

# ECHO))

SPE Suez University Student Chapter Annual Magazine

Issue 13 | Jul 2021

## INDUSTRY DIGITALIZATION

## SPACES OPEN DURING ENERGY TRANSITION



EXCLUSIVE INTERVIEW WITH  
**H.E. TAREK EL MOLLA**

“

WE HAVE A VISION FOR MODERNIZING ALL ACTIVITIES OF THE OIL AND GAS SECTOR, AIMING AT RELEASING EGYPT'S FULL POTENTIAL IN THE PETROLEUM INDUSTRY.

”

**H.E. TAREK EL MOLLA**





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# Foreword



**Amgad Saeed  
ECHO Chairperson**

## **KNOW YOURSELF**

Dear Reader,

We all have different interests, lifestyles, goals, skills, personalities, mindsets, and that is why each one of us is SPECIAL in his own way. It may be a cliché to say that you are special, but that doesn't mean it's not true. **You are unique, you must have something that separates you from other people. But do you know what that is?**

If you start asking yourself this question, then you are on your own journey to know who you really are and what you are capable of.

Let's start with your personality. Have you ever asked yourself: "Who am I?" "What are my strengths and weaknesses?" "What are the things I like and dislike?" Knowing your traits tells you where you stand and indicates what your future goals are and how you can develop your skills to match them. You may ask your family, friends and colleagues for help here – what things about your personality stand out to them?

The best way to really know yourself is to put yourself in a team and engage with your teammates, do tasks that you think you like, try different teams and tasks before you choose what you really like doing. If you are in college, you have a priceless opportunity to join a visionary, supportive team like **SPE Suez Student Chapter**. Student Activities are the shortest way to try and achieve so many things during University. Try different job roles and always ask for Feedbacks from your manager and teammates.

**Are you a good listener? Are you supportive? A team player? What about your habits? What are the best habits you have? What are the things you are most proud of doing?** Again, you may ask other people what they enjoy most about interacting with you.

In this way, you can identify your biggest strengths and the things that make you, truly, special. It also helps you gain more confidence, and it can provide a road map for your decisions. But it doesn't stop there.

Knowing your strengths will give you the best ways of handling a situation. If you don't know how to achieve the target but you are a hard worker, start there. If you don't know how to write a proposal, but you are a good learner, use that to your advantage. **Know yourself.**

I started my journey at SPE three years ago as an International Relations member, going through many leadership positions after, and here I am saying my last words as the President for this season. It's never been easy, but it worth every minute. During these years, I had many goals, and with them came many challenges and responsibilities.

And with everything I have gone through I've got to say that the journey of discovering yourself and defining your goals will never be easy. In fact, we must go through all the obstacles to really learn and be ready to go for even more difficult situations. **Life is known to be hard, and we must be ready for it.**

**With respect,  
Amgad Saeed  
SPE Suez '21 President**



## **ENGINEERING THE FUTURE OF ENERGY**

**Hesham Gaafar**  
**ECHO CEO**

Dear reader,

Life would seem impossible without energy; think of losing electricity for a week where you have no lights in your room, no charge in your phone or PC, and you cannot follow up with the news, and this is just one type of energy we use!

Energy is a blessing that most people take for granted. By working towards better energy, we are directly contributing to the welfare and happiness of people, but that makes our responsibility even more.

With the recent awareness of environmental sustainability, we have to accept that Energy Transition is here to stay, and we need to do our best to ensure that our industry plays an important role providing the world with cleaner and better energy.

Every cloud has a silver lining, you should never feel hopeless. Consider the Energy Transition as an opportunity to get creative, at the end of the day, it is engineers who make the change.

**"Scientists investigate that which already is; engineers create that which has never been." Albert Einstein**

What we know for sure is that; today more than 80% of the world's energy comes from Fossil Fuels, and they will continue to be a major part in the energy mix for many years to come. However, it is our duty as future engineers to make sure they are extracted, produced, and distributed with the least carbon footprint possible.

Almost one fifth (21%) of the world's 2,000 largest public companies – including O&G majors – have committed to meet net zero targets, and in order to help the O&G industry reach that target, we need to educate ourselves about the newest technologies, and most importantly understand the current situation of the climate and the steps the industry have taken and still needs to take. In conclusion, we need to be prepared to take the next step: ENGINEERING THE FUTURE OF ENERGY.

With respect,

Hesham Gaafar

SPE Suez '21 Secretary

## About Eng. Tarek El Molla



- Received his B.Sc. in Mechanical Engineering Cairo University in 1986.
- Joined Chevron (Egypt) in Jan. 1987.
- Worked in different fields and held various positions in Engineering, Operations, Planning, Sales and Marketing.
- In 1998, he became Sales Manager and Member of the Board of Directors of Chevron Egypt S.A.E.
- During the period from 2002 until 2008, he got several Chevron assignments and managed projects in Dubai, Kenya & Singapore.
- In 2008, he became Managing Director–Marketing of Chevron Egypt.
- From 2008 until the end of 2010, he moved to Chevron South Africa, held the position of Regional Manager in charge of South & Central Africa's Commercial & Industrial Business.
- In Jan. 2011, he joined EGPC as the Deputy CEO for Foreign Trade. During this period of time (2011–2013), he was also assigned as Deputy CEO for both Internal Trade & Operations.
- He was appointed as EGPC's CEO in Aug. 2013.
- On 19 Sept. 2015, he was appointed as Minister of Petroleum and Mineral Resources.
- On May 10, 2017, the French President awarded him the “Ordre national de la Légion d'honneur” at the rank of Knight, one of the oldest French accolades, in recognition of his efforts in developing the Egyptian-French relations in Oil & Gas industry.
- On June 14, 2018, Eng. Tarek El Molla has sworn in as Minister of Petroleum and Mineral Resources, in the new Government of the Prime Minister, Dr. Mostafa Madbouly.
- On December 22, 2019, Eng. Tarek El Molla has sworn in as Minister of Petroleum and Mineral Resources, in the new Government of the Prime Minister, Dr. Mostafa Madbouly.

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## EXCLUSIVE INTERVIEW WITH

### H.E TAREK EL MOLLA The Minister of Petroleum and Mineral Resources

**Hello, your Excellency Eng. Tarek we are eager to know more about inspiring career path.**

Well, it was quite a journey, having my B.Sc. in Mechanical Engineering from Cairo University in 1986, I started my career at Chevron Co. (formerly Caltex) from 1987 till 2010, where I worked in different fields and progressed in various positions, until I held the position of Regional Manager in charge of South Africa. In 2011, I joined EGPC, as a Deputy CEO for Foreign Trade, and was also assigned as Deputy CEO for both Internal Trade & Operations, along with my work as a Deputy for Foreign Trade, during the period (2011 and 2013).

In August 2013, I was appointed as EGPC's CEO and continued there till I was assigned the post of the Minister of Petroleum and Mineral Resources in September 2015.

I worked in two consecutive Governments, the first one, was with Eng. Sherif Ismail, and then I had the honor of renewing confidence to continue as Minister of Petroleum and Mineral Resources in the new Government of the Prime Minister, Dr. Mostafa Madbouly in June 2018 and once again in December 2019.

I am honored to have received the "Ordre national de la Légion d'honneur", at the rank of Knight, from the French President, one of the oldest French accolades.

**In the last few years, Egypt's petroleum sector was able to break barriers and achieve unprecedented results in upstream, midstream, and downstream activities. This would not have been possible without a well-studied plan and vision. How do you manage as a key leader despite all the existing challenges?**

Of course, we have a vision for modernizing all activities of the Oil and Gas Sector, aiming at releasing Egypt's full potential in the Petroleum industry. Actually, it was mandatory to start strongly with a vision after overcoming serious challenges that addressed this Sector before 30<sup>th</sup> June 2013 revolution, due to political, security and economic instability. We've recognized that our Sector's strategy for achieving this vision, should be parallel to the changes and recent developments in this industry worldwide, thus, we were able to achieve major success stories that reflected positively on maintaining energy resources security in Egypt, that attracted the world's attention



**By/ Hesham Gaafar - Amgad Saeed - Mohamed Ayman**

and Egypt has become once again the best destination for investment in the various oil and gas activities. On top of which, the most prominent success stories are achieving self-sufficiency of natural gas and once again we joined the natural gas exporting countries club after reaching the highest gas production rate in the history of Egypt. We also, have succeeded in re-operating Idku and Damietta LNG plants, to export LNG via the Mediterranean. As a result, the Gas Sector achieved a growth rate of about 25% compared to the previous negative growth rates. In fact, the oil and gas upstream activities witnessed a great quantitative leap; e.g. signing about 130 oil and gas exploration agreements with IOCs, with investments of about \$18 billion, and succeeding in attracting major companies, such as ExxonMobil and Chevron to work for the first time in this domain in Egypt after putting, the West Mediterranean and Red Sea regions, on the upstream investment map.

In the Refining domain, we are implementing new refinery projects contributing to achieving self-sufficiency in gasoline and fuel oil by the year 2023, together with developing Midstream system, and energy subsidies reforms that were reflected, positively, on fuel consumption rationalization, besides operating major projects in the petrochemical industry and expanding the implementation of several other new projects & major complexes to maximize the added value of our natural resources.

Furthermore, we've applied an advanced approach for developing the skills of human cadres and preparing youth leaderships through non typical programs. We

have also become one of the first Sectors in Egypt that worked on implementing digital transformation. We started relying on digital methods in managing the work system and raising performance efficiency in the various activities of the Sector.

**We see that Egypt is full of promising potentials in the Mediterranean and the Western Desert. How do you see, Your excellency, the Oil and Gas Industry and Its Macro Environment Developing in 2021 and the Next Few Years?**

We seek to uncover all potentials in the east and west of the Mediterranean, the Red Sea, Western Desert, and the Gulf of Suez, the oldest production area. So, currently and for years to come, the Sector will witness intensification of upstream activities, particularly after inking significant agreements with major IOCs and putting new development areas on the business map, such as the Western Mediterranean and the Red Sea. Several areas and blocks were assigned to major IOCs, such as ExxonMobil and Chevron, to work in Egypt for the first time, in the Mediterranean and Red Sea, in addition to major companies already operating in Egypt such as Shell, Eni, Apache, Total, BP, Wintershall Dea, as well as Arab companies such as Kuwaiti KUFPEC and Emirati Mubadala. These Companies possess the advanced technologies and the required experience to operate in those virgin & deep areas.



Despite the challenges and repercussions of COVID-19 pandemic during 2020, the Petroleum Sector has succeeded in signing 22 agreements for oil and gas exploration with major international companies, with minimum investments of about \$1.6 billion, and total signature bonuses of \$139 million, for drilling 74 wells. More agreements will be signed over the coming period, particularly after launching a new bid round for EGPC and EGAS for oil and gas upstream activities in 24 blocks. These agreements are considered fundamental pillars for realizing more discoveries and maximizing Egypt's production and reserves from new areas in its economic waters in the Red Sea as well as the Mediterranean, hoping that these efforts will succeed in achieving new discoveries.

On the other hand, as for oil refining industry in Egypt, we are working on its expansion, to be able to fully cover the country's demands through its local production, achieving self-sufficiency of gasoline and diesel by the year 2023, after the completion of all new refining projects in Assiut and Alexandria. The Petroleum industry will witness a technological shift and major fundamental positive change in management methods and decision making, after the completion of all digital transformation projects that are currently being implemented, in the framework of the Petroleum Sector Modernization Project.

### **What technologies do you foresee as having the most impact in the coming years?**

Our priority is to adapt new technologies and digital solutions to benefit the oil and gas industry in Egypt and to achieve the best results. For example, in the upstream domain, the era of cheap and easy oil and gas has ended, therefore, we cooperate with

major IOCs to use advanced exploration and drilling techniques to reach the deep oil and gas reservoirs layers, as well as deep and ultra-deep offshore areas. The Italian company, Eni, has applied these new technologies, very efficiently, in Zohr field and in its recent discoveries in the Western Desert, as well as technologies that contribute to increasing the oil recovery factor and improving the productivity of brown fields. Furthermore, we recently launched the first upstream digital platform (Egypt Upstream Gateway - EUG), which works through digital solutions to make subsurface information and data available to companies interested in investing in Egypt. Furthermore, we have almost completed the application of the linear programming system in all refineries, as a modern system that helps raising the operational efficiency of the refineries.

### **As the largest oil & gas conference and exhibition across Egypt, North Africa, and the Mediterranean, what are you most looking forward to at EGYPS 2021?**

After the great success of EGYPS 2020, we deemed it wise to postpone the 5<sup>th</sup> edition of the EGYPS Conference and Exhibition until February 2022 in light of the challenges of Covid-19 pandemic. We expect new successes this year, in light of major companies joining the Egyptian market for the first time, such as Chevron and ExxonMobil and the official declaration of the East Mediterranean Gas Forum (EMGF) as an international intergovernmental organization. Within the economic stability that Egypt enjoys, it proved to be an attractive destination for investments, and betting on investing in Egypt is profitable.



**Could you please share with us the impact of the successful middle management and human resources modernization for the young oil and gas professionals?**

No doubt that youth potential and talents development contribute to the sustainability of the Sector's successes. We need to provide cadres capable of leading the Sector's work sites and projects over the coming period, particularly as we are carrying out a large number of projects in all fields and there is a continuous growth in the Sector's business as well as investments. Currently, two major IOCs have joined the Sector as our partners such as ExxonMobil and Chevron, which is great of course and, in turn, requires a clear mechanism for setting young leadership cadres, and this is what we have implemented through a specialized development program for middle and young management branched from the human development program in the Petroleum Sector's development and modernization project, in collaboration with our foreign partners' positive participation in this regard .

That youth groups were sent abroad to engage in the IOCs' system of work in their various branches worldwide to acquire the latest methods of management and work along with the techniques applied to the basic technical activities of the Petroleum Sector in the Upstream domain, in addition to the main administrative skills such as strategic thinking, planning, financing, tasks and procurement.

**International and local analysts see Egypt as an important energy hub in the region; considering the energy transition, how will Egypt play a vital role in it?**

In Egypt, we are working to maximize natural gas utilization to make use of its efficiency as a significant transitional fuel to cope with the world trend of relying on clean energy, due to its environmentally friendly characteristics.

Therefore, Egypt's initiative to establish the Eastern Mediterranean Gas Forum and its cooperation with the neighboring countries in this forum will contribute in expanding natural gas usage in many fields as part of the energy transition to clean fuels in the future. In fact, the forum has, recently, launched two initiatives in this regard for natural gas de- carbonization and use of LNG as fuel for ships.

**Finally, we would appreciate your advice to young petroleum engineers who will be competing in the job market soon.**

Well, addressing the Youth, I'd like to say that... you are the safety cover for oil & gas future in Egypt, with your capacity to give. I'd like, also, to ask them to arm themselves with scientific and practical skills through continuous knowledge of the latest studies in their field of specialization, double their efforts, increasing achievement and innovation, and participate, strongly, in building the country, and young people should invest this concern, by increasing their training and development opportunities in presenting positive initiatives that are applicable at all domains , as well as refining their skills and raising their personal competence in light of the provided modern technologies and be familiar with the digital applications worldwide.



# SPEI President 2022

## Kamel Ben-Naceur

By/ Aisha Raafat

**Q1: would you tell us about your studies, career and your journey in SPE?**

I have joined SPE as a Member in 1985, while working with Schlumberger in the United States. However, my engagement with the SPE started earlier, as my first co-authored paper dates back to 1981, and it was on hydraulic fracturing. I have authored many SPE papers so far, related to the areas of production enhancement specially, hydraulic fracturing, well construction, software development, project management, CO<sub>2</sub> capture and storage and talent development. These papers were published in SPE Journals, including the Journal of Petroleum Technology, The Way Ahead, SPE Formation Evaluation and SPE Reservoir Engineering. I joined several of committees, including the SPE Forum Series, the CO<sub>2</sub> Capture and Storage, the Business Management and Leadership, and I have chaired several international SPE Conferences. I was also a SPE Distinguished Lecturer on the topic of CO<sub>2</sub> Capture and Storage. In 2008-2011, I was member of the SPE International Board of Directors, as Technical Director for Management & Information. I was also very pleased to receive several international SPE and AIME Awards.

**Q2: What are your goals for this year? What steps have you taken to continue the success of SPE?**

This year follows 2020, which has tested the world's resilience through many aspects: health, economy, education, social relations. It has affected the energy sector, and many industry colleagues have lost their employment. The world got together to develop a solution to the pandemic through vaccines at a pace never seen before, and that will put the world in a sustainable recovery mode. My goals in this context with the SPE are principally focused on 2 fronts, alongside 2021 SPE President Dr Tom Blasingame. The first one is related to a dialogue with our member and student



Kamel Ben-Naceur is CEO of Nomadia Energy Consulting, where he advises on sustainable energy policies and global/regional energy economics and outlooks. He has worked as a chief economist for a major oil and gas company and oilfield services company.

Ben-Naceur has also worked as a director of the International Energy Agency and as an energy minister for the Tunisian government.

He has chaired several SPE global committees, including Business Management and Leadership, the International Forum Series, and CO<sub>2</sub> Capture and Storage

members to send a positive and realistic message about the recovery of our sector. The second one is to work with the SPE Executive Director and his staff, along with the SPE Board to guide the SPE through what would be the most difficult financial period of its history.

### **Q3: What kind of challenges did you face during your career and how did you overcome these challenges?**

I have 4 decades of professional experience, through which I have faced many challenges. I would classify them in 2 categories: the first one there were several industry cycles with a very short time frame which leads to loss of employment of many valuable colleagues. I tried more to avoid losing that talent who were at risk just because they were working in the wrong place at the wrong time; if there was a negative outcome, I would try to guide them to find work opportunities elsewhere. The second category relates to my own change of professional area, within the same company or outside it. And I handled it through my own personal development and networking with the right people.

### **Q4: What are your expectations for the future of petroleum industry? And How does SPE fit into the broader landscape of Oil and Gas field?**

The petroleum industry has been a key element of the industrial/economical revolutions since over a century. Thanks to the availability of oil and gas, the world has been developed since the end of WW-2. Much needs to be done to achieve the Sustainable Development Targets of the United Nations, as almost a billion people have no access to electricity.

Future energy scenarios and the Climate Paris Agreement (2015) indicate that oil and gas will still play a key role in the energy mix in the coming decades. SPE will play a central role in knowledge exchange and dissemination for the oil and gas industry, but also in emerging areas that are peripheral, but strongly connected: Hydrogen, CO<sub>2</sub> Capture, Utilization and Storage (CCUS), Geothermal.

### **Q5: How do you think Coronavirus has affected the oil and gas industry? And do you think that events and conferences can be held online?**

The COVID-19 pandemic has created a triple shock:

health, economic, and energetic. Oil demand has dropped by 8% during the year (levels not seen in 3 generations). The WTI prices were gone deeply negative for the first time in history. It has also leaded to the laying off of hundreds of thousands of valuable employees in our industry. The level of activity in our industry has reached its lowest level in 2 decades.

It has been difficult to hold physical meetings. The SPE, thanks to the preparedness and the hard work of its staff and members, has managed to hold a number of virtual meetings in 2020. The majority of our members still prefer to attend physical meetings, however, as it gives the opportunity to network, as well as see some of the latest technologies through the exhibitions that are organized.

### **Q6: We would love to know your opinion about ECHO magazine and your advice to keep it advanced.**

I enjoy reading the ECHO magazine particularly the part about the Young Researchers' work which is a testimony of the quality of the research, and the academic talent in the region.

During our past seasons we have won many awards, could you please give us some advice to achieve more success?

I want to take the opportunity to congratulate the Suez University for winning the Presidential Award for Outstanding Student Chapter 2020, as well as having won it 5 times, a remarkable achievement for a relatively young institution. You are a role model for the MENA region, and should continue the excellent work in this recovery period, specially in support of the new graduates to find professional opportunities in the oil & gas/energy sector.

### **Q7: Could you kindly give some advice to students and fresh graduates who are about to compete in the oil and gas industry?**

My advice to students is to focus on getting good grades in technical disciplines, and for fresh graduates to get an understanding of the energy transition and its implication on the future trajectory of energy demand and supply. Given the tough market conditions, fresh graduates should also look at opportunities in disciplines that are peripheral to their core area of expertise, also to join the oil and gas industry when the industry outlook becomes clearer.



# Tameer Nassser

By/ Mohamed Ayman

**Q1: In the start of our interview, could you please tell us about your background and the transition you made to your current role at Baker Hughes?**

I have an overall 22+ years track record of leading multibillion dollar investments across oil and gas, transportation and power sectors.

I am currently Baker Hughes' Director and General Manager of Egypt and Sudan with responsibilities to lead and grow the business portfolio across oilfield services and equipment, turbomachinery, digital solutions and artificial intelligence. My previous role was the Chief Financial Officer "CFO" of North Africa covering Egypt, Sudan, Libya, Tunisia and Algeria.

I joined Baker Hughes from GE where I was the CFO of North East Africa working across oil and gas, power, transportation and healthcare sectors.

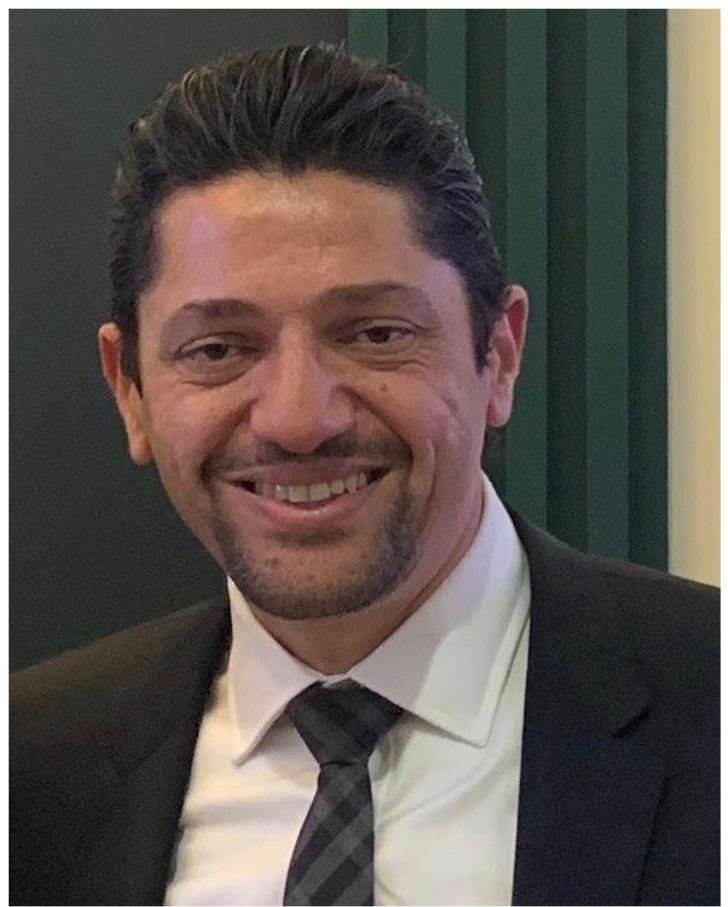
Before my two years tenure with GE, I worked for 9 years with BG Group where I held various LNG upstream and midstream finance and governance roles for the multibillion dollar business.

I started my career with PwC and spent 9 years auditing a portfolio of multinational clients across several industries and locations before I moved to BG Group.

I am a certified public accountant in the State of Colorado and hold a bachelor degree of commerce with an accounting major.

**Q2: How did you overcome your journey challenges to draw up your success and reach this high position?**

Simply by working hard, focusing on my development and having the right takeaways from my mentors throughout my career.



**Director and General Manger  
at Baker Hughes.**

A strategically and commercially astute business leader with 23+ years' progressive experience in mega projects across oil & gas, power, transportation and healthcare industries. This exposure enabled me to possess the in-depth knowledge of the business details that supports my holistic view as a leader.



**Q3: 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 an energy technology company. We invest in technology thus always come with innovative solutions to our customers. Latest technologies include a range of solutions focused on driving the energy transitions and improving efficacy and productivity.

These technologies include AI software, conditions monitoring, deflaring and controls and hydrogen-fueled turbines. We also invested in several carbon capturing, use and storage solutions.

**Q4: Recently, Baker Hughes was almost the only company with a revenue, how were you able to manage this great success during the COVID-19 crisis?**

Baker Hughes have a diversified portfolio of products and solutions which was a key factor to manage the risk of the low activity in 2020.

**Q5: How do you see the future of Oil & Gas industry and where are the key opportunities in this industry?**

The demand for oil and gas will still be there. Baker Hughes is well equipped and has a focused strategy towards addressing the energy transition into a diversified sustainable energy mix. We're excited for the future and to take Egypt's energy forward.

**Q6: As a student chapter, we always aim to achieve local and international awards, what's your advice for us to continue our march and conserve our success?.**

Work hard. Always work on your personal development. Be perseverant and don't let anything put you down. You also need to be aware of what's going on around you in the world.

**Q7: Finally, what's your advice to students and fresh graduates who are about to join the actual industry life?**

Always strive to be different. Distinguish yourself in any career direction you want to pursue.

This can be achieved by developing a range of personal skills and thinking out of the box creating opportunities rather than waiting for them. Never hesitate to ask for help and guidance as you move on.

**You need to be aware of what's going on around you in the world**



**By/ Hesham Gaafar - Amgad Saeed**

**Q1: Kindly, talk to us about your studies, career and your current job rule.**

First, I would like to thank you for this opportunity to share with you this discussion. I am a proud alumna of the faculty of engineering in Ain Shams university where I studied electrical engineering. I joined Schlumberger right after graduation in 2006 as a Digital Implementation Consultant in Digital & Integration division, then I decided to move to the field as a Wireline Field Engineer. After few years in the field, I got promoted to Field Service Manager taking care of Wireline operation in Egypt. Following this very exciting assignment, I took an educational leave where I studied a MSc. degree in Energy Transition from Imperial College London in the UK. This was followed by consulting work in the low-carbon energy sector in collaboration with key organizations like IEA, OGCI and the UK government. Currently, I hold the role of Reservoir Performance Division Operations Manager where I take care of our portfolio of products and services covering Wireline, Testing and Well Services business lines across Egypt, Sudan, Jordan and Lebanon.

**Q2: Was the oil industry your dream industry? Did it meet your expectations?**

Surprisingly speaking, I never had my eyes set on the oil industry or the energy industry altogether. Given that I studied electrical engineering, I was intending to join a company belonging to that sector, in fact I have done few internships in the electronics industry. However, after graduation when the Schlumberger opportunity appeared, I was very excited to enter a very unfamiliar industry. It turned out to be a very good decision! As a matter of fact, the O&G industry is very unique, and it aligns with my personality a lot. It has a lot of challenges, extremely fast-paced, dynamic and packed with technology and innovation.

**Q3: How do you see the efforts done by the industry to ensure women empowerment and gender equality?**

The oil and gas industry has been historically male-dominated for understandable reasons, however; over the decades there has been a massive change in this perception. The industry has put massive effort to attract, retain and promote females by addressing key issue like work environment and pay gap between males and females in some companies. Diversity and inclusion is



**Field Development & Engagement Manager | Reservoir Performance Division at Schlumberger**

now embraced in almost every company corporate strategy and driven by the senior leadership team. Celebrating and shedding the light on successful female figures helped set a clear example for others and particularly younger generations who need a role model to follow. And finally, I believe that the best way to empower women in the O&G industry – as well as any other industry for that matter – is to be supported by a fellow successful woman.

**Q4: What are the innovative services which were applied recently in Egypt by SLB?**

The most recent project delivered by Schlumberger's Digital division is the "Egypt Upstream Gateway" which is an innovative national digitalization project to promote Egypt's exploration and production potential worldwide. This is a digital platform that will enable global access to the country's subsurface data, which is kept evergreen by enhancing legacy datasets through reprocessing and new studies. This unique digital initiative will be used to unlock the potential of Egypt's petroleum sector and promote the

country's exploration and production potential worldwide. I invite everyone to read more about it on our public webpage. (Source: SLB Newsroom)

### **Q5: How do you define Energy Transition? What do you think the role of oil and gas during the transition?**

The Energy transition is both exciting and challenging at the same time, but most importantly is a reality that's accelerating around the world and is imposing an everlasting change that is here to stay. In its simple sense, it is shifting from fossil fuels to a more cleaner form of energy like renewable energy, hydro and geothermal. On a wider sense, energy transition will change the way we generate and consume energy, will impact all sectors – power generation, buildings, industry, heating, cooling and transport – and will influence the agendas of both the private sector and governments around the world. For the Oil & Gas, it can be an opportunity for growth or a death valley for companies who won't be able to catch up with the transition and diversify their portfolio of products and services to remain relevant to the new energy landscape that is ahead of us. I believe, Schlumberger is one of the leading companies specially within the OFSE (Oilfield Services & Equipment) sector. In early 2020, we have inaugurated our New Energy Division providing new energy technology ventures and innovative partnerships. Today, reducing our carbon footprint and sustainability is a key pillar in our corporate strategy. This is an exciting time to join the energy sector!

### **Q6: Who do you think should take actions towards climate change? Only politicians, Big corporates or every human being should take actions?**

The topic of climate change is very close to my heart, hence my studies in Energy transition and my consulting work with the Imperial College Business school on the same topic. I believe, there is no one major player, nor one solution for the climate change issue. It requires collaboration & innovation. In terms of collaboration; Governments, private sector and consumer should work together. The government will enforce the policy and supporting subsidies for new technology and innovation. Private sector will fund these technologies and support its commercialization and finally, a climate-aware technology-savvy consumer is needed to create the demand and drive the change.

### **Q7: How can students educate themselves about the new energy trends and take an effective role in the future of energy?**

I believe the current generation of students are extremely lucky. The world is interconnected and there is a massive amount of information at their fingertips. I personally find the educational platforms like edX, Coursera, HBS Online very useful to understand the underpinning energy technologies.

For a broader Energy outlook, it's very beneficial to follow the yearly reports from renowned organizations like IEA, IRENA and the World Energy Council that provides comprehensive statistics on different topics like Renewable energy, Hydrogen, Carbon capture & storage and their rate of adoption around the world. Finally, to get a view on how the IOCs perceive the energy transition, reports like "BP Statistical Review of World Energy" published annually and the famous "Shell Scenarios" sets a layout for the different pathways to net-zero by 2050. The most important thing is to remain curious, that is how you will continuously learn.

### **Q8: it is always said "New Challenges Bring New Opportunities". According to this statement, do you agree there are new opportunities for O&G professionals?**

Absolutely. It is well-established that the energy transition will rely on the O&G majors to provide the technology, strict adherence to standards, sector maturity and the inherent ability to attract investors. This is similarly applicable to the O&G professionals given they stay up to date with new technologies, policies and the business models that will govern the new energy landscape. In my head, the energy leader of the future will have the O&G background, the understanding of the energy transition and the mastery of new trends like digitalization, decarbonization and decentralization.

### **Q9: What are some essential skills you think students who wish to join the industry should have?**

Assuming the solid engineering background is present, which is key to work in a challenging and technology-intense industry like the Oil & Gas or the energy sector in general, I would say there are few soft skills that are essential. First and foremost is sound decision making and ownership. For our fast pace industry, it's very important, not only to take the right decisions quickly, but also to take ownership of these decisions. Secondly, communication, openness and honesty. Finally, time management to be able to enjoy life or as we say in Schlumberger: "Work hard and play harder"

### **Q10: Finally, this is an open space for you. We would be pleased to hear from you any mistake you wish next generations could avoid, you can talk of a challenge you could overcome, or a situation that was life-changing for you.**

If I would like to leave you with one advice that is very applicable to next generations is to "Show Up" in your career and in your life. This means being prepared to put in the work, walk that extra mile regardless of outside factors or obstacles, whether you have the motivation or not. Set up a goal and a life vision, fall in love with it and do whatever it takes to reach it.



## Sercan Gul

Sercan Gul is a Ph.D. candidate, graduate research assistant, and lab manager working for The University of Texas at Austin. His main research interests are the automation of drilling fluid measurements and maintenance. He holds two master's degrees, one in Petroleum Engineering from Middle East Technical University and the other in Statistics and Data Science from The University of Texas at Austin. His previous experience includes being a drilling engineer and rig manager for various private companies in Turkey.

# Automated Surface Measurements of Drilling Fluid Properties: Field Application in the Permian Basin

## Summary

Accurate and frequent mud checking is essential for maintaining the primary well control barrier and optimizing fluid hydraulics and hole-cleaning ability. However, a full mud report while drilling is provided only once or twice a day and the measurements are mostly performed using traditional equipment and it is difficult to verify the test interpretation. So, we present an automated mud skid unit (MSU), which performs continual drilling fluid sampling and measurements at variable temperatures. The unit provides the non-Newtonian rheological constants characterizing a yield-power law fluid as well as the real-time friction factor and critical Reynolds number using a pipe-viscometer measurement approach. Other important fluid properties such as pressurized density, oil/water ratio, and temperature are provided using high-quality in-line sensors. The unit is controlled by a programmable logic controller coupled with a Linux operating system for data analysis. The system sends real-time detailed mud reports to engineers working either on-site or remotely.

The MSU was deployed in the Permian Basin for automated mud monitoring during unconventional shale drilling operations. The MSU provided mud check data 25 times more frequent than those generated by the mud engineer at temperatures of 50 and 65.5°C. Drilling-fluid-related issues, such as chemical overtreatment as well as sudden changes in mud density, rheology, and oil/water ratio, were reported immediately to the drilling crew.

## Introduction

Well construction operations depend on the maintenance of appropriate fluid properties and when they deteriorate, fluid-related problems can arise, including well control events and wellbore instability when mud density is not appropriate, hole cleaning and pack off events when fluid rheology is compromised, excessive fluid loss, and potential reservoir damage when fluid loss control is insufficient. Fluid maintenance, in turn, relies on API methods which are labor-intensive and time-consuming, requiring the involvement of a mud engineer to clean and recalibrate equipment, load samples, perform measurements, and interpret test results. The test conditions typically do not properly reflect downhole conditions and present occupational hazards to the operator.

Most of the studies on automated fluid measurements and characterization have concentrated on mechanically automating the API standardized instruments. However, the proposed methods do not solve the issues related to equipment cleaning, calibration, and test temperature control. In this study, we present details on the recent deployment of automated real-time mud characterization equipment, which can provide pressurized density, rheological properties, real-time friction factor, critical Reynolds number, water-cut, and temperature by automated sampling, heating, testing, and data analytics.

## Theory

A pipe viscometer provides high quality data of rheological properties with precision and reliability. It measures the wall shear stress generated by the fluid flow inside a test section at different flow rates. It only requires a variable-rate pump, a flowmeter, a fluid with known density, and differential pressure measurements inside the test section.

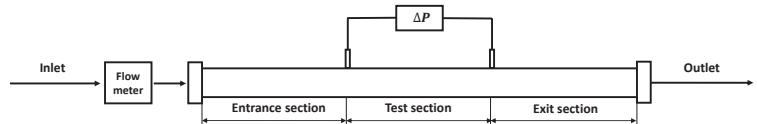


Fig. 1—Pipe viscometer schematic.

## MSU configuration

The system includes a two-barrel reservoir tank, two automated pneumatic valves, two 8-kW heaters, a centrifuge pump, a Coriolis flowmeter, a water-cut analyzer, two thermally insulated horizontal pipe sections, four absolute-pressure transducers, programmable logic controller, and Linux data acquisition and control system. The operation of the MSU and the analysis and subsequent communication of the data are all fully automated, requiring no human interaction.

The centrifuge pump draws fluid into the test sections using the inlet connected to mud tanks by a hose. After circulating the fluid and filling the pipes, three-way pneumatic valves close the loop. This is required to decrease heating times and performing the tests in a uniform drilling fluid sample. Once the test is completed, the fluid is discharged by a second hose back to the mud tanks, and a new sample is drawn into the test sections for the next set of measurements. Fluid density, temperature, and flow rate were measured using the Coriolis flowmeter. The point pressure data in the test sections (which were separated by 1.06 and 3.56 m) were measured by absolute-pressure transducers. Pump, valve, and heater control, as well as data recording, were accomplished using a programmable logic controller system with an update rate of 10 Hz. Fig. 2 shows a picture of the MSU.



Fig. 2—Picture of the MSU.

The measured data were compared with the theoretical pressure losses predicted using the Blasius equation.

$$Re = \rho v D / u$$

$$f_{Blasius} = 0.316 \times Re^{-0.25}$$

$$\frac{dp}{dl} = \frac{2f\rho v^2}{D}$$

The mean absolute percentage error (MAPE) was calculated by taking the mean of absolute percentage error (APE) for each single data point

$$APE = 100 \times \left| \frac{A_i - F_i}{A_i} \right|$$

$$MAPE = 100 \sum_{i=1}^{n_0} \left| \frac{A_i - F_i}{A_i} \right|$$

where  $A_i$  is the actual value,  $F_i$  is the forecast value,  $i$  indicates each measured data point, and  $n_0$  is the total number of measurements. Good agreement was observed between measured and theoretical results as shown in Fig. 3, with maximum APE of 3.5%, MAPE of 1.6%, and coefficient of determination ( $R^2$ ) of 0.99.

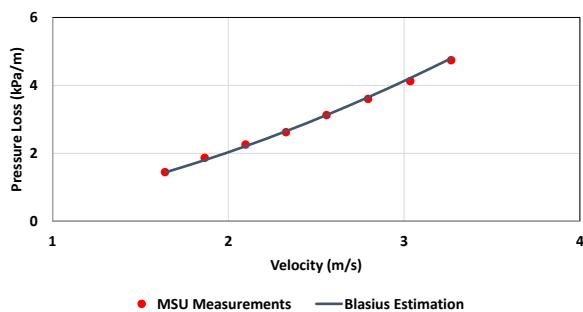


Fig. 3—Calibration test results of the MSU by water at ambient temperature

## Results and Discussion

The measurement accuracy of the MSU was verified further with experimental measurements of actual mud systems. A total of 15 tests were performed using various WBM and OBM formulations at 25, 50, and 65.5°C. The obtained results were compared with a standard rotational viscometer (model Ofite 900; OFI Testing Equipment, Inc., Houston, Texas, USA), which can operate at different temperatures. Good agreement between the two different viscometer measurements was observed, indicating that the pipe-viscometer method is accurate and can be applied to deliver real-time drilling fluid characterization for field muds.

The original paper was written by Gul et al. (2020) and published in SPE Drilling and Completions (December 2020 issue).

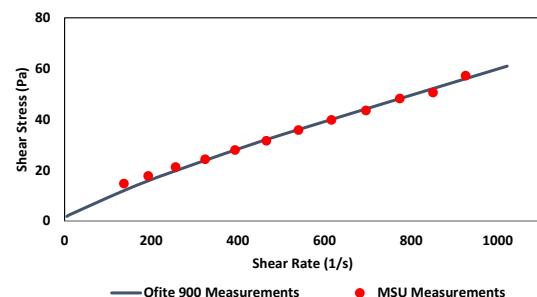


Fig. 4—Experimental comparison of rheology measurements by an Ofite 900 instrument and the MSU for a 1200 kg/m<sup>3</sup> (10 ppg) OBM at 25°C.

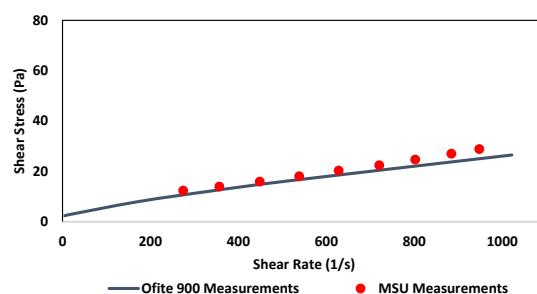


Fig. 5—Experimental comparison of rheology measurements by an Ofite 900 instrument and the MSU for a 1200 kg/m<sup>3</sup> (10 ppg) OBM at 65.5°C.

Rheological Properties	Measurements at 25°C		Measurements at 65.5°C	
	Ofite 900	MSU	Ofite 900	MSU
$\tau_y$ (Pa)	0.51	1.29	1.97	1.68
$K$ (Pa·s <sup>m</sup> )	0.31	0.28	0.10	0.14
$M$	0.75	0.77	0.79	0.76
PV (mPa·s)	45	46	21	22
YP (Pa)	9.5	10	5.3	4.8

Table 1—Comparisons of calculated rheological properties obtained by an Ofite 900 instrument and the MSU for the 1200 kg/m<sup>3</sup> (10 ppg) OBM at 25 and 65.5°C.

## Conclusions

- Automated characterization of essential physical and chemical fluid properties (PV, YP, pressurized density, and oil/water ratio) can be conducted at a high frequency. The rheology measurements were performed using a pipe viscometer.
- Compared with conventional Couette-type viscometers, the presented system is much less prone to plugging by solids in the fluid. Moreover, the pipe viscometer also allows for the characterization of additional rheological parameters, which cannot be obtained with Couette-type viscometers, such as the critical Reynolds number, characterizing the transition from laminar into turbulent flow, and the friction factor in the turbulent flow regime.
- A typical measurement cycle for obtaining basic fluid parameters takes only 5 minutes, allowing for more than 10 independent updates each hour, whereas density and water-cut values are provided continually. This supports our claim that these fluid parameters can be provided in real time.
- Fully automated fluid measurement is quickly becoming a reality. Its potential benefits to well construction operations include better hydraulics management, which is key to optimized drilling performance, and optimization of fluid treatment and maintenance. In fact, automated fluid measurement is essential if fluid treatment and maintenance, including solids control, are to be automated as well.

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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.



The Petroleum Arabian Conference and Exhibition is our mega technical event organized by SPE Suez, AUC, Cairo and Alexandria Universities Chapters, targeting a broader scope of students. One that is technically and financially supported by the most reputable oil field companies.



A 3-months school in which offline and online sessions are conducted for university students about the basics of research and research ethics. At the end of the school participants are guided by mentors to do their research.



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# Suez Projects



A club that offers short and long track development in different hard and soft skills throughout the season for SPE Suez members.



SPE Business Summit (SBS) is a three-day event held online where you discover the latest developments in different fields, hear inspiring keynotes from leaders and enhance your knowledge.



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.



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## Kristian Gjerstad

Gjerstad is a numerical modelling engineer focusing on developing models of physical systems and processes. He has 10+ years experience from the petroleum industry where the main focus has been modeling and automation of drilling processes. Holds (PhD) within petroleum from University of Stavanger (UiS).

# Exploiting the Full Potential in Automated Drilling Control

## Abstract

Automation is multi-disciplinary task which needs collaboration between the different parties in the drilling industry. In this paper we discuss which technologies within instrumentation, control systems and communication that should be in place for a typical model-based automation and well protection software to work optimal. We highlight the gaps present today that will take some time to fill and there are some aspects that can give significant cost reduction and improvements in automation and safety.

## Introduction

Drilling automation is currently in the process of taking the step from automating single tasks and machines to automating and optimizing the entire drilling process which is called Drilling Systems Automation (DSA). It incorporates a vision of automating every process from the well plan to a finished wellbore. Dedicated software applications tailor-made for protecting the well, increasing safety, automating repetitive operations and optimizing the drilling process have been on the market for a while. We will call these systems automated drilling control systems or ADC systems. The number of rigs with a sophisticated ADC system running actively in Realtime is not high, and even when it is used, its potential is not fully utilized. One of the main reasons for this is that ADC systems in practice are based on models of the drilling process running in parallel with the process, and therefore requires the exact same inputs (in real-time) as the real process in order to work optimally. Many of these inputs are today entered manually because the instrumentation, equipment and infrastructure needed to automate the data transfer are not in place.

## Basic principles of an ADC system

### Process replication based on a digital twin

One of the core components of an ADC system is a drilling

model whose task is to simulate in real-time the dynamic behavior of selected physical quantities in the well as a digital twin.

#### ADC systems functionalities

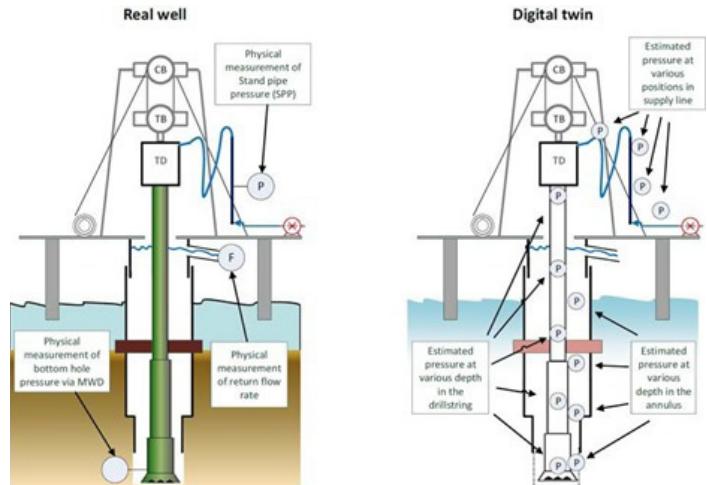


Figure 1 - A well with its digital twin

Drilling automation functions can be divided into the four groups:

1. Predictive safeguards: they are safety mechanisms that put restrictions on the input parameters of the drilling process. The input limits are calculated by using the models to simulate and predict which input values give desired responses.
2. Realtime safety triggers: If any of the measurements are higher or lower than the limits, warnings are given, and

Data acquisition system	Minimum refresh rate (Hz)	Maximum latency (ms)	Comments
Rig sensors (DCS)	10	100	Demanded by mechanical model components
Mud logging data/system	1	1.000	
Downhole measurements (MWD)	0,05	20.000	Assuming not having WDP
Mud properties from the pits	0,1	10.000	
BOP control data/system	10	100	
Choke manifold data/system	10	100	

Table 1- Refresh requirements

automatic sequences are initiated.

3. Automated sequences: an ADC system automatically runs specified drilling activities consecutively after each other in a sequence such as pump start-up, tripping/casing running, friction tests and reciprocation.

4. Control functions: can be designed to run various operations exactly as specified and to optimize the overall process in terms of cost, speed and wellbore quality, while maintaining safety.

## Practical challenges with a model-based digital twin approach

### 1. Measurement accuracy

It is a problem for mud flow into the well, block position and velocity, hook load and return flow rate.

### 2. Sensor reliability

In some cases, the measurement accuracy is in general good enough, but in harsh drilling environments there might be problems with reliability against occasional errors in the instrumentation. An ADC-operator continuously monitors the operations and performs a manual evaluation of important sensor signals.

### 3. Non-automated input data and operation about operational context

Some of the input signals needed by an ADC system must be entered by the operator. Although technologies for automating such measurements exist, there are not many rigs that have field proven systems installed. It is also crucial that the ADC system knows exactly which operation is ongoing and how it is performed.

### 4. Calculated and interpreted signals

An ADC system uses values that are not directly measured but are a result of interpretations such as bit depth, well depth and status signals telling if the drill string is connected to the top drive and if it is in slips.

## Suggested solutions and improvements

There are design rules for how rigs can meet the challenges with respect to the underlying control systems,

instrumentation and actuators.

- An ADC system must have access points for the relevant real-time data signals like field measurements and data derived in other systems which can be normally read from a few data acquisition systems or control systems on the rig. However, the industry has recognized the need for a more collaborating environment where each company focus on their area of expertise while leaving tasks outside of their core-business to other parties.
- Based on how fast the dynamics in the underlying physical processes are, there will be different requirements on the refresh rate and maximum latency of the different types of input data.
- The relevant machines and actuators need to be computer-controlled with a precision or accuracy suitable for the control task.
- An effective approach to solve the problem of failures in instruments and communication lines is to increase the level of redundancy. Critical measurements should be based on at least two sensors.

## Summary

The tasks that must be completed in order to fill the gap in drilling automation can be summarized as follows:

- Continuing the ongoing work in opening the communication between different software systems on the rig and making information available for others. This is especially important for the DCS, MWD systems, mud logger systems and well control systems. It includes, in addition to measurement signals, status signals, interpreted signals and other signals that give information on how operations are performed.
- Automating manual operations that affect the drilling process and establish procedures that ensure that such operations are available for other systems to read.
- Improving accuracy and redundancy of measurements, especially those identified as critical.
- Improving transfer rates and update rates, and precision on machines and actuators in order to enable even more advanced control functions.



## Judy Feder

I synthesize technical papers and write regional updates and feature articles for JPT magazine, and write articles for SPE's website, online publications, and newsletters.

# Drones Move From “Nice To Have” to Strategic Resources For Projects

## Introduction

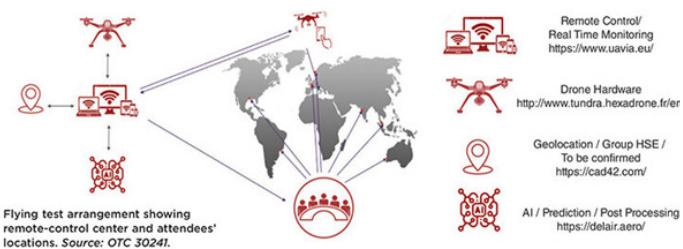
While drones have been used on oil and gas facilities for video inspections and other tasks, they have been operated by an on-site pilot or one positioned on a bobbing workboat adjacent to an offshore platform. Now a proof-of-concept study conducted by TechnipFMC has tested the feasibility of a global drone system with drones operated remotely by pilots based anywhere in the world. The study is the subject of a paper presented at the Offshore Technology Conference Asia in Kuala Lumpur in November.

Construction supervision and health, safety, and environmental (HSE) monitoring were the main drivers of the study. The construction supervision application is part of a larger digitalization ambition to monitor and manage construction activities with data generated from the drone ultimately feeding an internal software dedicated to this business process. Potential HSE applications include crisis management, human safety, evacuation assistance, hazardous-area identification, traffic control, carbon-footprint reduction, and environmental surveys.

One of the study's main objectives was to move from traditional unmanned autonomous vehicles (UAV) to resident systems and to investigate the possibilities they could offer. Aerial views have been used extensively to reduce personnel exposure in specific situations such as difficult access or potentially dangerous inspection areas like active flares, confined spaces, or high structures. In these cases, the drones are controlled by an on-site pilot who is either within their line of sight or a short distance away.



Combining AUV technology with embedded and associated intelligence from the internet of things (IoT), artificial intelligence (AI), and cloud and edge computing should enable drones to fly safely in complex and dynamic environments, resulting in integrated, resident systems that are permanently deployed at construction sites and available 24/7 without the need for an on-site certified pilot. Implementing these technologies will make data accessible and available in real time to people working on the project worldwide and it will also generate new work processes for project management and execution.



Flying test arrangement showing remote-control center and attendees' locations.

## Flight and Operations Testing

According to the paper's primary author, Nicolas Tcherniguin, manager of offshore business and technology with TechnipFMC, digital tools such as image recognition, machine learning, and simulation

of digital twins based on the drone's flight have been tested. Remaining bottlenecks have been identified, and some have been addressed while others will require additional efforts. AI development will offer additional features, especially if they can be integrated with other ground monitoring devices.

The security level of the global drone system is enhanced with an architecture of hardware and software. A remote-control interface secures the mission planning, performance, and data collection through features such as geofencing, smart navigation algorithms, real-time monitoring of vital flight parameters, and secure remote connections using available internet protocol or Global System for Mobile Communication networks. According to Tcherniguin, a couple of hours of training are adequate for an operator to be able to control a drone in a safe, secured, and limited flight envelope, avoiding any interferences with the environment and obstacles and in strict compliance with local regulations.

This cloud-based interface also allows sharing of live-streaming data to the project team members wherever they are located, simultaneously storing the data on the cloud. The integrated control platform offers new opportunities to supervise and potentially manage construction projects.

Three remote flight sessions were conducted over 1 year to demonstrate different features linked to advanced drone systems. TechnipFMC's Flexi France site 200 km west of Paris was used as a live testing facility. In collaboration with different startups, a professional ecosystem was gathered to demonstrate what is already achievable and what will be feasible in the future. For the last of the three sessions, flights took place in France, the remote-control center was in Rome, Italy, and the attendees were everywhere around the globe.

## Going Forward

Future deployment of resident systems will require more logistics and the use of more complex technologies and systems, resulting in higher costs. Current and future applications to maximize return on investment may include 4D planning, safety and security, inspection, mapping, monitoring, and tracking. It is anticipated that others will emerge with the development of AI and advanced tooling or sensing capabilities.

Since the last flight test, drones are being used on a first offshore structure construction project in Louisiana. The drones are not yet fully resident, but they embed AI to secure operations and provide valuable insights into the construction activities.



## Anjana Sankara

Experienced publishing professional with skills in editorial project management, website publishing, print publishing, email marketing, copyediting, and writing. Creative problem solving is her key skill.

# How Data Analytics Skills Can Open New Opportunities for Oil and Gas Professionals

Susan Nash, director of innovation, emerging science, and technology at American Association of Petroleum Geologists, discussed the permeation of analytics across the industry's verticals—upstream, midstream, and downstream. She argued that skills in analytics can propel innovative ideas in young engineers.

While the louder voice currently heard is the apocalyptic prognostications that the industry is dead, the reality is that most people agree silently that the society needs the benefits of the oil and gas industry for several more decades. "I don't think it will be as bad as people predict ... but at the same time now is the time for us to think in terms of energy and the big picture so that we think globally in terms of where analytics and data are used and how they are used," said Nash.

Current disruptors of the industry—COVID-19 and demand destruction—only accelerated what was already in motion in the industry such as the energy transition, net zero, and carbon phaseout. Nash compared the popular novel Love in the Time of Cholera to innovation in the time of COVID-19. The parallels being that innovation is also done out of sheer love and is not without pain, with the rewards being wonderful. But where do the opportunities lie? How

can one pivot during the pandemic? Data analytics can open broad categories of opportunities.

Lost revenue streams caused by the downturn have led companies to focus on optimization and efficiency. Not every operation can be shut down; instead there's an increased tendency toward automating the supply chain and using sensors and the industrial internet of things to bring down cost. These operations depend heavily on collecting, processing, and analyzing data.

As the automation of unmanned platforms grows in number and remote operations going to extremes, data skills become coveted in maintaining safe, reliable operations. Professionals interested in analytics can find roles in remote monitoring, impact assessments, inspections, and execution and automation of workflows.

Where there are data generated and collected, there is analysis of the data. Compliance is another area that uses data analytics. For example, when plugging and abandoning wells, state regulations require reports by subject matter experts for each plugged, abandoned, or inactive well. Consultants with experience in compliance are finding opportunities there.

Another data-heavy example is saltwater disposal.

# UPSTREAM DATA ANALYTICS APPLICATION



## Geoscience

Science identification (salt, fault, acoustic, facies, surface, tracking)  
EOD mapping  
Facies classification  
Waveform dustening  
Tops Propagation  
Well log prediction & reconstruction



## Reservoir

PVT estimation  
Core property estimation  
Unconventional multivariate analytics  
Refrac well selection fast-track field development planning  
Real-time reservoir management  
Eor screening



## Drilling

Rig state identification  
Drilling dysfunction identification  
pressure loss detection  
RSS downlink identification



## Completions

Completions event identification  
Treatment pressure prediction  
fracture diagnostic  
Fracture chacterization  
Multivariate analysis



## Production

Well event identification  
Automated forecasting  
Well performance tracking  
Artificial lift monitoring and optimization  
Emission monitoring  
Pipeline leak detection



## Facility

Equipment health monitoring  
Downtime prediction  
Inferential model  
Process digital twin

Disposal wells require continuous monitoring of injection of the water and the balancing of load shifts between wells to avoid seismicity. These require analysis of data from the sensors. Subsurface studies for storage of CO<sub>2</sub>, and H<sub>2</sub> are also projected to be important in the future.

"The key is to think about your capabilities as multipurpose. In the future we need to expand the way we see the subsurface," said Nash. ... [In the future] we will also see the subsurface in terms of structural stability and apply that to work with a team of civil engineers; see the subsurface in conjunction with geothermal, groundwater, seismicity, so we'll be working with teams such as hydrologists."

For professionals interested in building data skills, the massive repositories of data that are publicly available can be a good starting point. Being creative in finding ways to work with the data or how to store them efficiently is a valuable skill. As most digital platforms encourage building fit-for-use applications, Nash recommended working with the provider and using the tools they already have to create applications that are rapidly deployable. Using the fail-fast approach can get such ideas off the ground quickly. "You may have success; if not, start over and try again. You can make your own experience by being entrepreneurial."

While degrees in data science are good for systems thinking, building data skills by learning through open, online sources like Coursera and combining it with experience can be effective to arrive at solutions.

The historic shift in the energy mix today, with the demand for renewables picking up, has created a significant imperative for the oil and gas industry to become efficient in operations and capex. A

second major ongoing theme is the recent growth in automation in industrial processes as part of the 4th Industrial Revolution (4IR). A core element of 4IR is data and analytics. How are we going to equip people with these new skills in industry and academia?

Many companies are developing a new set of competencies for petroleum engineers and geoscientists. However, there is some resistance and denial among the workforce. "Why do I need to learn these things?", "We are already doing more with less", "Why should I learn Python?"

Sankaran advised that more industry professionals should acknowledge a need for data skills exists. This will help in accepting responsibility for upskilling and explore the roles and opportunities available for data analytics.

A common trend among the successful application of digital skills is a domain engineer taking an old problem and coming up with a new way of solving it by using automation or machine-learning tools. This method combines human intuition with machine calculations in fundamentally different ways. To reinvent yourself, embrace a continuous learning culture. "Every discipline and new role has its own lingo ... technical jargon that you need to learn and understand the culture a little bit as well. There is no secret formula. There are many paths. You must walk the path yourself."

Applications of the data analytics methods are now somewhat sporadic. Technologies in machine learning and artificial intelligence are evolving rapidly. The discipline will evolve in the next few years and help determine the clear winners. Until then, the best approach to arrive at a data-driven solution is by first defining the problem you are trying to solve.



## What is Digital Twin Technology - And How is it Used in Oil and Gas?



### Jane Whaley

Jane Whaley is a geologist with a BSc from Bristol University and 40 years of experience in the oil industry, ranging from high resolution seismic surveys to technical studies with IHS. She has been involved with GEO ExPro Magazine since 2005. Previously Associate Editor in Europe and Africa, she was Editor in Chief from 2010 until 2020, helping steer and develop the product in print and digitally to the very popular magazine it has become. She continues writing for the magazine among other outlets and has a particular interest in energy transition issues.

The idea of the 'digital twin' is catching on in the oil and gas industry. But what exactly is it, and how can it help?

### What is Digital Twin Technology - And How is it Used in Oil and Gas?

A digital twin is a virtual representation of a physical object or process and it is important because it allows analysis of the data and systems with a new concept. It is a bridge between the physical and digital world. As described in Network World: "a digital twin is a computer program that takes real-world data about a physical object or system as inputs and produces as outputs predictions or simulations of how that physical object or system will be affected by those inputs."

It is the advent of cloud computing together with machine learning algorithms and rapid computing power that has made the idea of integrating all data together a practical reality. 'Smart' components containing sensors are used to gather data about the realtime status, working condition and position of a physical item, such as an engine – or an offshore drilling rig. The data is sent to a cloud-based system, which stores and analyzes it, combining it with and comparing it to other relevant data, so the twin simulates the physical object. Additional information integrated with the sensor data into the twin includes engineering content, such as diagrams and specifications, as

well as financial considerations and uncertainties like weather, customer demand and supply disruption. Updating is constant and in real time, so fast decisions can be made using all available information.

The concept has caught on rapidly. Global research and advisory company Gartner identified digital twins as one of the most important trends in 2018, and it is now being used in a range of industries, from transport to manufacturing and healthcare.

## Digital Twins in Oil and Gas

As an industry at the forefront of technology that already works with dynamic software models, oil and gas is also taking advantage of this concept, both in ensuring efficient and safe ongoing operations and in designing new techniques and facilities. Independent risk management and quality assurance expert DNV GL has undertaken research that suggests that in the oil and gas industry "cloud computing, advanced simulation, virtual system testing, virtual/augmented reality and machine learning will all progressively merge into full digital twins which combine data analytics, real-time and near-real-time data on installations, subsurface geology, and reservoirs".

At the moment much of the oil industry work involving digital twins is being undertaken in the design of platforms and similar installations, with data on both existing and planned installations being constantly fed into the models. By using the cloud for storing datasets from all over the world, accurate and wide-ranging information is used to ensure a new design is both up to date and robustly tested. It requires a big investment in systems, sensors, and analytics, but many companies believe it is worthwhile.

The concept is used in operations, where it can help inform decision-making around optimizing production and maintenance by assessing how actions or events affect a virtual model of an asset. Since it is possible to model not only existing conditions but to also simulate extreme circumstances, the digital twin enables the operator to evaluate the most appropriate procedures to ensure both optimal production and personnel safety.

## Oil Majors Creating Twins

### Echo by Equinor

Equinor has developed a digital twin solution it calls Echo, which is used to access and visualize data from a range of its cloud-based databases. It is in place at ten assets so far, including the giant Johan Castberg field and the recent Mariner development.

One of the more innovative aspects of digital twin

technology that Equinor has been investigating is the use of the 'digital field worker', whereby everyone in the field can effectively bring the 'office' with them. Issues that previously had to be resolved onshore in the office can now be carried out entirely in the field with digital tools. Equinor says that over 6,000 employees will adopt advanced digital solutions such as Echo during 2020, adding that "Everyone with access can enter the digital twin at any time, irrespective of whether they are onshore at the office, or offshore on the installation."

### APEX by BP

BP is using its own digital twin system, APEX, a production optimization tool that has created a virtual copy of all the company's production systems throughout the world. The company says APEX added 30,000 bopd to production in 2017 alone. It also considerably speeds up processes, with the company citing a systems optimization procedure that used to require about 24 hours now being done in a mere 20 minutes.

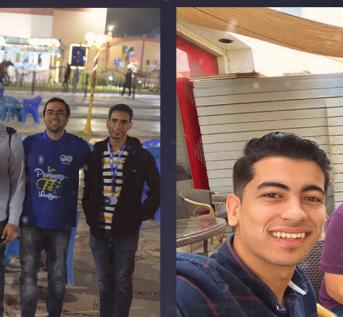
APEX is also a surveillance tool, capable of spotting issues in the field before they have had a chance to affect production. It can be used to test 'what if' scenarios; by pairing the model with the actual data, irregularities can quickly be detected and different procedures can be simulated, tweaking various components to ensure the optimum solution. As BP says: "virtually verifying before refining the reality."

In 2017, Shell was the first operator to participate in a Joint Industry Project initiative focused on advancing the structural integrity management of offshore assets using digital twins. It continues to roll out the concept over its assets, most recently collaborating with Kongsberg to create a fully realized dynamic digital twin of the Nyhamna facility, a gas processing and export hub for various fields in the Norwegian North Sea, including Shell's Ormen Lange project.

## Embracing Digital Twin Technology in Oil and Gas

Digital twins are here to stay, throughout the E&P cycle, from subsurface modeling and the design of rigs to optimizing production, increasing safety, reducing field personnel, refining and distributing hydrocarbons, and in the installations required to process continually evolving and maturing with the asset. The establishment of this sophisticated technology is complex and expensive, but the evidence suggests the financial and practical rewards are worth the investment.







## ***Energy Realities: The math behind “The New Energy Economy”***



### **Mark P. Mills**

Mark is a senior fellow at the Manhattan Institute, a McCormick School of Engineering Faculty Fellow at Northwestern University, and author of *Work in the Age of Robots*.

#### **Realities about the Scale of Energy Demand**

Hydrocarbons supply over 80% of world energy. Since 1995, total world energy use rose by 50%, an amount equal to adding two entire United States' worth of demand. The small two percentage-point decline in the hydrocarbon share of world energy use entailed over \$2 trillion in cumulative global spending on alternatives over that period; solar and wind today supply less than 2% of the global energy.

When the world's four billion poor people increase energy use to just one-third of Europe's per capita level, global demand rises by an amount equal to twice America's total consumption. A 100x growth in the number of electric vehicles to 400 million on the roads by 2040 would displace 5% of global oil demand.

Replacing U.S. hydrocarbon-based electric generation over the next 30 years, renewable energy would have to expand 90-fold to replace global hydrocarbons in two decades. It took a half-century for global petroleum production to expand "only" 10-fold. Would require a construction program building out the grid at a rate 14-fold greater than any time in history. Eliminating hydrocarbons to make U.S. electricity (impossible soon, infeasible for decades) would leave

untouched 70% of U.S. hydrocarbons use—America uses 16% of world energy.

For security and reliability, averages of two months of national demand for hydrocarbons are in storage at any time. Today, barely two hours of national electricity demand can be stored in all utility-scale batteries plus all batteries in one million electric cars in America. Batteries produced annually by the Tesla Gigafactory (world's biggest battery factory) can store three minutes worth of annual U.S. electric demand. To make enough batteries to store two-day's worth of U.S. electricity demand would require 1,000 years of production by the Gigafactory (world's biggest battery factory).

## Realities about Energy Economics

Over a 30-year period, \$1 million worth of utility-scale solar or wind produces 40 million and 55 million kWh respectively: \$1 million worth of shale well produces enough natural gas to generate 300 million kWh over 30 years. It costs about the same to build one shale well or two wind turbines: the latter, combined, produces 0.7 barrels of oil (equivalent energy) per hour; the shale rig averages 10 barrels of oil per hour. It costs less than \$0.50 to store a barrel of oil, or its equivalent in natural gas, but it costs \$200 to store the equivalent energy of a barrel of oil in batteries. Cost models for wind and solar assume, respectively, 41% and 29% capacity factors (i.e., how often they produce electricity). Real-world data reveal as much as 10 percentage points less for both. That translates into \$3 million less energy produced than assumed over a 20-year life of a 2-MW \$3 million wind turbine.

In order to compensate for episodic wind/solar output, U.S. utilities are using oil- and gas-burning reciprocating engines (big cruise-ship-like diesels); three times as many have been added to the grid since 2000 as in the 50 years prior to that. Wind-farm capacity factors have improved at about 0.7% per year; this small gain comes mainly from reducing the number of turbines per acre leading to 50% increase in average land used to produce a wind-kilowatt-hour.

Over 90% of America's electricity, and 99% of the power used in transportation, comes from sources that can easily supply energy to the economy any time the market demands it. Wind and solar machines produce energy an average of 25%–30% of the time, and only when nature permits. Conventional power plants can operate nearly continuously and are available when needed. The shale revolution collapsed the prices of natural gas & coal, the two fuels that produce 70% of

U.S. electricity. But electric rates haven't gone down, rising instead 20% since 2008. Direct and indirect subsidies for solar and wind consumed those savings.

## Energy Physics: Inconvenient Realities

Politicians and pundits like to invoke "moonshot" language. But transforming the energy economy is not like putting a few people on the moon a few times. It is like putting all of humanity on the moon—permanently. The common cliché: an energy tech disruption will echo the digital tech disruption. But information-producing machines and energy-producing machines involve profoundly different physics; the cliché is sillier than comparing apples to bowling balls.

Firstly, if combustion engines scaled like computers, a car engine would shrink to the size of an ant and produce a thousand-fold more horsepower; actual ant-sized engines produce 100,000 times less power.

Secondly, if solar power scaled like computer-tech, a single postage-stamp-size solar array would power the Empire State Building. That only happens in comic books. No digital-like 10x gains exist for solar tech. Physics limit for solar cells (the Shockley-Queisser limit) is a max conversion of about 33% of photons into electrons; commercial cells today are at 26%.

Finally, if batteries scaled like digital tech, a battery the size of a book, costing three cents, could power a jetliner to Asia. That only happens in comic books. No digital-like 10x gains exist for batteries: maximum theoretical energy in a pound of oil is 1,500% greater than max theoretical energy in the best pound of battery chemicals. About 60 pounds of batteries are needed to store the energy equivalent of one pound of hydrocarbons. Storing the energy equivalent of one barrel of oil, which weighs 300 pounds, requires 20,000 pounds of Tesla batteries (\$200,000 worth). At least 100 pounds of materials are mined, moved and processed for every pound of battery fabricated. A battery-centric grid and car world means mining gigatons more of the earth to access lithium, copper, nickel, graphite, rare earths, cobalt, etc.—and using millions of tons of oil and coal both in mining and to fabricate metals and concrete.

China dominates global battery production with its grid 70% coal-fueled: EVs using Chinese batteries will create more carbon-dioxide than saved by replacing oil-burning engines.



## Ratnika Prasad

She is focused on leveraging investor and industry action to accelerate the investments, business models, and policies need to accelerate the energy transition. Previously, she worked as a consultant with Bain and Company. Prasad holds an MBA degree and an MPA/ID degree from Harvard Business School.

## Introduction

The energy transition is accelerating faster than any market observers have anticipated. Pandemic-driven demand and pricing shocks, together with growing climate concerns, have put intense scrutiny on the oil and gas sector to transition to a climate-aligned future model.

After pandemic hit the world, we have witnessed loss of jobs in traditional oil and gas careers, how the energy transition offers not just challenges but opportunities, including for people of all ages, to help companies adapt, innovate, and compete. With their deep technical training, on the ground operational know how, and experience working with a diverse set of workers, oil and gas engineers hold transferable skills that are critical in designing the energy system of the future. Here, we highlight six opportunities in the oil and gas sector for oil and gas engineers to work on a cleaner future.

## As the Energy Transition Accelerates, Spaces Open for Oil and Gas Engineers

### Methane Management and Flaring Elimination

With 84 times more potency in the short term, annual methane emissions from the oil and gas industry are equivalent to the climate impact from all the world's passenger cars and freight trucks in one year. Addressing methane emissions, thus, is one of the more critical facets of curtailing the effects of climate change. Moreover, methane is not just an environmental issue but an operational one, representing safety issues and lost revenues from leaks and wasted gas stream. From majors' oil companies, we expect methane and flaring related opportunities to continue to grow.

New job roles emerging With increasing regulation and scrutiny of methane emissions, there will be a strong demand for environmental engineers who can develop company life cycle inventories for methane, field engineers for on the ground measurement and monitoring, and data scientists who can analyze data from continuous monitoring and create predictive algorithms to estimate

carry needs to avoid flaring.

## Decommissioning Orphan Oil and Gas Wells

Tens of thousands of officially documented orphan oil and gas wells are creating environmental hazards for their communities. "Orphan wells" are wells that became uneconomic over time and were left without being safely decommissioned. According to a paper published in the Columbia University's Center on Global Energy Policy, orphan well plugging could lead to 120,000 to 500,000 good-paying jobs.

The Canadian government's billion dollar site-rehabilitation program in Alberta has seen a pickup in demand for wellsite supervisors and engineers at companies. We expect similar roles and opportunities to rise across the US. New job roles emerging. The chance to address orphan wells safely makes direct use of well-engineering and well-decommissioning skills held by operators and oilfield service companies incredibly valuable.

## Carbon Capture and Storage

Many respected scenarios for achieving net zero rely on a robust role for carbon capture, utilization, and storage (CCUS). However, a tremendous amount of innovation is required to make carbon capture and storage feasible at scale and address concerns around the permanence of capture and concerns of leakage. Companies are increasingly putting their know-how into successfully scaling up CCUS technology.

New job roles emerging. Geologists, reservoir engineers, and well engineers hold the specialized skills and experience from past exploration and production work that will be critical in overcoming technical challenges and bringing down the cost of permanent storage of CO<sub>2</sub> in reservoirs. Additionally, process engineers in the oil and gas industry already have mastery over gas handling and separation processes that operate at huge scales, making them well poised to contribute to this future area of work. Finally, it is important to transfer oil and gas well engineering expertise from the CO<sub>2</sub> enhanced oil recovery (EOR) industry to the CO<sub>2</sub> storage industry. However, they are not experienced in the wider hydrocarbon industry. This branch of oilfield knowledge can be captured and put to work to help scale carbon-capture solutions.

## Converting Refineries/Petrochemical Plants

With the shift to electric vehicles and demand for

cleaner fuels in cars, planes, and residential and commercial heating, companies are increasingly looking at improving the operations at refineries and converting refineries to produce new outputs, such as renewable diesel and hydrogen. Companies such as Marathon Petroleum and Phillips 66, which are increasingly converting their refineries to biofuel production, need more and more health, safety, and environment professionals to manage the conversions.

New job roles emerging. Refineries of the future offer several new opportunities for engineers to help in process optimization as well as quality control to ensure that refinery products have a minimal environmental and health footprint.

## New Materials Innovation

With the increasing recognition of the cradle-to-grave environmental and health effects of certain categories of petrochemicals, there is a growing demand for bio-based plastics and other alternatives, which can have lower environmental footprints and can be recycled or composted more easily. Materials innovation roles continue to grow at companies which need scientists and supply-chain engineers who can innovate for a more circular economy.

New job roles emerging in Material science engineering requires health and safety checks to ensure that new materials not just match performance standards but also reduce the waste burden.

## Geothermal

Highly specialized oil and gas in petroleum engineering cost companies thousands of dollars to train a single engineer. These same skills are widely applicable to the growing renewables sector of geothermal, making it attractive for companies to steer their engineering workforce in this direction. This includes opportunities with both deep wells for electricity as well as shallow ones for residential heating/cooling.

New job roles emerging. The geothermal sector offers several opportunities for oil and gas engineers to use their skills in reservoir engineering and in operations, especially drilling deep, complex, geothermal wells.

The pandemic has marked a substantive shift for the oil and gas industry into renewable source. However, this need not spell doom for the industry's highly trained workforce. Many will find jobs beyond the traditional activities of the oilfield that take advantage of their knowledge, experience, and familiarity with decades of oilfield technology development and innovation.

# The Importance of Petroleum Education

## Dr. Ahmed Algarhy



**Assistant Professor at  
Marietta College**

### Introduction

When we asked Dr. Algarhy who has a bachelor's degree in mining engineering from Cairo University in 2003. Later, he got a post-graduate diploma in natural gas engineering and a Master's degree in petroleum engineering from Cairo University. In 2014 he relocated to the United States and got his second Master's Degree in Petroleum Engineering and a Ph.D. in Petroleum Engineering from Texas Tech University. He worked for many companies and universities such as Advantek International, OGS, Khalda Petroleum Company, Texas Tech University, Selman & Associates, and currently he

works at Marietta College. The purpose of this article is to highlight his views on challenges he encountered during his career, how he has overcome them, key differences in working in Egypt and United states, Egypt as an important energy hub in the future with all the discoveries found offshore recently, idea of PioPetro, sustainability plans for PioPetro to remain a free educational platform, Covid-19 impact Covid-19 on the oil and gas industry, his thoughts about Echo magazine and share things he thinks they would help young generations.

### Challenges he encountered during his career and how he overcame them.

The major challenge he faced according to him was that he is not a petroleum engineering graduate. And also he had a low total grade in Mining engineering. The reason is he used to work during his undergraduate education. To do a master's degree in petroleum engineering and get high grades was very challenging.

### Key differences in working Egypt and United States

The work environment in Egypt is more stressful and less organized and has more routine and less paid. On the other hand jobs in Egypt are more stable than in United States.

### Egypt as an important energy hub in the future with all the discoveries found offshore recently.

Egypt is the only country in the East Mediterranean region ready for that mission. There are 2 LNG facilities in Damietta and Edku. In addition, the new big discoveries in the Shorouk and Noroos area in the Mediterranean. Egypt also made a deal to facilitate the gas exports from Israel and Cyprus through the Egyptian pipelines and LNG plants. Regarding crude oil, Egypt made an MOU with Iraq to receive a portion of the Iraqi crude oil exports, and maybe a similar scenario can be done with Libya in



the future. Add to that the crude oil received from the Arabian Gulf area through the Sumed pipeline. For the electricity, Egypt these days can produce double what the Egyptians need, and the government is working to export the extra electricity to Sudan, Libya, and Jordan, and maybe Iraq, and Europe in future plans. All of these discoveries, deals, and achievements will make Egypt a major global hub for energy business in the near future.

### Idea and motivations behind establishment of PioPetro project

He used to work for the SPE YP in Egypt before he had relocated to the USA. Also, he worked for OGS, the famous Egyptian training company and is now teaching university students. All of that helped me to come up with ideas and projects that help students to learn and get a world-class petroleum education free of charge. He joined Marietta College in 2018 and he was lucky to get full support from the upper management after he submitted the proposal to found the PioPetro non-profit organization. As you know, because of Covid 19, most of the Summer Internships get canceled and PioPetro offered a great program for an online internship. As a result of the summer internship, PioPetro got a rocking success and later we decided to do a few short courses every month to serve more students free of charge.

### Sustainability plans for PioPetro to remain a free educational platform

PioPetro services for students will stay free of charge and this is the main objective of the project. Until now Marietta College donated more than 10000 USD to the project. To make PioPetro sustainable, they made a plan to deliver paid services to petroleum companies under the name of PioPetro Professionals and PioPetro Consulting. All the money will be collected from the paid services will go to enhance and increase the student's services. This plan if effective will sustain and keep the

student's services free of charge worldwide forever.

### Impact of Covid-19 on the oil and gas industry and how to young professionals to stay motivated

Oil prices go up and down every few years and good companies always like to hire the best engineers available when the oil price goes up. So you must be ready by preparing yourself for that future job offers. Studying hard, training, good work ethics and attitude, and good language and presentation skills are the keys to success. Whenever you get the chance to get an internship or free online training, never say no. All of us will get good jobs in the end but maybe we will suffer a little bit to find the job you like. Remember, when the pandemic is over, all countries will start a race to economically recover from the COVID19 crisis and it will be a high need for energy and this will create a lot of jobs for petroleum engineers in the near future.

### His thoughts about Echo magazine

The first time he has read the Echo Magazine was about 7 years ago. It was impressive to him to see an amazing high-quality magazine done by Egyptian students. Honestly, he did not see a better magazine published by any undergraduate petroleum program in the United States. He is very happy and proud to talk to younger brothers and sisters via this awesome magazine.

### Share things he thinks they would help young generations.

A piece of sincere advice to all petroleum engineering students, try to learn a programming language (something like Python), learn data analytics and enhance your English fluency to help you to find your dream job.



**Amgad Saeed**

**ECHO Chairperson  
Chapter President**



**Hesham Gaafar**

**ECHO CEO  
Chapter Secretary**



**Mohamed Ayman**

**ECHO COO  
Chapter Vice President**



**Ahmed Elsaed**

**Editor In Chief**



**Abdelhakeem Elshinnawi**

**Art Director**



**Helal Yousry**

**Treasurer**



**Youssef Gamal**

**Editor**



**Guot Tong**

**Editor**

## **ECHO TEAM**



**Suez University  
Student Chapter**



**Noha Ibrahim**

**Graphic Designer**



**Hossam Ashraf**

**Graphic Desiner**

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## For streamlining and derisking exploration opportunities

### Applications

- Opportunity assessments

### Key benefits

- Create project objectives and timelines and assign team members
- Clearly display and rank worldwide portfolio and assets
- Align multidisciplinary teams
- Enable full auditability and repeatability

### How it improves opportunity assessments

The cloud-based ExplorePlan\* accelerated exploration planning solution streamlines exploration strategies to improve efficiency and reduce uncertainty. It connects business objectives with data and technical workflows to enable you to compare and rank exploration opportunities at any level and stage. By providing easy access to all relevant data—both structured and unstructured—ExplorePlan solution bridges the gap across technical teams, offering a collaborative workspace for faster and better decision making.

### Frame and execute exploration projects

To kick-start an exploration screening project, the ExplorePlan solution enables you to assign a team, define activities and tasks, request peer review, link corporate or historical knowledge, and capture all technical outcomes for faster decision making and project closure.



*ExplorePlan solution streamlines your opportunity assessments so you can compare and rank prospects with greater efficiency and cross-domain intelligence and collaboration.*

### Access knowledge base to improve your interpretations

The ExplorePlan solution displays all corporate and historical knowledge—such as the general petroleum system, geology, stratigraphy, and structure—about a basin or region in a knowledge board to help you better understand and assess opportunities. You can leverage the existing knowledge base, create new data, link knowledge to technical workflows in Petrel\* Petrotechnical Suite, and share new insights across the team. The knowledge board also enables you to deep link to Petrel E&P software platform projects in the DELFI\* cognitive E&P environment's data ecosystem, making it easier to track a project.

### Discover all relevant E&P data

Further investigate areas of interest on a global map where you can discover all E&P data—from corporate, public, and vendor information to seismic and wells data, interpretations, and models to reports and publications. You can also compile and further curate data in the knowledge board.

### Compare and streamline exploration portfolios

With ExplorePlan solution, you can compare exploration opportunities—ranked by KPIs such as recoverable resources, risk, and NPV. And it enables you to link directly to corporate and asset portfolios of assessed exploration opportunities in the GeoX\* exploration risk, resource, and value assessment software, as well as the Petrel Petrotechnical Suite, to update opportunity assessments. The solution also incorporates analytics powered by TIBCO Spotfire® so you can create custom dashboards for portfolio reporting, assessment performance tracking, and analog data statistics.

### What is the DELFI cognitive E&P environment?

The secure, scalable, and open cloud-based DELFI environment provides seamless access to software across exploration, development, drilling, production, and midstream applications—all delivered via a flexible and personalized SaaS subscription model. Combined with domain expertise, digital technologies in the DELFI environment help solve challenges across the E&P life cycle.





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