposed to uniformity of active seismic sources, the variability causing a point in the subsurface to be illuminated by waves with opposite polarities. Such a polarity disparity is obviously detrimental to the image quality.

The third challenge is related to the requirement of having a precise velocity model for constructing microseismic image.

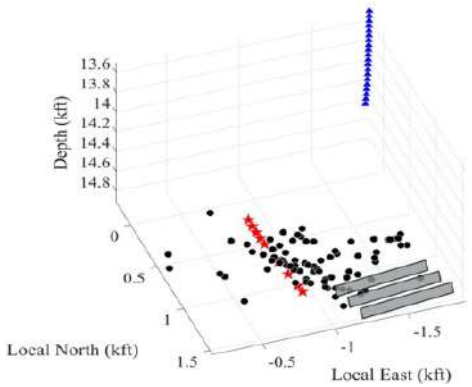

Fig. 1—Microseismic recording geometry and events. The stars, the triangles, and the dots indicate perforation shots in a nearly horizontal well landed in the Lower Wood-ford, 3C sensors in a single vertical well, and microseismic events selected for imaging, respectively. The transparent rectangles are approximately East-West oriented hydraulic fractures suggested by the attribute volume in Figure 3.

Woodford case study

We begin our examples with a data set acquired in the Woodford Field by a string of three component (3C) sensors deployed in a single monitor well (Figure 1) and processed for the standard microseismic deliverable a catalogue of event hypocenters. Out of our full catalogue, Our choice to decimate the available microseismic catalogue expresses our reluctance to let relatively high noise in low SNR events adversely influence an image. Another choice made in our both case studies is to apply conventional 3D prestack Kirchhoff depth migration to the vertical component of recorded data instead of 3D vector Kirchhoff migration to 3C data, the choice acknowledging unknown-at-present benefits of vector migration for microseismic imaging and the desirability to mitigate the propagation of errors in sensor orientation to the migrated volumes.

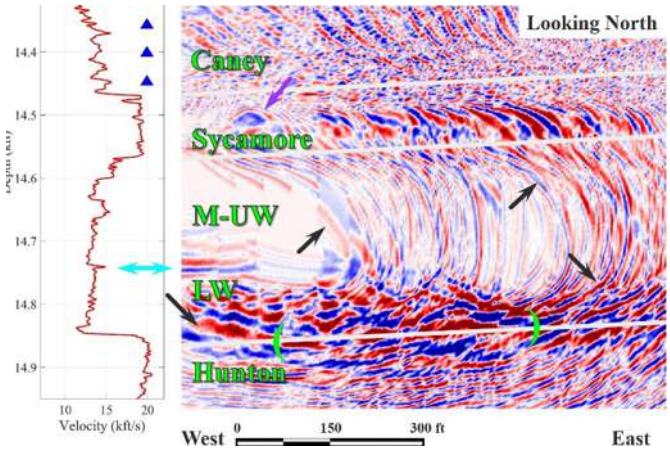

Fig. 2— P-wave sonic log (left) and West-East vertical section through seismic image volume (right). The gray lines (dipping at 2.5 ◦ from NE to SW) are interfaces of homogeneous layers comprising the velocity model used for imaging. The abbreviations M-UW and LW stand for the Middle-Upper Woodford and the Lower Woodford. The hole in the western part of the image, at depths between approximately 14.55 kft and 14.75 kft, is caused by restricting the lateral migration aperture to 150 ft from the vertical plane passing through a source-receiver pair. The blue triangles indicate the depths of the bottom three sensors of the receiver string displayed in Figure 1.

We utilize the P-wave portion of seismic velocity model, containing a mixture of isotropic and orthorhombic layers and fitting the available time picks with the root-mean-square (RMS) misfit of 0.86 ms, to compute a travel time table for prestack Kirchhoff depth migration. Then we migrate the squared-phase traces, equalizing the P-wave polarity across the data set, and output our image volume on a 5 5 5 ft grid. A vertical slice through the volume presented in Figure 2 exhibits the expected imaging artifacts, some of them indicated with the black arrows; but also, promisingly, it displays a number of sonic log-corroborated and geologically interpretable features. We mention the following:

- About 400 ft long portion of the Woodford-Hunton interface is well imaged.
- The high-velocity, about 8 ft thick layer (the cyan arrow) in the Woodford, separating the reservoir into the Middle-Upper and Lower units, is present in the image, attesting to the obtained resolution.
- Images of the Middle-Upper and Lower Wood-ford formations exhibit different textures, suggesting potential relationship to the formations' geology: The Upper Woodford is chert-rich, whereas the Lower Woodford is shale-rich.
- The purple arrow indicates an anticline in the carbonate Sycamore formation, a part of a karst structure that will become apparent in Figure 3.

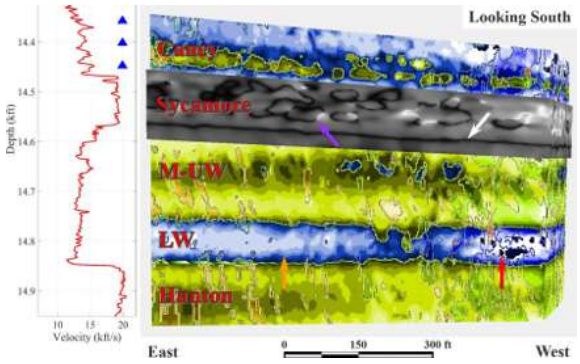

Figure 3—P-wave sonic log (left, same as that in Figure 2), and color blend of the local dip and azimuth attributes extracted from the migrated volume in Figure 2 (right). The black-and-white inset displays the dip attribute only.

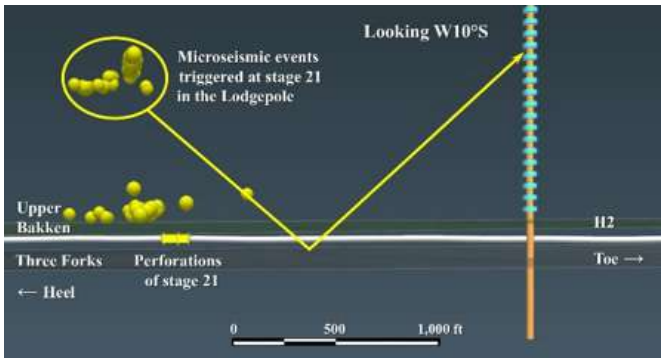

Figure 4—Lodgepole events (the yellow spheres inside the yellow oval) triggered at stage 21 of hydraulic fracturing of well H2 and used to construct microseismic image in Figure 6. The event cluster in the oval is located approximately 900 ft above the stimulated well H2. The Upper Bakken and Three Forks horizons mark the top and bottom of the Bakken reservoir. The cyan disks are 3C sensors deployed in the monitor well (orange).

Even though Figure 2 lends itself to geologic interpretation, removing artifacts from the image should make the interpretation more straightforward. With this goal in mind, we extract the local dip and azimuth attributes from the original image volume and display them as a color blend in Figure 3. Our dip calculation utilizes a gradient structure tensor to determine the dominant structural orientation in the image volume. The results are stored as a pair of 3D seismic volumes, capturing the local dip magnitude and the dip direction for each sample in the data. Those volumes are then combined according to a 2D color map, where the hue indicates the azimuth, and the gray scale indicates the dip. If a sub-vertical wave-front crosses a formation boundary and refracts, the image structure inflects away from or towards the monitor well, exhibiting variation in orientation and, hence, the color, allowing the formation boundaries to be visually interpreted. The Middle-Upper and Lower Woodford reservoir units are clearly identifiable by their colors (greenish and bluish, respectively); the Sycamore-Woodford interface (the white arrow) appears extremely sharp in the dip attribute only; and the previously unknown karst or mound structure in the Sycamore (the purple arrow) becomes unmistakable.

Bakken case study

We apply the same methodology to a data set acquired in the Bakken Field. For our purpose, we select 97 strong events triggered in the Lodgepole formation. The records of waves excited by those events exhibiting long codas accompanying the direct S-waves, such as the one displayed in Figure 5. The vertical components of the direct S-waves recorded in several downhole microseismic surveys carried out in the Bakken Field correspond to the slow S-waves to obtain their images.The geometry in Figure 4 implies that our sensors (the cyan disks) record reflected and scattered waves (schematically shown with the yellow arrow) from the reservoir zone stimulated prior to stage 21 because the event sources are located at the heel side of the stimulated well from the receivers. Then, as before, we compute volumes of the local dip and azimuth attributes, this time followed by the extraction of discontinuities from those volumes.

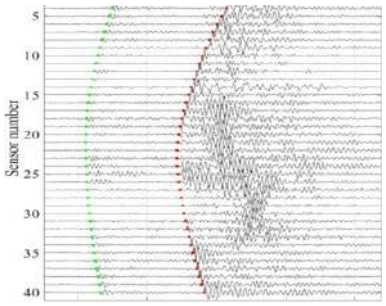

Figure 5—Vertical component of a representative Lodgepole event.

The green and red dots indicate modeled times of the direct P- and S-waves, respectively.

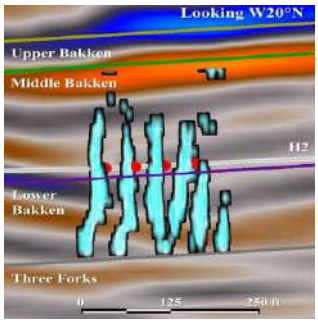

Figure 6—Discontinuities (cyan) extracted from volumes of local dip and azimuth attributes of the shear-wave image volume displayed in the background. The red circles indicate four perforation holes of stage 19 in well H2 placed at a 40 ft spacing. The Upper Bakken, Middle Bakken, Lower Bakken, and Three Forks tops are the interfaces in a layered velocity model used to create the image.

Although this is interpretation only and should be taken as such, any alternative would have to explain the regularity of spatial arrangement of the geobodies and their relationship to the perforations, something we find difficult without invoking hydraulic fractures.

Conclusion

Thousands of wells producing oil and gas are geosteered by logging while drilling, and data collected when completing the wells are primarily geared towards the understanding of fluid-flow properties of a reservoir rather than its geology. This is where microseismic monitoring comes in, helping map the rock ruptures and infer a reservoir volume contributing to production.

Christoph Kandziora

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He works in siemens since 2011. He started as Sensor System Integration Engineer for 3 years. After, he was promomted to be Technology and Innovation manager for 2 years. Now, he works as Siemens' Technology Consultant.

Applying Artificial Intelligence to Optimize Oil and Gas Production

Abstract

Artificial Intelligence (AI) has paved the way for significant efficiency and productivity gains in the oil and gas industry. One application, in particular, has been proven to benefit from these technologies: electrical submersible pumps (ESPs).

This article explores a unique AI-based application that enables operators to preempt costly ESP failures, while optimizing production at the same time. To illustrate, we will share a use case where 30 ESPs were deployed and monitored using an AI-supported predictive maintenance model. The positive results are applicable to offshore applications. In one case, the probability of an ESP failure was determined 12 days before an actual failure of the ESP occurred.

AI and Machine Learning, a brief overview and the use of AI-enabled monitoring

AI is usually referred to as the application of software algorithms that can be taught to do the kinds of work that typically require human intellect and learning abilities. It draws from such disciplines as logic, statistics and probabilities, as well as neuroscience and psychology.

Pattern recognition is a common AI example whether it involves finding exceptions and differences in data –ESP performance anomalies, for example– or distinguishing patterns in images, speech, or music.

(ESPs) account for about half of all the world's artificial lift deployments. They operate in below-ground production formations that can be extreme. For various reasons, ESPs are subject to failure and, in today's deployments, they can do so without warning. That's why an early warning system for ESP operations in the form of an AI-driven probabilistic, predictive maintenance model can be so desirable.

How ESPs are monitored today

Typically, ESP deployments include sensors and instrumentation to provide assess the conditions of their workings below ground in the well hole and in the reservoir. Many vendors offer sophisticated ESP troubleshooting tools that tap into historical ESP data to help operators investigate root causes of problems. This monitoring model can alert operators to issues requiring their urgent attention, most often it is reactive in practice, because the tools lack the means to predict an ESP failure.

AI to forecast ESP potential failures

Today's ESP diagnostic systems typically use two ways to ascertain operating issues:

1. physics-based modeling.
2. expert modeling.

In the former, mathematical equations describe the physical behavior of a process. The equations take a lot of expensive, highly skilled effort to develop.

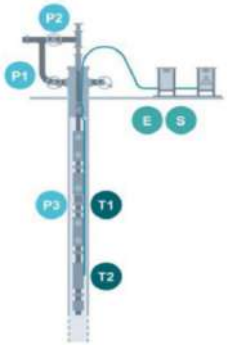
The latter-expert modeling-costs less to develop because its analytical model doesn't require as sophisticated skills as physics-based modeling. Its results are also more easily interpreted. But it tends to discover known anomalies in equipment behaviors, overlooking unknown ones that can still disrupt an ESP's operation or cause it to fail.

This is where Machine Learning (ML) interferes. It starts with a programmed neural network model, then uses historical equipment data to teach the model how a system and its constituent parts should behave in terms of the system's as-designed and as-tested operating parameters, ML enables complex systems to be modeled with ease, and the models can then recognize new phenomena in a particular set of data.

One challenge is that the complexity of a neural network model can make its analytical results difficult to interpret. Another big challenge with an ML-based monitoring and diagnostics model is that it requires a data training set, which needs significant time and effort to prepare. Nonetheless, once the ML model has learned the normal behavioral relations across all the varied parameters of a system, such as an ESP, it can start comparing massive amounts of system data to its baseline data set in near real time using pattern recognition.

Figure 1—ESP monitored process variables.

- P1: Annulus pressure
- P2: Production oil pressure
- E:Electrical motor current (measured at VFD)
- S: Motor speed (measured at VFD)
- P3: Inlet oil pressure at pump
- T1: Inlet oil temperature at pump
- T2: Pump motor temperature



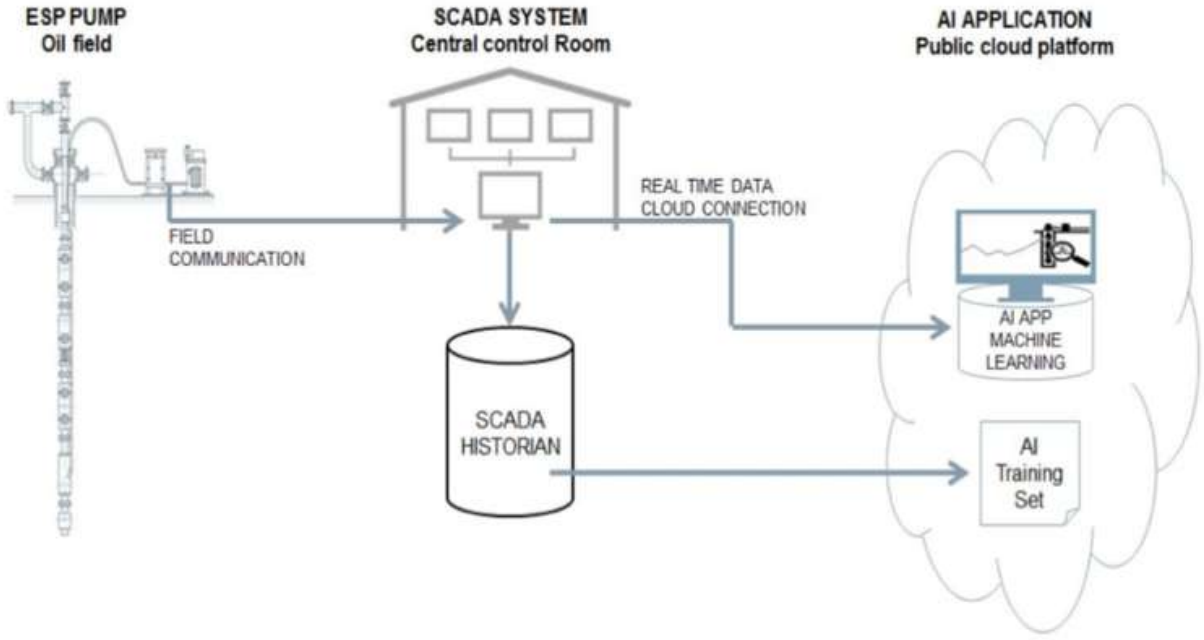


Figure 2—The ESP-monitoring system architecture. Shown are each of the key components and the main data flow required to establish secure connectivity between the physical ESP system and the cloud-based, artificial intelligence/machine-learning system that supports the predictive, condition-based maintenance model.

Using Historical Data For A Proof Of Concept

Verification of how well the ML variant models predicted operational issues was needed, tested against actual known historical results drawn from each ESP's physical operation. For this important validation, data pulled from the SCADA historian database for identical periods of an ESP's operations was used. It included normal operating data as well as data associated with ESP failures.

That became the data source input to the ML-based model, which was expected to conduct analytics on the data, so that time periods of normal ESP operation could be distinguished from time periods with anomalous ESP behaviors.

Once the ML-based model began processing the unfiltered historical data of the ESP fleet's variant groups, it showed that it could differentiate normal and abnormal behaviors over comparable time periods. In fact, the ML-based model accurately predicted abnormal behavior in the unfiltered historical data. This was validated by comparing its predictions against the historical records of the ESP fleet.

Given the outcomes of the ML-based model's performance in numerous tests conducted in controlled conditions, it proved the hypothesis that AI/ML technology can be usefully applied in the deployment of a practical, predictive maintenance model for ESPs.

Preparing the baseline training data set

In order to develop a common operating model of the complex ESP systems used in this project, sufficient high-quality data were required over enough of a time period to reasonably represent an ESP's typical operation. In addition, process data drawn from the SCADA historian database was examined to find extended periods of high-quality data without significant data discrepancies.

After extracting these data sets, the project's data scientists conducted manual data cleansing and evaluation, resulting in an optimized, baseline training data set for the ML predictive maintenance model. It represented a one-year period of ESP operation that the project could use as representative of normal ESP operations.

The last step in this preparatory phase of the project was to develop a generic, multi-layer, neural network with the ML monitoring application, then apply the different training sets to train each of the neural networks corresponding to their ESP variant counterpart.

Conclusion: AI, a powerful decision-support tool

What this project has shown is that, in effect, AI can be incorporated into a ML-based predictive maintenance model, thereby providing valuable decision-support to human operators of ESPs. One advantage of this pilot project's architecture is that the anomaly detections can be validated easily and independently using diagnostic tools that are available from the central SCADA system connected to the ESPs. The identification of previously unknown ESP operating anomalies itself further validates the use of AI/ML technology as a valuable analytical tool and the basis for a practical, predictive maintenance model for ESPs.

The newly discovered anomalies have given the ESP fleet operator fresh insights into the ongoing operation of these complex machines and now a record of those particular types of ESP operating behaviors. The operator also has a reason to investigate, find, and document their causes and develop appropriate mitigations or remediations should they occur in the future.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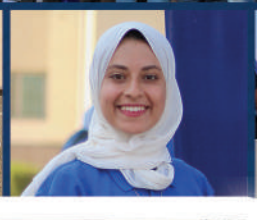

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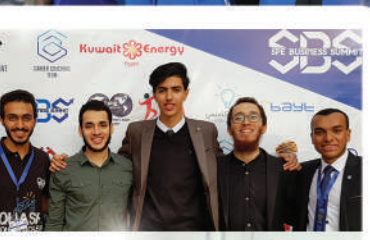
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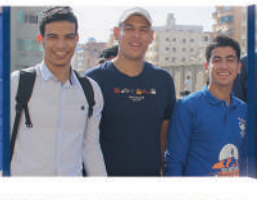


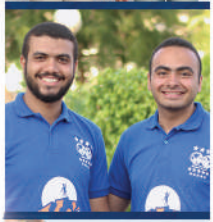








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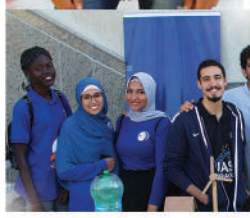
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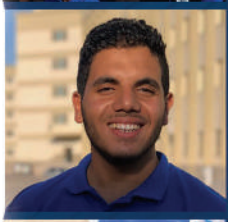




حجرة مناقل المعرفة

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The Growing Role of Unmanned Vehicles in the Oil Industry

Abstract

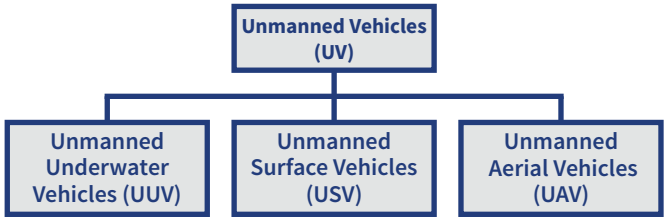
The life cycle of oil and gas fields can be divided into four phases: Exploration and Appraisal, Development, Production and Decommissioning. Unmanned vehicles (UV) are increasingly finding applications in all these four phases. The use of unmanned vehicles (UV) in air, sea and land can minimize exposure of personnel to dangerous environments, monitor the environment, improve efficiency of operations, integrity, site reconnaissance and data gathering.
Unmanned vehicles and robotics offer opportunities to the oil industry to make a step change to the way we do things. This paper presents an overview of the current and potential applications of the emerging technology of unmanned vehicles in the oil and gas industry.

Classification of UVs

For almost four decades, The oil industry has been using Remote Operated Vehicles (ROVs). They played a key role in the development of the offshore oil and gas industry. Recently, the industry has been also using Autonomous Underwater Vehicles (AUVs). ROVs and AUMs are both unmanned underwater vehicles (UUV). UUV is only one type of Unmanned Vehicles (UV). There is no standard terminology or a universal accepted classification for unmanned vehicles.

Unmanned Vehicles can be classified by the environment in which they operate to:

- **Sea:** Unmanned underwater vehicles (UUV),
- **Land:** Unmanned surface vehicles (USV),
- **Air:** Unmanned aerial vehicles (UAV), popularly known as drones.



Exploration & Appraisal

Searching for oil and gas is a complicated process. Activities include top desk review of maps and geological data as well as seismic surveys and drilling exploration wells. Land seismic surveys involve large number of personnel relying on 'boots on the ground' approach. Seismic survey crews often have to work in hostile environments and difficult to access geographical areas such as tropical jungles, mountainous terrain or deserts.

The research project is called METIS, Multiphasic Exploration Technology Integrated System. For hard access terrain, new innovative type of sensors for seismic surveys was developed. It is called DART (Downfall Air Receiver Technology).

Stewart et al (2016) investigated the use of drones for seismic surveys. They describe the design, testing and potential of unmanned aerial vehicles (UAV) with seismic-sensing capabilities. The seismic or vibration-sensing platform is attached to a drone. The geophone spikes become the drone's landing legs.

Tests were conducted to compare the response of the landed seismic-drone system to planted geophones and a conventional cabled seismic system. The tests results showed that seismic traces from the drone are quite similar to those of the planted geophones (Stewart et al 2016).

Outcrops can provide important geological information which is used for building a geological model which provide input to the reservoir simulation model. UAVs can be used to collect digital data for building a geological model using information from outcrops. E.g. Aramco recently used a drone for this purpose (Mezghani et al 2018). A geographic information system (GIS) is used in planning the flight route of the unmanned aerial vehicle (UAV). Suitable sensors and drones were selected for data acquisition.

UVs during the Development Phase

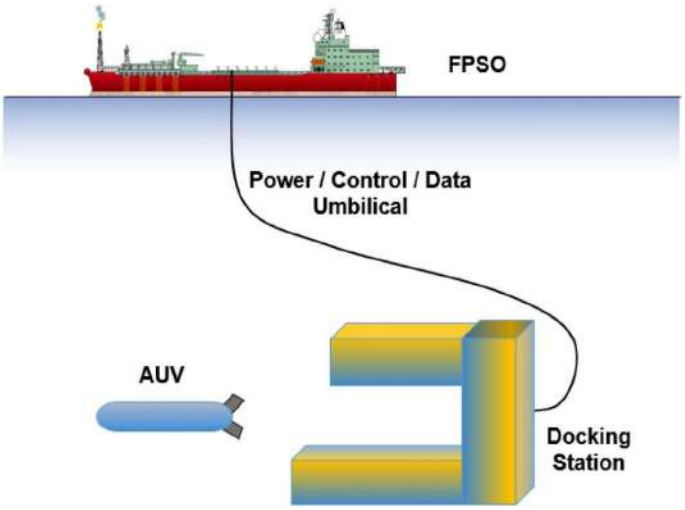
The development phase of an oil or gas field begins by preparing the Field Development Plan (FDP). Which is followed by facilities design, equipment procurement, topside facilities, fabrication and installation. Here, the required production and injection

wells per the FDP are drilled. The use of ROVs and AUVs to support offshore construction and installation activities is well established.

Autonomous Underwater Vehicles (AUV) get their power from onboard batteries. The batteries need charging and the data collected also need to be downloaded after recovering the Autonomous Underwater Vehicles (AUV)in the mothership.

A more recent development is the concept of a ”permanently” resident Autonomous Underwater Vehicles (AUV) on the sea bed (Newell 2018).

As shown in the figure below, after completing its mission, the Autonomous Underwater Vehicles (AUV) return to the docking station on the sea bed for charging the batteries and downloading the data to the host ship. Several consortiums are currently developing this concept.



UVs Support to Field Operations

In the oil and gas industry, asset integrity is about the prevention of major accidents. The aim is to prevent the unplanned release of hydrocarbons that may result in a major accident. Unmanned vehicles (UVs) are used to carry out inspection activities for onshore facilities, pipelines, offshore structures and submarine pipelines.

Unmanned vehicle (UV) systems can also be used to improve emergency oil spill response (Hall 2018) which include:

- Dividing the coast line in the event if an oil spill into segments.
- Assessing the level of oil spills along the shoreline.
- Assisting with the booming plan by identifying best locations to place the booms in order to contain the spill.
- Surveying wild life in the affected area.

Decommissioning and UVs

Decommissioning of oil and gas facilities is a fast growing activity. Government legislation is driving these activities in areas like the North Sea and the Gulf of Mexico. Main decommissioning activities of offshore fields include survey and removal of marine growth, plug and abandonment of wells and cutting of flow lines.

Decommissioning of large offshore platforms and associated infra-structure becomes a project in its own right requiring teams with multiple skills such as project management, facilities engineering, drilling, operations, structure engineering and HSE.

Unmanned underwater vehicle (UUVs) are used to survey marine growth of underwater structures, confirm locations of submarine pipelines and identify obstacles in order to allow the planning of decommissioning activities. In many cases, old offshore platforms have changed ownership and modifications have been made to the topside such as installing additional water treatment module or replacing equipment. Sometimes, build drawings and documentation are not updated or even nonexistent. Lifting topside by cranes requires accurate knowledge of the center of gravity, sling loading and appropriate lifting points.

Drones are used to take digital photos to digitize offshore facilities. The digital data are used to generate geometric models for the topside and identify key parameters for lifting activities. Using drones to do this aerial surveys of topside structures can save hundreds of engineering man-hours and result in shorter decommissioning schedule.

Enablers and Challenges

Like any new technology, unmanned vehicle (UV) have their own challenges and key enablers.

Enablers

Advances in remote sensing technology such as lander light detection and ranging (LIDAR).

- Development in acoustic technology and digital infra-red cameras.
- Application of machine learning and data analytics which allowed the leverage of the large data gathered by the unmanned vehicles (UVs) to produce the relevant information.
- Collaboration between companies, academic institutions. Indeed, many of the new development involved cooperation between the multiple organizations and academic institutions from different Parts of the world.

Main Challenges

There are challenges that need to be addressed.

- Integration between different technology platforms.
- Reduce the cost of development, particularly for underwater vehicles.
- Unmanned vehicles (UVs) technology is progressing at a rapid pace and involves many societies and organizations around the world. Apart from API Recommended Practice 17 H, there are few standards dealing with unmanned vehicles (UVs).
- Slow adoption of new technologies.

Summary

This paper addresses some of the current and potential applications of the emerging technology of unmanned vehicles (UVs) in the oil and gas industry. The following concluding remarks are made:

- UVs are classified by the environment in which they operate.
- UVs are increasingly used throughout the life cycle of oil and gas fields from exploration to decommissioning.
- UVs offer numerous advantages such as increasing operational efficiency, enhance asset integrity and improve HSE performance.
- Conversion of multiple technologies has contributed to the recent advances in UVs.
- As the oil industry further embrace the digital transformation, UVs will find wider applications across the entire value chain of the oil and gas industry.

Dr. Gerhard Thonhauser

Innovator, Entrepreneur and Educator in Digital Technologies for the Oil and Gas Industry. He also serves as the Head of the Chair of Drilling and Completion Engineering at Montanuniversitaet Leoben, Austria a leading institution in research and development in the area of petroleum engineering.

Drilling Process Digitalization Using Advanced Machine Learning Techniques

Abstract

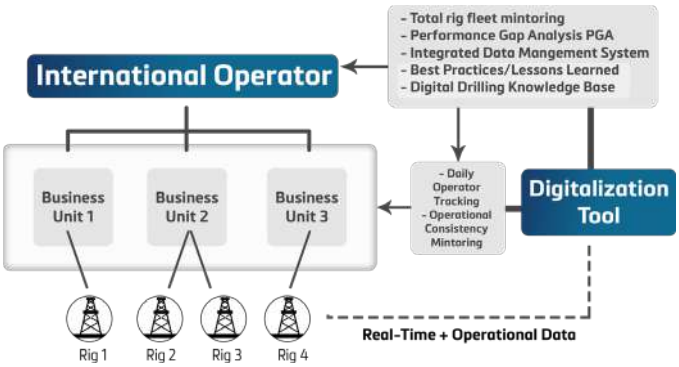
The digital era is upon us in the oil and gas industry. Enforcing the importance of digital transformation is mandatory to improve the overall efficiency of the drilling process. The digital transformation of drilling will provide an unprecedented stream of high-quality information, through the utilization of automated real-time drilling downhole tools, data analytics and predictive analysis. Therefore, a real-time measurement and processing technology were established to improve the performance of the rig crew and drilling operations. A monitoring process was implemented for all drilling operations and benchmarked against operational Key Perfoemance Indicators (KPIs).

Introduction

Currently, the oil and gas industry is seeking to increase the involvement of new advances in digitalization technologies at different sectors. When digitalization is performed, it opens the doors to increase the engagement of different firm levels in decision-making process. Usually rig sensor data is aggregated and stored at the rig-site and then transferred to the office.

Then, a digitizing step is essential at this phase to convert received raw data with high quality into a digital status based on which we can build further decision models using computing powers.

This digitalization process helps to increase fleet efficiency and drill more wells in less time through monitoring and control operations for the different business units.



Continuous Improvement Process

The systematic approach for improvement is required to make the result of the improvement process sustainable and increase the expected value.

The process consists of four main steps:

1. "Check" is required to measure and evaluate the current situation of the drilling process.
2. "Act" is important to evaluate the results of the measurement step and to determine positives and negatives in the current workflows, to decide what is required to improve the situation.
3. "Plan" is an essential stage to prepare for the required implementations. The Check and Act actions are converted into input for well planning and scheduling where the KPIs Targets, Lessons Learned and Best Practices are now part of the plan.
4. "Do" is the execution phase of the process. All the planned actions should be executed and reflected on the current workflows and coaching the crews to know how to react and run the plan.

Data Quality Control

Performance improvement process depends on accurate data and quality control. Usually, rig sensor data is aggregated and stored at the rig site and then transferred to the office. If data quality is poor to make the performance measurement possible, then monitoring or improvement process will not start.

A special set of quality KPIs is used to evaluate and measure the quality of aggregated data.

The data quality control KPIs are:

1. **Validity**: represents the ratio of valid received data values.
2. **Accuracy**: shows the ratio of accurate received data.
3. **Consistency**: measures the degree of uniformity of received data.

4. Integrity: shows the ratio of valid consistent relations between different sensors.
5. Timeliness: indicates whether the data is available at time needed.
6. Completeness: checks whether all necessary data received as it was expected.
7. Continuity: represents the regularity of received data.

Process Workflow Implementation

Real-time performance measurement tools are based on automated rig activities detection and classification from rig sensor data to evaluate the performance. It recognizes data patterns generated by rig equipment during drilling a well by machine learning techniques. The next step is setting-up the workflow and how to power the current existing workflows with the right information at the right time.

As a next phase, an advanced performance measurement tool translates the sensor data and converts it into objective information for the drilling performance. Before starting with the implementation of an information-sharing process, teams create shared reporting templates to improve the current workflow and power it with the right performance information.

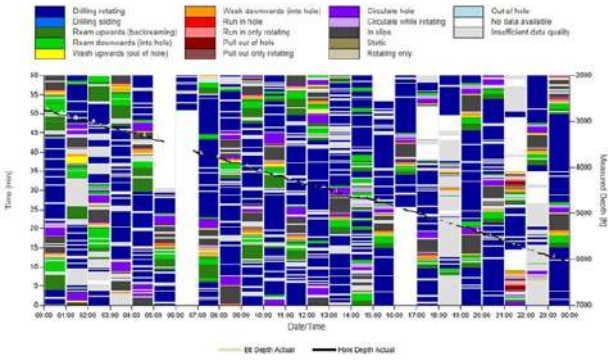


Figure 3—An example of automated daily report

Automated Drilling Performance Measurement

One of the next major tasks to be solved is how performance information of each drilling crew can be generated out of the automated daily reports. It is important to report these KPIs to drilling crews exactly at the time when they take place to find a common solution and to exchange the expertise. Different KPIs are used to monitor the drilling process during different jobs such as tripping, drilling formations, running casing, etc.

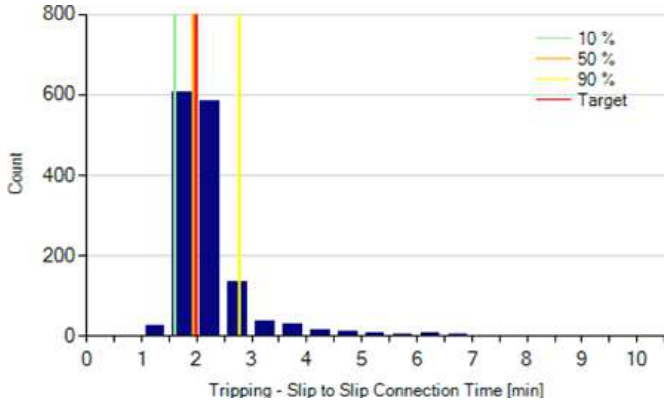


Figure 4—chart shows Slip-to-Slip KPI histogram.

Figure 4 Slip-to-Slip KPI histogram. In this histogram, the operations count is visible on the Y-axis and time ranges in terms of operation durations on the X-axis. So, the green bar of the left histogram means that %10 of operations for Slip to Slip connections were made in the time range of 1.5 to 1.7 minutes. The red line represents the target that has been set for this KPI.

Three Steps Of Improvement:

1. Distribution of timings for specific events has been analyzed and targets set using the existing best practice on the rig, shown on the histogram on the left-target 2 min (close or on the 50% mark).
2. Narrowing the distribution by more consistent operations improves the operational consistency around the best practice shown on the right-tighter bell curve.
3. Learning and adopting best practices improves the operational performance, so that the target shifts to the left gradually over time along with the bars expressed with the arrows on the right-move from the orange towards the blue curve.

all operations that took longer than the target are Invisible Lost Time (ILT). The shape of the histogram can be used to assess consistency and the potential of target development over time. This analysis can be done for all KPIs to identify the drivers of savings potential.

Just sharing this information between the parties helps the company to put the performance under control and support the teams that sometimes suffer from a shortage in resources or face some technical difficulties.

Invisible Lost Time Mitigation

This inconsistency of performing the same operations by crews using the same equipment, is the main source of the ILT which is the difference between the actual operation duration and the benchmark. Mitigation of ILT can be done through the following:

- Continuous measurement and communicating the information of the drilling performance.
- Development of recommendation on best practice for different operations by focusing on a small set of KPIs.
- Rig-site support and coaching by a support engineer on the rig-site to establish the process.

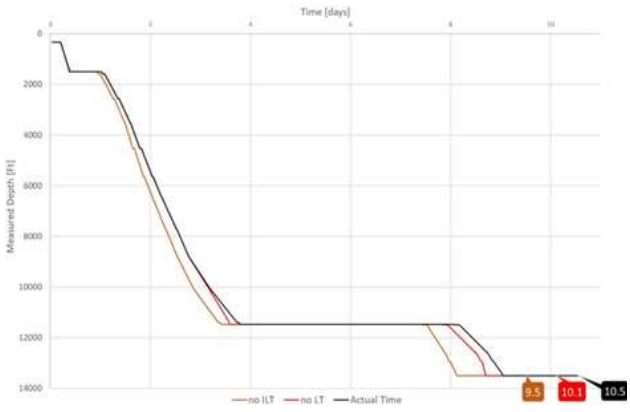


Figure 5—Performance Gap Analysis indicating the measured ILT.

ILT during drilling could be reduced by more consistent weight to weight connection times as well as by proper wellbore treatment and conditioning timing. Training Crews on working with the support of automated drilling report would help to increase consistency while performing Slip-to-Slip Connections both during Tripping and Running Casing.

Conclusion

Using historical drilling data will enable AI technology to calculate future predictions to improve the future. The digitalization of drilling process has the ability to sustain a constant flow of information throughout the internal structure of this operating company and its unique setup.

ADIPEC 2019

Abu Dhabi International Petroleum Exhibition and Conference

SPE Suez Participation in

- The Abu Dhabi International Petroleum Exhibition and Conference (ADIPEC) provides an unrivalled global platform for oil and gas professionals. The world-renowned conference program educates, provides knowledge transfer, and offers unparalleled networking opportunities.
- Participating Students had be given a Technical 4 Day Conference Pass to ADIPEC, allowing them to access the SPE Upstream Technical Conference of the program, which covers more than 100 sessions for the duration of the event from 14 – 11 November.
- SPE Suez University Student Chapter has been selected to participate during the "2019 SPE ADIPEC University Program", which was held on 13 - 10 November 2019, in Abu Dhabi, United Arab Emirates. The participants who have selected to represent SPE Suez are: Ahmed Haitham Desouky, Mohammed Al-Araby, Essam Helmy and Zeinab Al-Araby.

What is the SPE ADIPEC University Program?

This Program is for the benefit of the best undergraduate geosciences and engineering students from the Middle East and North Africa Region. 60 students have be selected to attend and participate.

The purpose of this program is to give students clear insight into the industry that they are about to join; to allow them to return to their universities and colleges with a positive message for their fellow students; and to provide opportunities for students to form new friendships and to work together on joint activities.

At the same time, the students will be interacting with a number of major industry employers through field trips and an onsite visit to ADIPEC.

Program Agenda:

1. **Day 1 – Professional Development, Sessions, Networking and ADNOC HQ Visit:**
Students participated in team building and professional and technical skills sessions, as well as a Visit to ADNOC HQ. They had a chance to meet the other participants and network with many professionals.
2. **Day 2 – Professional Development, Sessions, Networking and ADIPEC Visit:**
Students attended further professional and technical skills sessions as well as having the opportunity to visit ADIPEC.
3. **Day 3 – Final Presentations, Judging & Awards:**
All student teams will give their final presentation in front of a panel of judges, ending the day with awards for the top student groups.

The Students Team Project

As a team, they were requested to review renewable energy strategies and investments by oil and gas companies. Also, the team needed to decide on the best strategy that promises the highest profitability and most sustainable returns yet allowing to excel in meeting technical and technological demands.

International Mega Conferences

IPTC 2020

(International Petroleum Technology Conference)

In January 2020, Ahmed Haitham Desouky- the SPE Suez President- has been selected among 100 students globally to represent SPE Suez and Suez University, with a privilege to participate in the «2020 IPTC Educational Week». Which was held on 16 - 11 of January 2020, in Dhahran, Kingdom of Saudi Arabia.

What Is The International Petroleum Technology Conference (IPTC)?

The International Petroleum Technology Conference (IPTC) is a collaborative effort amongst the Society of Petroleum Engineers (SPE); the American Association of Petroleum Geologists (AAPG); the European Association of Geoscientists and Engineers (EAGE); and the Society of Exploration Geophysicists (SEG).

Education Week – Undergraduate University Students

This program is for the benefit of the best undergraduate science, geoscience and engineering students from national and international institutions around the globe, with up to 100 students selected to attend the program.

Education Week Overview

1. **Day 1 [evening] – Students Arrival and Welcome Reception:**
   Students arrived on this day. Students got together for the first time in person at the Welcome Dinner – committee members, YPs and VIPs were invited. The Committee Chairperson (Najwa Al Azaimi) opened up the program with welcome remarks and students provided a full briefing of the program.

2. **Day 2 – VIP Speakers, Sessions, Networking and Virtual Game Overview:**
   This full day session allowed students to hear from VIPs, inspirational YPs and key people in the industry. Students had a chance to ask questions and network with speakers and one another and learn more about the industry they are about to enter. Student teams also received an overview of the group assignment.

3. **Day 3 – IPTC:**
   Students brought to IPTC on the opening day to attend the Opening Ceremony and Executive Plenary Session followed by a visit to the Exhibition. They had free time to explore IPTC Exhibition further and attend sessions as they see fit. They needed to complete various tasks or seek relevant information to complete Exhibition assignment – this helped to ensure students are visiting IPTC with purpose.

4. **Day 4 – Field Trips:**
   Students took part in different locally based field trips as they were culturally focused. They had the opportunity to visit many culturally focused places such as:
   - Ithra - King Abdulaziz Center of World Culture.
   - Desert Camp Lunch - In Al-Hasa.
   - Qaraa Caves - In Al-Hasa.
   - Qasr Ibrahim & Qaisariah - In Al-Hasa.

5. **Day 5 – Virtual Game Completion, Awards and Closing:**
   Student teams had the morning to complete the group assignment. In the afternoon, the winning teams announced at the IPTC Closing Ceremony.

2020 IPTC Educational Week showed a very unique experience, with a lot of enthusiastic students around the world. Many technical and personal knowledge has been added to them, and what made the experience more unique is the diversity of the 100 students from all over the world to share their experiences, traditions and having fun together.

The Technology Arm of Sustainability

Sami Alnuaim,
2019 SPE President

He has been with Saudi Aramco for 30 years, where he has worked in reservoir engineering, production engineering, research and development, and at the upstream computer center.

Introduction

The oil and gas industry faces three key questions regarding sustainability. Can we transform oil and gas into a cleaner, efficient source of energy with minimum or zero-net CO2 emissions? How do we use technology to transform our industry to a low-carbon-intensity industry to help in addressing the global climate change challenge while extending the economic and social benefits of oil and gas to improve human lifestyle on earth? Can we scientifically and globally measure the sustainability performance of our industry with respect to the following four pillars: environmental impact, economic growth, social development, and lifestyle improvements?

I believe that with the best practices, the right strategy, adequate R&D investment, and the appropriate technology deployment, our industry can and will achieve these goals. The fact oil and gas will be part of the energy mix well into the future, and about the significant economic and social development our industry produces. Given global opinion, we have no choice except to develop and use technology to transform our industry to be a low-carbon industry with minimum environmental impact across the entire oil and gas value chain.

Using technology to Improve the upstream sector

The upstream requires large amounts of energy to extract oil and gas from reservoirs and transport it to surface facilities through subsurface tubing and gathering lines, often going through harsh environments, including subsea. This provides many opportunities for improved energy efficiency, which reduces costs and is therefore good business practice. Upstream is also a technology-intensive sector, where new technologies have been deployed, helping the sector to be more sustainable. Advanced high-resolution seismic channel acquisition, processing technologies and algorithms, interpreted with the help of high-performance supercomputers, have significantly lowered the exploration risk and decreased the number of dry holes drilled. Geo-steering technologies and the software infrastructure that supports them have helped our industry to precisely place thousands of subsurface horizontal sections away from water and gas contacts. This, in turn, has significantly reduced the amount of energy needed to lift the produced hydrocarbons from those wells.

Smart-well completions and downhole deep-sensing technology have helped us to better manage reservoir fluids and keep the undesired fluids in the reservoir. This lowers the amount of energy needed to lift the hydrocarbons and reduces the volume of produced water to process, treat and dispose at the surface. Production and logging technologies have generated a significant reduction in the materials, time and energy used. Advanced predictive algorithms and artificial intelligence systems are helping to predict and avoid drilling problems hours before they can cause hazardous events such as blowouts, leaks, stuck pipes, or additional sidetracks.

CCSS Technology To Reduce Carbon Emissions

Carbon capture, storage and sequestration (CCSS) technology developed by our industry will play a significant role in the global climate response, possibly toward close to zero-net emission in the long term. CCSS technology offers the opportunity to capture CO2 from large industrial facilities (both within and outside our industry) and process, store, or sequester it in mature or depleted oil reservoirs for enhanced oil recovery objectives.

The International Energy Agency (IEA) considers CCSS as part of a portfolio of actions to be taken by the oil and gas industry that can account for %14 of total energy-related CO2 reductions needed by 2060. Our industry is already beginning to use solar and wind energy to provide the required energy to seismic crews, drilling rigs, artificial lift pumps and remote wellsite facilities, especially offshore. This usage is likely to grow. Upstream companies that deploy technologies such as those above will see energy efficiency benefits and help to reduce the carbon intensity of operations to explore, drill and produce oil and gas resources.

Improving Midstream and Downstream sectors

In the midstream sector the energy efficiency of pumps, compressors and other equipment at our facilities has increased significantly in the past decade. Flaring was significantly reduced after building the required infrastructure to capture the methane and process and use it for petrochemicals or power generation. Cogeneration technologies, which generate power utilizing what used to be vented steam, have resulted in significant energy savings.

In the downstream sector, according to IPIECA, oil refining is an energy-intensive activity, accounting for about half of all the energy consumed by the oil and gas industry as a whole. Hence, enhancing the energy efficiency of oil refineries, terminals and downstream complexes should be a strategic objective for our industry. Facility energy management systems allow us to optimize energy use in steam generation, electricity produced from captive power plants (cogen), energy consumption across all processing units and further optimization of emissions across all facilities units.

Conclusion

There is a growing consensus within the oil and gas industry to address the four pillars of sustainability, with more focus on social development and environmental climate challenges along the industry supply chain. The game-changer technologies will be energy optimization, CCSS, crude-to-chemical, gas-to-power in lieu of coal, renewables use across the value chain and power conservation (energy efficiency). Just deploying current best practices globally will take us far.

The industry is investing more than 1$ billion in the next 10 years through the Oil and Gas Climate Initiative, a -13 company CEO-led initiative, to expedite the technology development. I believe that our industry has a leading role in helping to achieve the Paris agreement. We can only remain a leading industry if we evolve in line with global economic, societal and environmental expectations.

Social Impacts

6 Sigma Program

A set of techniques and tools for process improvement. In partnership with Excellence Center, 20 students had a thorough overview of the concepts of these techniques in a one-day concentrated program.

NAPESCO Yard Trip

12 students had the opportunity to attend the yard walkthrough where they explored the different tools present enabling them to further understand the theoretical knowledge they study.

Orphans Visits

Serving the community is one of our responsibilities. During the "Orphans' Week", we conduct several visits to orphanages where we organize funny and amusing activities aiming to draw a smile on the faces of orphans.

Qarun Winter Training

Aiming at closing the gap between academics and practical, we provide opportunities for students to gain field experience. 15 students went on the -7day internship in the fields of Qarun

EDCTC Leadership Program

Two-day program where 20 students had the chance to learn the styles, techniques and strategies of leadership. The program included fantastic workshops and interacting games that make it easier to comprehend the concepts.

EDCTC Creative Problem Solving Program

20 students attended the one-day program that focused on the concepts and methodologies of problem solving. The program was assisted with games and workshops to create an interacting learning environment.

PACE

Petroleum Arabian Conference and Exhibition (PACE) is a three-day conference, held annually in AUC at the mid of March, presented by SPE Suez, Cairo and AUC student chapters. one that is technically and financially supported by the most reputable oil field companies. Three days begin with a panel discussion gathering a panel of CEOs and top managers in the oil and gas industry. In addition, different powerful technical sessions, workshops and competitions given by the most respectable pioneers in Egypt and worldwide.

Research School

A -3months school in which offline and online sessions are conducted for university students about the basics of research, research ethics and present an idea in the field of petroleum and mining engineering at the end of the school, and the one who would present the best idea would be rewarded with a training in Kuwait Energy Egypt company.

SPE

MEGA P

Our masterpiece for this season, it discusses different fields in career planning, science, business, AI, IoT, digital marketing and soft skills to provide you a clear vision and guide you to your suitable career. As we look forward to empowering our readers in the non-technical aspect.

Criterion

Science Fair

An exhibition held in the university in which live experiments are done through which we turn the theoretical meaning of petroleum theories into physical form such that we could make a small separator, ESP, SR pumps, hoisting system, bits, acidizing, etc.

SBS

SPE Business Summit (SBS) is a three-day event held in October in FUE where you discover the latest developments in your field, hear inspiring keynotes fromleaders or enhance your knowledge. SBS is presented by SPE Future and SPESuez begins with 9 panel discussions and followed by different sessions,mentoring circles and workshops which is presented by more than 65 specialists in more than 10 fields, such as marketing, sales, digitalmarketing, IT, freelancing, entrepreneurship, BD, HR,photography and filmmaking, translation, career coaching and soft skills.

SUEZ

ROJECTS

School Visits

In which we visit various schools and present presentations about renewable energy for primary and preparatory school students, teach them how to keep the environment clean, warn them from the dangers of pollutants to the environment, do experiments and play games related to the information presented.

Development short and long tracks programs, based on training, showing and ensuring separated levels of contents, although provide tangible and intangible skills, also it involves of sessions and workshops which presented to All SPE members and Suez University students. To sum up, we aim to contributing, enhancing and spread our values.

Skills Club

Technical Club

An educational project that is conducted weekly for petroleum engineering department students in the university. It consists of topics that are related to the oil and gas industry such as: (FDP) Field Development Plan, Well Intervention, Well Logging, Fishing, Hydraulic Fracturing, and Well Control.

Zhi Zhong

Postdoctoral Researcher fellow at The University of Texas at Austin
He has Ph.D. in Geological and Earth Sciences/Geosciences (2013 - 2017) from West Virginia University. Now he works as Postdoctoral Researcher fellow at The University of Texas at Austin. He is very skilled at Geology, Data Analysis and Matlab.

Artificial Intelligence Assisted Hydraulic Fracturing Design in Shale Gas Reservoir

Abstract

Hydraulic fracturing is a typical and vital technique applied in shale gas reservoir development. Numerical simulation used to be a common tool to optimize the parameters in hydraulic fracturing design determining the stage numbers, injection pressure, proppant amount, etc. However, the current understanding of shale gas storage and transport mechanism (e.g. adsorption/desorption, diffusion) is basically adopted from the lessons learned from coal seams through past experience, which might not help an efficient numerical simulation development.

In this study, how artificial intelligence assisted data driven models assist the hydraulic fracturing design in shale gas reservoir is discussed. It starts by collecting field data and generate a spatial-temporal database including reservoir characteristics, operational/production information, completion/stimulation data and other variables, Neural Network models are then developed to study the impacts of all parameters on gas production as well as perform history matching of the field history.

Introduction

Hydraulic fracturing was firstly introduced to oil and gas industry in 1949 and has evolved into a standard operating practice to enhance the oil/gas recovery mostly in conventioal reservoirs.

In 1997, Nick Steinsberger performed hydraulic fracturing by pumping a mixture of water, sand, and various chemical additives into the well bore at a sufficient pressure in the Barnett Shale and successfully boost the gas production significantly. Since the first commercial operation in Barnett shale, the combination of hydraulic fracturing and horizontal drilling have turned unproductive shales into the largest natural gas fields in the United States.

Hydraulic fracturing design requires considerable engineering judgement to determine the in-situ fracture properties, such as fracture shapes, length, width, heights, permeabilities, etc., which plays an important role in determining the success of shale development. Design of fractures requires determination of expected fracture properties, expected recovery and most importantly, to maximum economic returns.

Methodology

The overall workflow of this study is illustrated in Figure 1 with three main steps: database generation, artificial neural network modeling and AI assisted hydraulic fracturing design.

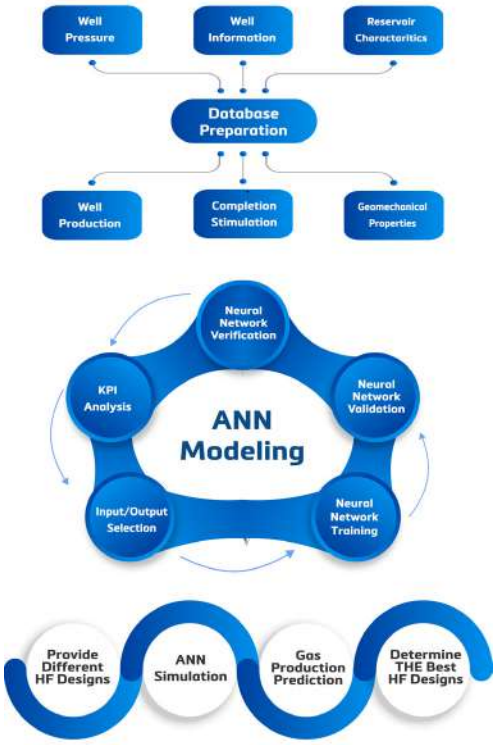


Figure 1—Workflow of AI assisted HF design

- Once inputs and output are selected, neural network training begins with 80% training data, 10% validation and 10% verification. As long as satisfactory training results are received, the neuralnetwork model is ready to predict reservoir performance for different hydraulic fracturing design scenarios.
- Preparation of a representative Spatio-temporal database is a vital step. The database is based on field data integrating static information such as reservoir characteristics, geomechanical properties,completion and stimulation data as well as dynamic data such as gas/water production and wellhead pressure.
- Neural network modeling is based on the developed database. Analysis of Key Parameter Indicator must be done to identify the influence of each individual parameter on gas production andfurthermore to determine proper inputs for the neural network training. Fuzzy Combinatorial Analysis is the main algorithm implemented in KPI performance.
- Once inputs and output are selected, neural network training begins with 80% training data, 10% validation and 10% verification. As long as satisfactory training results are received, the neuralnetwork model is ready to predict reservoir performance for different hydraulic fracturing design scenarios.
- Table 1 shows all parameters included in the database for the neural network training process.

G1:Well Information	G2:Reservoir Characteristics	G3:Geom echanical Properties
North Coordinate (m)	Porosity (%)	Bulk Modulus (psi)
East Coordinate (m)	Permeability (md)	Shear Modulus (psi)
MD (ft)	Net thickness (ft)	Poisson's ratio
TVD (ft)	Water Saturation (%)	Minimum horizontal stress
BTU Area	TOC (%)	G5:Stim ulation Properties
Deviation	Langmuir Volume (scf/ton)	Average injection pressure (psi)
Inclination (°)	Langmuir Pressure (psi)	Average breakdow n pressure (psi)
Azimuth (°)	G6:Operational Properties	Average initial shut in pressure (psi)
G4: Completion Properties	Wellhead pressure (psi)	Average injection rate (bbl/min)
Total clusters	Cum. Gas production (24 months)	Average breakdow n rate (bbl/min)
Total stages	Cum. Water production (24 months)	Injected slurry volume (bbl)
Cluster spacing (ft)		Injected clean volume (bbl)
		Injected proppant volume (bbl)
		Stimulated lateral length (ft)

Table 1—Database for Neural Network Modeling

Once the database is ready, KPI (key parameter indicator) analysis was performed using software IMPROVE™ to study the impact degree of each parameter on the output (cumulative production of two years). Fuzzy pattern recognition technology plays a vital role in recognizing the impacting rankings of all parameters on the ouput when KPI is performed .If there are too many parameters included in the database, it is suggested using the most influencing parameters as inputs for the neural network development. This is a subjective decision that engineers could select the parameters which he/she considers essential for the neural network training based on KPI results.KPI results of this databse is shown in Figure 2.

Rank	Feature	% Degree of Influence	Rank	Feature	% Degree of Influence
1	G1-East-m	100	21	G1-North-m	21
2	G1-BTU Area	99	22	G3-Shear Mudulus	21
3	G2-NetThick(ft)	87	23	G5-Stim-AvginjP(psi)	21
4	G3-Youngs Modulus	65	24	G2-Por(%)	19
5	G2-TOC(%)	55	25	G5-Stim-MaxPrpConc(lb-gal)	17
6	G1-TVD	52	26	G2-Sw(%)	15
7	G1-Completions Date	51	27	G5-Stim-AvginjRate(bbl-min)	10
8	G1-MD	49	28	G5-Stim-AvgBreakdown Pressure	10
9	G3-Bulk Mudulus	47	29	G4-Cluster Spacing	9
10	G1-Turn On Production Date	42	30	G5-Stim-AvgMaximum Pressure	8
11	G5-Stim-TotPropinj(lb)	38	31	G2-Perm(md)	8
12	G4-TotNoStages	36	32	G5-Stim-Prop-Stg(lb)	7
13	G2-AvgLangVol(scf-ton)	34	33	G5-Stim-Avg Max Rate	6
14	G5-Stim-AvgISIP	33	34	Shot Density (Shots-ft)	6
15	G5-Stir -CleanVol(bbl)	32	35	G5-Stim-SlurVol(bbl)	5
16	G4-Comp-LatStim(ft)	32	36	G2-production and completion date difference	5
17	G2-AvgLangP(psi)	32	37	G5-Stim-AvgBreakdown Rate	4
18	G4-TotalClusters	30	38	G1-Azm	4
19	G3-Min Horizontal Stress	26	39	G5-Stim-Avg Frac Gradient	3
20	G3-Poisson's Ratio	26	40	G1-Deviation Type	2
			41	G1-Incl	1

Figure 2—KPI analysis result

Neural network model was trained after the selection of inputs and output using IMPROVE™. The parameters with the impact degree more than 10% have been selected as inputs, cumulative gas production in 24 month is the output. Based on KPI analysis result, some completion and stimulation parameters: G5-total injected proppant amount, G5-total injected clean volume, G4-total stage number, G5-Average ISIP, G4- Stimulated lateral length, G4-total cluster numbers, G5-Average injection pressure, G5-maximum proppant concentration, G5-average injection rate, G5-Average breakdown pressure are playing important role on the cumulative gas production. The architure of the neural network model is illustrated in Figure 3.

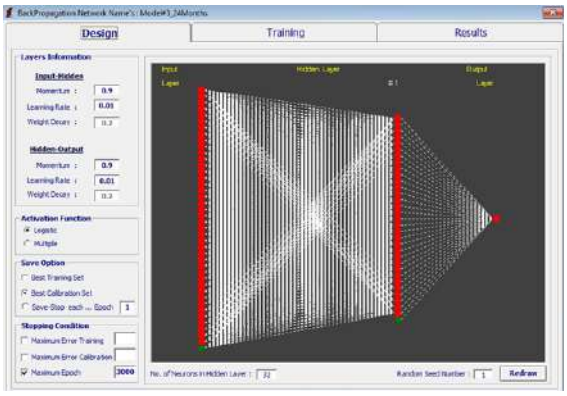


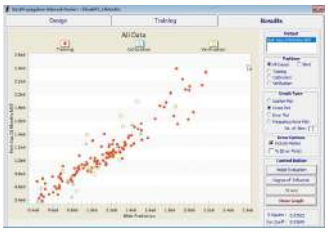
Figure 3—ANN architecture

There are two possible applications depending on the operation purposes:

1. Design optimum hydraulic fracturing parameters for each well: Hydraulic fracturing design can be focused on changing only completion/stimulation parameters for each well to simulate the cumulative gas production. In this study, cluster number, stage number, injected clean volume and injected proppant volume are changed to predict the cumulative gas production in 24 months using the generated neural network model. The design is not limited to these four parameters; more parameters can also be included depending on the design interests.
2. Forecast cumulative production for wells drilled in the same reservoir: If there are other wells that have been drilled and stimulated, the neural network model could be an efficient tool to predict the cumulative production.

Results

Neural Network Training



The AI based neural network model training, validation and verification results are shown in Figure 4. Red dots represent neural network training result, triangular shape and square shape represent neural network calibration and verification results, respectively. The overall correlation coefficient of the neural network training result is 0.93699, which is acceptable; therefore, this model is used for further simulation tests of hydraulic fracturing designs.

Hydraulic Fracturing Design Simulation

As mentioned earlier, the generated neural network model is used to simulate 200 different hydraulic fracturing design scenarios. Simulation run time of all scenarios is in less than 1 second, which is extremely advantageous compared with numerical simulation model. The best 10 scenarios were shown in the following Table 3. The orange color row shows the actual HF design parameter and its corresponding cumulative gas production in 24 months. The rest rows show different HF design and the simulated cumulative gas production. Each parameter shows a positive correlation with the cumulative gas production, the more injected clean volume and proppant volume, the higher cumulative gas production.

G4-TotalClusters	G4-TotNoStages	G4-Cluster Spacing	G5-Stim-CleanVol(bbl)	G5-Stim-TotPropini(lb)	Rich Gas-24 Months-MCF
42	14	41	92352	4232687	497980.542
51	17	33	150440	8373761	836569.471
54	18	32	166171	7953351	850195.724
51	17	33	157388	8485487	866576.528
54	18	32	162992	8322024	869464.124
57	18	30	161504	9034555	881462.129
57	19	30	163346	9485270	887315.037
57	18	30	166459	8736423	895229.874
72	19	24	172053	9451686	917670.271
60	20	28	176533	9454762	928194.423
74	23	23	206300	11242000	1038813.519

Table 3—Top 10 HF design scenarios

Conclusion

In this study, neural network model is developed and used to simulate hydraulic fracturing design. More than 200 scenarios with wide ranges of completion/stimulation parameters (cluster number, stage number,injected clean volume and injected proppant volume) were designed in order to predict the cumulative gas production in 24 months. This manuscript demonstrated the application of artificial intelligence insimulating hydraulic fracturing design.

Next Challenge: Pumping Up the Future

Imran Butt

is the country director at Baker Hughes in Pakistan. He started his career in the late 1990s with Shell and moved to Baker Hughes in 2000.

Career Journey

On my first day at work I had the feeling that I had finally made it after many years of school. Soon after, I quickly realized that this was just the start of a long journey and I had just taken the first step. During the interview process, I was asked whether I was "mobile"; at the time I wasn't exactly sure what that meant, but I quickly found out. Within the first few weeks of getting hired, I was sent on a plane to attend technical courses, and since then I have never looked back. I have worked in 36 countries and my family and I have relocated four times over the course of my career. The word "mobility" has changed significantly over the years, from very short notice to every several years now. New countries, new schools, new communities: What a fantastic adventure!

I began my career with many career questions and very few answers. I wanted to learn how to get better at my job and how to build my franchise within the greater oil and gas community. Over the years, I worked with several people that helped me answer these questions. When I joined Baker Hughes, I spent 4 years at the Celle Technology Center in Germany. I was fortunate to be surrounded by so many great minds, I quickly realized that I was at the hub of knowledge and I had the opportunity to interact with experts every day.

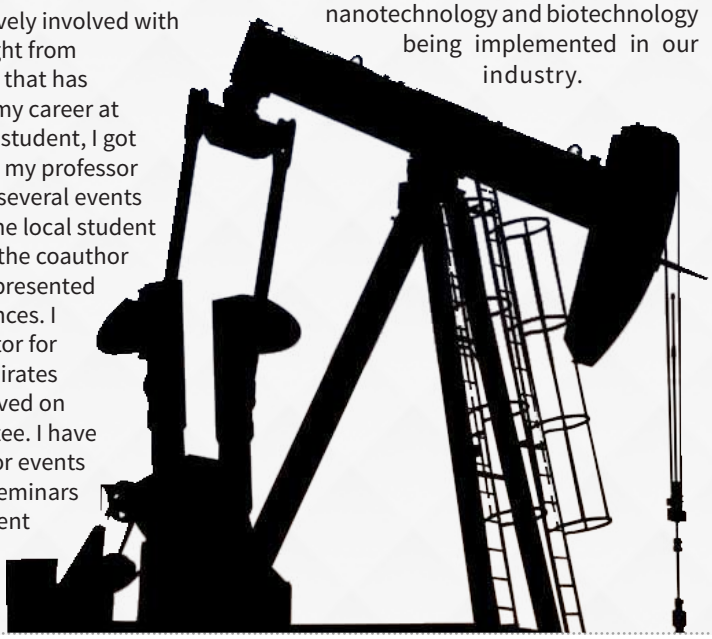
I have been productively involved with SPE in many ways right from my student days and that has positively impacted my career at different stages. As a student, I got introduced to SPE by my professor and I participated in several events and volunteered in the local student chapter. I have been the coauthor of some papers and presented them at SPE conferences. I then became a director for the SPE Northern Emirates Section and later served on the regional committee. I have raised sponsorship for events and have delivered seminars and lectures for student chapters and young professionals.

An Innovative, High-Tech Industry Awaits You

Today's oil and gas industry is as high tech as it has ever been. The technology that is needed to reach to the deepest formations in the search for hydrocarbons is very close to what is required to reach outer space. We have scientists and scholars who are required to guide the drillers with the help of seismic and other geophysical data and analysis in order to produce hydrocarbons.

Once produced, the refinery is a completely different world managed by another set of experts. And that's not all—not only does the industry needs engineers, but we also require finance and management experts to run the business. Lawyers, supply chain professionals, human resources experts and people from many other professions are required to ensure that we can ethically run our business and provide a clean energy source to the ever-growing population.

Innovation is a key mission of most oil and gas companies. Over the last 100 years the industry has come a long way in lowering the frequency of spills and common blowouts to the point where we have truly become a safety-conscious industry. The future will bring more developments as we are already seeing nanotechnology and biotechnology being implemented in our industry.



Be a Part of the Answer

The oil and gas industry will need more experts in the future and it will become harder to get to the hydrocarbons. The opinion that the oil and gas will only last a few more years is incorrect. If you look at the proven reserves alone, you will see that we easily have 100+ years of production, and that is without even fully quantifying the unconventional reserves and the exploration for new reserves that is continuously ongoing. With the number of pressing challenges in our industry today, I believe that the focus on people is a must. We need to ensure that we can hire the right people and invest in their development and training so that they can contribute to providing the right solutions.

As a fresh graduate with good grades, you will likely have several career options to choose from. I would suggest joining an organization that believes in employee training and development. It is helpful to research information about their trainee programs and how they encourage their employees to develop. Ensure that the programs give you both field and office experience.

The oil and gas industry can be quite rewarding but it is also a lot of hard work. If you want to be successful, do not shy away from working long hours and putting in the extra effort.

ECHO Around The World

Dr. Farouk Elbaz

Director of the Remote Sensing Center and Research Professor at the Department Computer Engineering, in addition to, Associated Faculty at the Department of Earth and Environment, Boston University, Boston, MA, U.S.A.

I applaud each and every one of you for the effort resulting in ECHO, the Society of Petroleum Engineers Suez University Student Chapter Magazine. It's is a very handsome publication that conveys sound technical papers and others useful information. I very highly appreciate your innovation and hard work. You exemplify the intellectual energy that is coupled with concern for the future."

Dr. Nathan Meehan

2016 SPE International President. He is a Senior Executive and Spiritual Advisor at Baker Hughes and previously he was President of CMG Petroleum Consulting; and General Manager, Exploration & Production Services for Union Pacific Resources.

"I am impressed by your ECHO Magazine level and your commitment to volunteerism. The Outstanding Student Chapter Award doesn't come about without both great student leadership and a high level of activity. The important thing isn't my expectations for SPE Suez, but it is your expectation. Will you maintain high levels of activity? Will you generate creative things to do that span the technical, social, and service areas? I think it is important that SPE Suez conserve its excellence and distinction forever"

Mr. Darcy Spady

2018 SPE International President. He has also served as CEO of Contact Exploration in Canada and Hungary and more recently as head of sales for Sanjel Corporation.

"Wow! ECHO is amazing magazine. I have not seen this sort of publications before. It is very well-done. It looks extremely professional. One of the best things is that you have got a good advertising. You have done a great job getting this sponsorship level. That is tremendous!"

Mr. Sami Alnuaim

2019 SPE International president. Also, he has been with Saudi Aramco for 30 years, where he worked in reservoir Engineering, production Engineering, Research, development, and the upstream computer center.

"Firstly, I would like to congratulate your section in suez university in the beloved country of Egypt for such great awards and achievements. I am sure these awards did not come out of nowhere. There were a lot of hard-work and didications done by your students and faculty members to reach such exellence. That posts a smile on the face of people, improves their lifestyle, and supports their economy".

Ms. Shauna Noonan

Current SPE international president. Also, she is the chief of artificial lift engineering for Occidental Petroleum Corporation, based in Houston.

"Congratulations on all the awards. Your members should be proud of those accomplishments. Forty-five percent of the award criteria is what your chapter has accomplished in Industry Engagement (%30) and Community Involvement (%15). The first two criteria require reaching out and interacting with people outside of your academic institution.

Mr. Robert Ziegler

Global SME Managed Pressure Drilling at Weatherford & Global Deep-water Advisor.

"You really did a great job with your magazine. It's a very nice and professional one. Every year try to keep developing it to copy with others around the world. Anyway, your magazine is a big work."

Mr. Karim Badawi

Managing Director - Egypt and East Mediterranean at Schlumberger.

"ECHO is a very good magazine for many reasons. It is made by students, which is very important in your success in the future because you interact with different people and, you know how to edit, how to print, and how to commercialize for it. All these things are keys for your success soon. You share news about different companies, technical articles and, interviews with different profiles, which is an indication of your bright future. I wish you continue this great work and keep it up."

Mr. Sameh Sabry

General Manager of wintershall Dea Petroleum Company in Egypt.

"I was personally positively surprised with high quality and level of professionalism in editing and publishing ECHO magazine. I enjoy reading it, in particular the interviews with key players in the oil and gas industry in Egypt as well as the Case Study and Advanced Technologies sections. Keep it up!"

Mr. Kamel El-Sawy

President of Kuwait Energy Egypt

"Echo is a very informative magazine with great stories, ideas and developments that touch a whole range of different technical areas and backgrounds. We believe in the power of inspired young people and their role in driving their communities forward to be the future leaders. During 12 years of great efforts and sustainable achievements, we are extremely proud to constantly support Echo since its first publication in 2009 till this issue of 2020. KEEP GOING!"

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ECHO Chairperson
Chapter President

Abdullah Sharaf
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SPE SU SC

TransCoil gets production back on line—in less time and at a lower cost than rig deployment

Case study

The challenge

One of our customers in the Middle East had experienced lengthy wait times for a rig required to retrieve and install electrical submersible pumping (ESP) systems. Yearly rig schedules made it difficult to arrange unplanned workovers, resulting in downtime of three to six months or longer.

They needed an alternative deployment method to eliminate the time delays and costs associated with using a rig to retrieve and install their ESP systems.

The results

Baker Hughes and the customer partnered to develop the TransCoil™ rigless deployed ESP system. It features an inverted ESP system that connects the motor directly to a new, proprietary power cable configura-tion that extends the setting depth of rigless-deployed ESP systems.

The TransCoil technology eliminates the traditional ESP power cable-to-motor connection for even greater system reliability. And with no in-well "wet connection," it doesn't require a rig to pull and replace it if the wet connection fails.

50%
faster ESP installation time

50%
lower workover costs

8,000
BOPD well back in production after 1-yr downtime

The first TransCoil system was installed in a well that had been waiting one year for a rig to replace an ESP. It brought 8,000 BOPD back on production, without interrupting the operator's established annual rig schedule. Installation time, including mobilization of a BHGE coiled tubing unit, was reduced by 50% compared to a rig-deployed system.

Baker Hughes

Kuwait Energy

Egypt

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