ECHO

SPE Suez University Student Chapter Magazine

Issue 9 | March 2017

Interview with Mr. Darcy Spady
2018 SPE International President

Principal Components Methodology
A Novel Approach to Forecast Production

Minimizing Environmental Impact:
Exploration and Production on an Urban University Campus

Methodology for Constructing Stochastic Decision Trees

PUBLISHED BY
Society of Petroleum Engineers
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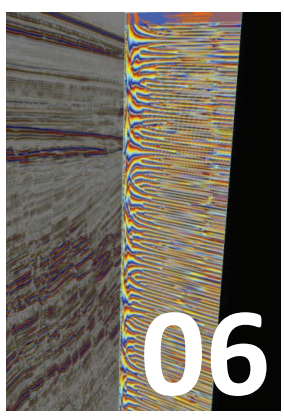

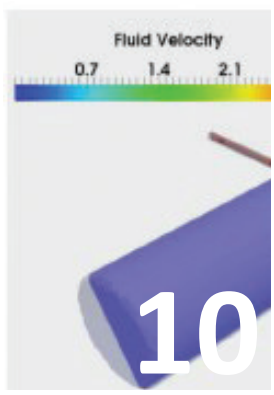

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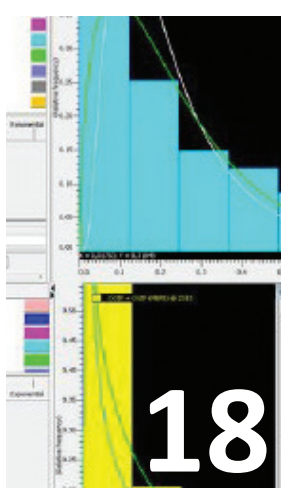
ISSUE 9 COVER

An offshore rig at dusk, ready to recieve a chopper. Photo from UK North Sea assets Blane and Enoch Image: Faroe Petroleum



Ali Fathy Ali
Chapter President

What it takes to be GREAT!

How does a needy Russian tennis club, with only one court, create players ranked in the top twenty best women tennis players more than the entire U.S? How could a moneyless and poorly educated British family in a remote village bring up three world-class writers? In each case, the echoing question is where did those great achievement come from? How did they grow?

Does it come from being born talented or from having all required facilities available? If the answer is being talented, so how did Thomson Edison, whose teachers told him that he was too stupid to learn anything, invent the light bulb after one thousand trials? And if the answer is having all the facilities available, so how could the Wright Brothers invent the first airplane allowing human to make a fully controlled and sustainable flight for the first time with just a poor workshop?

As a matter of fact, no one can deny that both facilities and talent are extremely paramount factors of any success, but what I would like to say that they are not the prime movers of the roaring success stories. Indeed, the main critical ingredients of booming success are hard work combined with your passion and enthusiasm towards realizing or achieving something. Passion and hard work must be very connected together, where passion is the component that determines the level of hard work. Passion is what keeps stimulating us to continue running after our dreams during the times of hardships and downs, or even when others try to forestall us.

Since the oil boom, the O&G industry has featured one theme which is being always flagging challenges and hardships and getting ready to face them over different decades and this is reflected through the up-and-down curve of the oil barrel prices over the petroleum history which has never been steady. I do remember the first words in Carl Gatlin book about petroleum engineering, “In short, we don’t know what it is, how it originates and accumulates, how to find it, or how to get it all out of the ground.” However, our spectacular industry has taught us that if you hit the bottom, then it is a must that you will rebound again and reach the ultimate height. Nowadays, we are in the rebound phase and our current role must be following our existing passion towards the O&G industry and working hard to make the best use of very soon upcoming opportunities, as opportunities will not wait for those who are not prepared to catch them.

As youth, we have to keep planning our career path and continue our march equipped and armed with passion, curiosity, sense of purpose, and innovation, because the future is ahead of us and the future is always vague, so we should be well prepared for what it is carrying and what it is bringing to us. We should believe in ourselves that we are exceptional that we never let tough situations and hard times set us back or sabotage the paths we are paving for ourselves.

ECHO represents a fabulous story of success which go much greater on the regional and international scale to be one of the most successfully and widely spread professional SPE publications around the world year by year. It has become a masterpiece in a short time due to its rich content and top picks collected from high figures and profiles in the O&G industry globally and finally retouched with a crew of skillful editors and designers.

ECHO 9 has come out this season with a massive amount of work, search, effort and dedication. The release of this issue would not have been possible if we did not have such a competent team. Thus, I owe them a very special greeting and sense of gratefulness to all of them without whom this distinguished product wouldn’t have been accomplished. And last but not least, sincere gratitude to everyone I have met since I have started my journey in SPE who have done me a favor. It has been a great journey of sharing, affecting, teaching and influencing others through four years of volunteerism.

And To the 2017 Team, you are the biggest asset of the chapter and you are the reason that pushed me confidently and made me never afraid of mounting barriers. I have been getting over obstacles because you are my backbone in the chapter and now it is your turn to continue the success novel of excellence that you are its heroes.

Finally, I would like to extend my cheerful thanks to each volunteer around the world who devoted their time and efforts for the sake of serving individuals in O&G industry contributing to make our industry a great one.

And remember again “Hard work beats talent when the talent fails to work hard” – Tim Notke

Mohamed Yasser
Chapter Secretary

Dream it possible

Is a dream enough to change the world? Of course, it is. Walt Disney once said, “All our dreams can come true, if we have the courage to pursue them”. It was his dream who changed the world’s perspective about animated stories and movies, making a new era in human history. We do not usually expect from someone whose artworks have been rejected as they were claimed to lack creativity to be the owner of the most successful company dedicated for family’s movies. Chasing a dream and trying to make it come true is the best adventure you can ever have.

I once had a dream, to be a magazine editor. Then I found myself the CEO of one of the most reputable magazines ever published by students, not only in Egypt, but also in the world. I can remember my friends encouraging me to take this challenge, and I can also remember my haters watching over me, waiting for me to fail or fear that challenge.

On a greater scale, when you consider the current status of oil and gas industry all over the world, you feel everything is telling you that you cannot do it. “You won’t find a job”, “The industry is living one of the worst downturns it has ever faced in its whole history.”, “Petroleum era has come to its end”. They try to disappoint you in every possible way. But when you take a look on those who have decided and managed to change the world, not only in our industry, but also in any other field, you will believe from deep inside that if no one is trying to disappoint you, then you are walking with the crowd; and who walks with the crowd will never make a difference.

I once listened to one of the pioneers of our industry speaking about his thirty-year journey in our field. He joined a similar faculty like ours, expecting he would get an easy job and earn a lot of money; the dream that everyone of us has in that stage of his life. But as life is always unpredictable, he graduated to find a similar case of disappointment pervading, as the industry was facing a terrible downturn then too. Needless to say, a tremendous number of students shifted their careers then, in other words, they decided to give up on their dreams. But he was different. He refused to let his dream go that easy, so he started asking about the history of our nature through consulting his professors and those who were more experienced. They advised him to wait as the Petroleum Industry was, and will always be, unpredictable. Now, he is one of the industry leaders as he was responsible for the MENA (Middle East and North Africa) region for one of the most reputable drilling companies all over the world, just because he believed in himself and his dream.

That was a turning point in my life. Only then, I totally believed in Martin Luther King’s say, “We must accept finite disappointment but we must never lose infinite hope”. The current situation may be disappointing; your dream may seem unattainable; you may feel that you lost everything; but in fact, hope is the only thing that you should never lose.

Practical wise, How can I achieve any of my dreams in such a complicated situation? Apple’s slogan is the best answer. You just have to “Think Different”. Think different about your problems. Think about different solutions, different ways, different everything. Our era is the one that needs innovation and different thinking about every single further step in your life, whether to apply for a job or to learn a new skill. You have to know that “The continuous development of a candle would have never come up with a light bulb”-Oren Harari.

Stay Focused! You may be passionate about various fields or skills, but more than one passion will distract you from catching your dream in any of them. The golden rule here is to know something about everything then to know everything about something.

“Problems are not stop signs, they are guidelines”-Robert Schuller. Make use of every bad situation you have been through. You fell? Stand up, try and try until you catch your dream, and remember, “The bullet that does not kill you makes you stronger”-Friedrich Nietzsche.

“A dream doesn’t become reality through magic; it needs sweat, determination and hard work”-Collin Powel. You have to work hard in a smart way while being dedicated. It’s the only way you can achieve whatever you dream about. It may not be easy to find your passion; but when you do, you cannot let it go. Follow your passion, work hard and always tell yourself, I am the one who is going to change the world.

Interview with Mr. Darcy Spady
2018 SPE International President

By Osama Radwan

Osama Radwan while interviewing Mr. Darcy Spady in media room.

Mr. Spady has an extensive background in the natural gas, oil and heavy oil segments of the industry, having worked a decade for Schlumberger across North America in their wireline and pressure pumping segments, as well as with the Columbia Natural Resources / Triana Energy group in the Appalachians, Atlantic Canada and internationally. He has also served as CEO of Contact Exploration in Canada and Hungary and more recently as head of sales for Sanjel Corporation. His expertise of three decades in both the independent producer and service segments of the industry greatly enhances his role at SPE.

1- Firstly, Could you tell us more about your experience as SPE member and your professional career?

I graduated from petroleum engineering university of Alberta in Canada in 1986 and I became a member immediately. We really did not have a student chapter and we did not have a section in Canada. It was a part of CIM like AIME. On my first SPE membership card, it said under the section "non-section" because Canadians were in Canadian petroleum society, but I became a member in spite of this. Meanwhile, I spent nearly half of my career in the service sector with Schlumberger wireline and Dowell Schlumberger, then Schlumberger pumping, so wireline, cementing, fracturing and services career. More recently, I was for three years with a company called SANJEL which was pressure pumping. Half of my thirty years' experience is service. The other half, I have been with medium size or small operators mostly doing exploration and completion work in North America primarily.

2- How did you draw up your success story to be SPE 2018 president?

I was just a member of various sections for a number of years. When I moved to a little place called Mt. Carmel in southern Illinois in the United States. There was a tiny section called Southern Illinois section. There were not many members and I became a membership chair, and so I got involved at the section level in a very small section, then I moved to West Virginia in the United States because I was experienced as a section executive, so I became the publicity chairman in Appalachian Section in Charleston, West Virginia. In the big world of SPE, I had two places with experience as an executive in SPE. Suddenly, I knew how to be SPE section executive. Eventually, we sold our company with 8000 small shale gas wells to Chesapeake Energy. I moved back to Canada to Calgary and became involved with several little companies. As soon as I got back to Calgary, the local section said, "Come join the section because you have section experience", but the Calgary section was 5000 members. At that time, Calgary section was the second biggest on earth. In very short time, I became on the board and as a regional director in 2013. I thought this is wonderful; I can serve and now then I am done, then some people said, "No, you should consider running for presidency". I thought I do not think I can, and then we put the nomination papers together. I put my name and my wife said, "You are going to win" and as always, my wife was right. I won the nomination, so that is how you get to be SPE president; you become a diligent worker in the section level and get involved in section activities as early in your career as you can and work hard.

3- How do you see the future of the industry in this downturn?

Oh, that is tough. Well, I graduated in 1986 which was probably the worst year in the last 30 years, so I have been here before. Out of my graduating class of 40, one person got a job and that was not me, so it is very tough right now, but the future is you. The future is the young professionals, and so I see the future very bright and very international, because if you look at the student chapters population; it is completely different than the professional members population, and so as we look to that mix. That is going to be the future. We are not the future. You are the future, the young people.

4- How do you feel about being the first Canadian SPE president?
Scared! It is a big honor. There are 6000 Canadians who are watching me. So I have a big load to do a good job representing Canada. I am so honored, because there are so many people who are much better than me, so I carry a big load, but you know, I am proud to be a Canadian SPE member. We have so many innovations with heavy oil and with unconventional gas and oil. We have done a lot of work in the background. We got to be in the foreground and I am looking forward to representing it well. We have so much expertise and so much technical experience. We can go between borders. We can talk to everybody; there is no political implication, so I hope I can visit more countries and do more things that maybe other nationalities cannot do. I would love to come to Egypt.

5- What were your plans in the university?
I wanted, number one, a job. Number two, I wanted to be an offshore drilling engineer. I never got to be an offshore drilling engineer.

6- We are eager to know your majors and degrees which you had achieved in the university.
I am just a Bachelor of Science and Petroleum Engineering, Just one degree.

7- How do you see our granted prizes like this gold standard for 2016 and the other outstanding prizes for 2014, 2015 and what is your advice?
Well, other than to continue doing what you are doing. You have done something right and clearly you have reached out to members. I think that is how you get those awards, by being broadly serving members of all kinds. It has not been easy for Egypt in the last decade. In spite of that, your chapter must have done something right with technical meetings, conferences and sessions. You have done it in spite of that entire political situation, which is what you have to keep doing.

8- What is your advice to thrive in the downturn?
Well, I think the best thing you can do is to fill your mind with as much technical information as you can while you have the time, so SPE is so good for downturns, because when you have a little available time, you can be reading papers, going to workshops, local section meetings and understanding what we do. Because when it gets busy, you get to know what you will need to know harder, so in a downturn, this is the time to read papers, think about technical content, get to know things and learn more. It is the best advice I give. Hang in there and learn what you can from SPE resources.

9- Of course, you know that funds presented from sponsors to chapters have been reduced too much. How will that cost reduction policy affect the activities and events?
We have looked at that at the board level. It has been very difficult in the last two years. Unfortunately, we have to download it to the sections, and that means there is more responsibility at the section level for making some of your own funds, but I think you need to remember a couple of things; the section is responsible for the student chapters, so you can do what you can, but hopefully, you can work with your section to help the student chapters a little bit and hopefully, the sections have a lot more resources, but every section around the world is suffering or losing money for probably the last two years. Some sections have found it better to go to companies and ask for sponsorships for a year. In other places, it is the exact opposite; they are actually getting sponsorship per event, so if you have an event on gas migration. Maybe, some of pressure pumping or cementing companies want to sponsor the gas migration event. Or, if you have something on drilling, and one of the companies doing a lot of drilling in a block in the area, it can sponsor that, so sections have to really scramble for money. We have been reduced dramatically on our conference revenue, so there is less to give out and at the section level the funds have been dramatically reduced, so there is nothing else I can say rather than work more creatively with what you have. I like the idea of per event sponsorship. It is more work, but then you can focus the dollars you raise on that event and probably be better for the sponsors to get better value for their money. I am sorry I wish I had a better answer.

10- Kindly, leave a massage for senior students and fresh graduates who are about to join the industry at this time.
Hang in there. Finish your degree. It will turn around. There will be jobs again. If you got the chance and able to financially get another degree maybe get a business degree or an MBA or some addition. Keep educating yourself, be patient. It will come. It took a long time in 1986 for me. What you will learn in trying to find a job in a tough market will help your entire career. It is a benefit, but it is very difficult, so I understand, but finish your degree, look for more education if you can afford it. Get a job that is similar, but not direct; go to something maybe on the upstream side or a mining job or something related to the industry if you can.

11- What do you think of ECHO magazine, which is a product of 100% student work?
Wow! I think it is amazing. I have not seen this sort of thing before. It is very well done. It is glassy. It looks extremely professional. One of the best things is that you have got good advertising. That is excellent. You have done a great job getting this sponsorship level. That is tremendous!

"One of the things I am speaking about a lot is community conscience because I am also a farmer. When I farm in my field, I passed a wellhead, and I think how the person is using the land interacting with the oil and gas companies. That is the community. We must be good community members. It is not telling people you drill here without caring about the community. It is a part of community conscience."

Mr. Darcy was in his tractor when he passed by a wellhead in a green field.

Thin-Bed Tuning-Frequency: Thickness Estimation

Victor Aarre - Geophysics Advisor - schlumberger

Introduction

It is well known in the industry that seismic reflections from geological interfaces in the earth's interior interfere with each other. This interference may either be constructive or destructive. The seismic wavelet is, according to the Fourier theorem, the sum of a number of individual frequencies, where each frequency has its own amplitude and phase. When a seismic wavelet is reflected from two neighboring reflectors (defined as the top and bottom of a thin bed), the amplitude spectrum of the reflected wavelet will hence be different from the spectrum of the original wavelet. This is because each frequency in the wavelet will have different amplitude, due to the interference between the reflectors (I.e. the two reflectors act as a filter). By examining the spectrum of the reflected wavelet, it is hence, in some cases, possible to infer the presence and thickness of thin beds in the underground. These thin beds are often of great commercial interest for the energy industry, because the most common scenario is a sand body embedded in a shale host rock. A sand body is often porous and permeable, making it a perfect reservoir rock for hydrocarbons. Shale rocks are most often not permeable (unless the rock is fractured), and are hence excellent reservoir cap (and source) rocks, keeping the hydrocarbons in place in the embedded sand body.

Prior Art

There are a lot of prior arts in this domain. The most famous approach was discovered, and patented, by BP. The commercial name of their approach is "The Tuning Cube". That invention was further elaborated on in a paper, written by K. Marfurt and R. Kirlin, in the Geophysics journal in 2001. That paper is an excellent introduction to the general scientific topic.

What's common for all existing methods I know of (for thin-bed detection through spectral decomposition) is that those methods attempt to infer the presence of thin beds through studies of the amplitude spectrum of the reflected waveform. This is a challenge; because the amplitude of the individual frequencies in the source wavelet is not equal (i.e. the amplitude spectrum of the wavelet is not "white" or "flat"). This means that the reflected seismic must become spectrally balanced before the tuning analysis begins. This spectral balancing step is complicated, at least when we do not have any wells available for joint log/seismic wavelet estimation, and we hence need to use blind/statistical methods for the spectral balancing step.

Description of the Invention Including Examples and Drawings

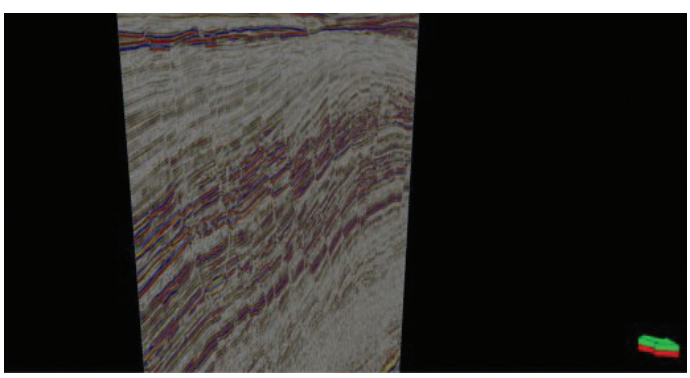


Fig.1 - One vertical section intersecting a 3D seismic cube

We will perform the analysis independently on each trace in the cube, and the method is hence not restricted to 3D seismic. It works equally well for 2D and 1D seismic data. The method is actually not dependent on seismic at all. It can work on any time series of any data (e.g. voice, radar, x-ray, etc.).

For each trace, replicate it into the desired number of spectral components one want to analyze. This number is in general dependent on the sample rate (which determines the maximum frequency, called Nyquist frequency) and the number of samples in the trace (which determines the number of spectral components which are required to fully represent the input trace).

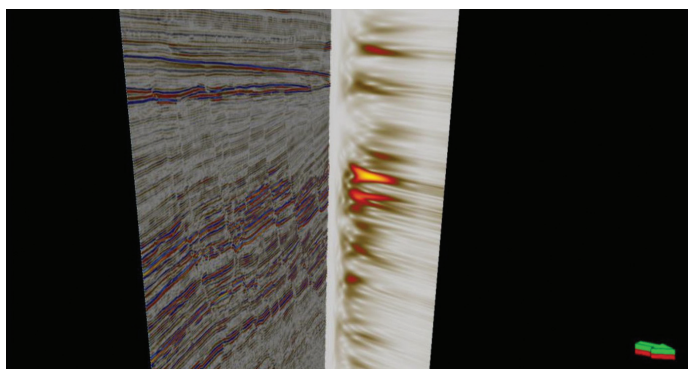


Fig.2 - This is the amplitude of the individual spectral components

In Fig 2, Note that the lowest frequencies (to the left) and the highest frequencies (to the right) are very weak, compared to the amplitudes in the center of the spectrum. It will be impossible to establish spectral high's or low's without first doing a spectral balancing step. This is the step we aspire to avoid with this invention. Note that the amplitude of each spectral component is, in general, identical to the Envelope (which is often also known as the "Reflection Strength") of that spectral component.

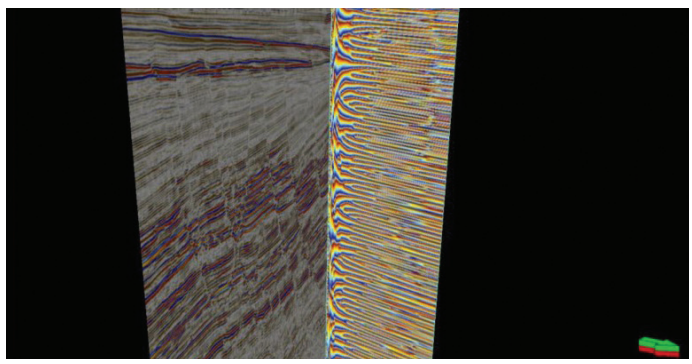


Fig.3 - This is the instantaneous phase of each spectral component

The value range is +/- 180 degrees. Please note that the phase spectrum is independent of the amplitude of the individual spectral components, and does hence not require spectral balancing.

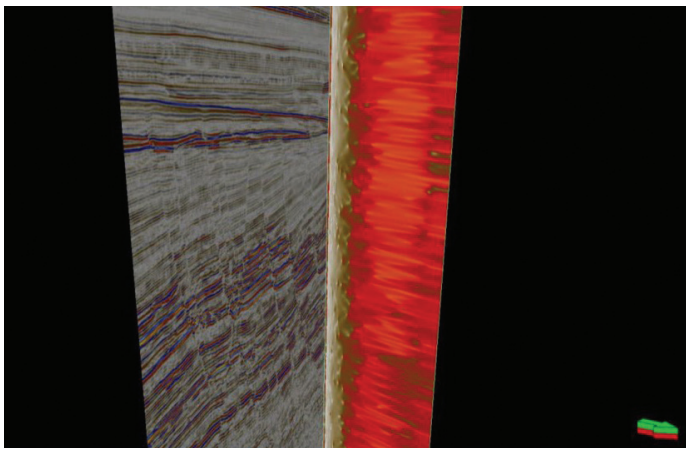


Fig.4 - This is the instantaneous frequency for each spectral component

Instantaneous Frequency is per definition equal to (1/360) * d/dt (instantaneous phase), and the unit is (of course) Hz (i.e. oscillations per second).

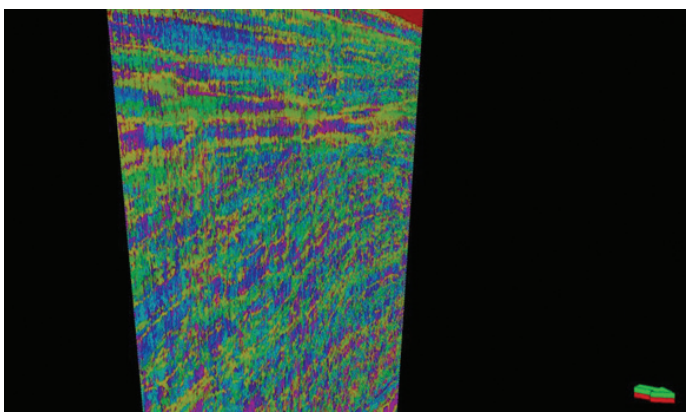


Fig.5 - The corresponding "tuning thickness" result

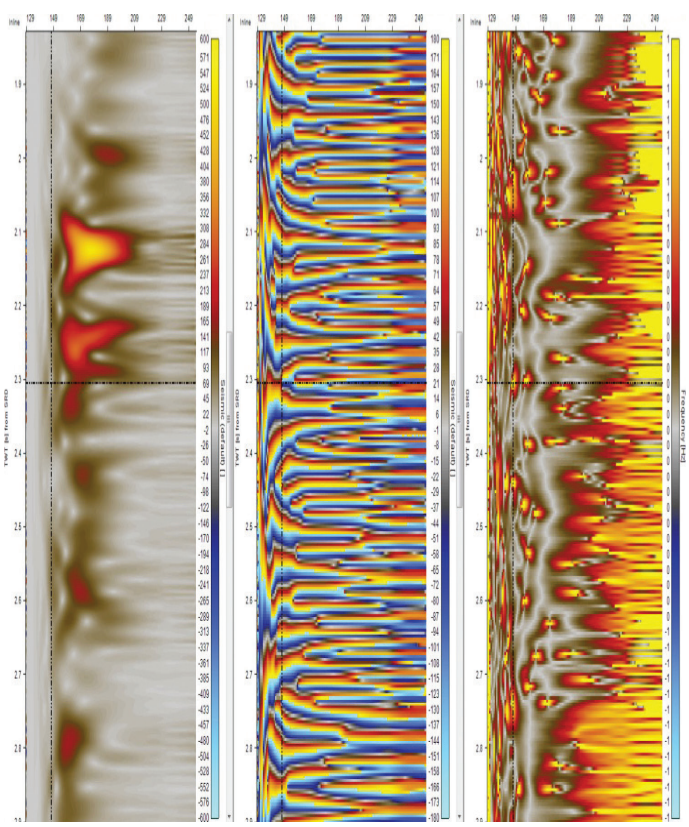


Fig.6 - A comparison between frequency-dependent Spectral Amplitude/Envelope (to the left), Spectral Phase/Instantaneous Phase (center) and "Instantaneous Frequency Error" tuning frequency" estimate (Di) to the right.

Summary of the Method

The reflected seismic must become spectrally balanced before the tuning analysis begins. This spectral balancing step is complicated, at least when we do not have any wells available for joint log/seismic wavelet estimation and we hence need to use blind/statistical methods for the spectral balancing step. The summary of this invention is a practical and simple way to estimate tuning frequency through an investigation of the phase spectrum, instead of the amplitude spectrum (as done by all prior art), of the reflected seismic. This removes the dependency of the spectral balancing step, which is required by all existing methods.

The steps are as follows, for each individual trace in a 3D seismic volume:

1) Split the trace into a set of individual spectral components, each with its own unique frequency F.

2) Calculate instantaneous frequency Fi for each spectral component (please note that instantaneous frequency is the derivative of instantaneous phase; this means that the instantaneous frequency is totally un-correlated to the seismic amplitude of the spectral component).

3) We know that, in theory, the instantaneous frequency Fi for each sample in the spectral component F should be identical to F. This will not be the case for samples where we have destructive interference (because we do not have a reflected signal there for that spectral component, and the phase will hence be undefined, as it's a singularity), and the spectral component Fi will hence be different from F.

4) Quantify the difference Di between Fi and F, and use this as an indicator measure of destructive interference, for each spectral component F.

5) For each sample in the input trace: search for the spectral component Ft where the difference Di is maximum for that sample. Ft will be the tuning frequency for that sample. The search may optionally be bound between user-provided limit frequencies F_{min} and F_{max}.

6) The limit frequencies F_{min} and F_{max} can optionally be estimated from Di for each spectral component, and may possibly be estimated as a smoothly time-varying function. This is because Di will be highly chaotic for the lowest and highest frequencies. These are the frequencies outside the bandwidth of the seismic wavelet. We can hence use a measure of chaos in Di to establish where the frequencies start to become reliable, and hence determine the limits of the useful frequency spectrum for the input seismic data.

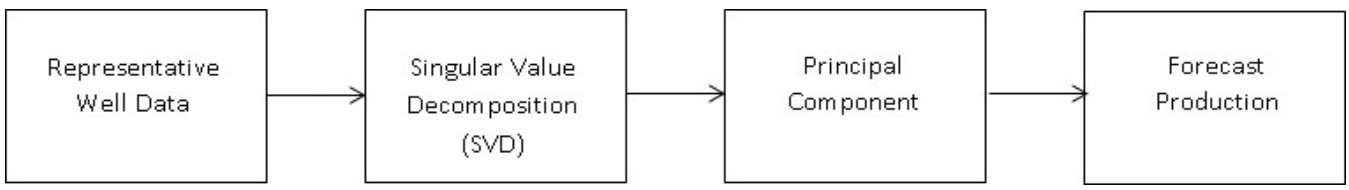
7) Optionally calculate the tuning thickness T from the tuning frequency Ft for each sample in the input trace. We know that the tuning frequency is inferred from destructive interference, and that the most likely cause for destructive interference is a thin bed with equal, but opposite polarity, reflectors. We can hence use this equation: T = 1/ Ft.

Principal Components Methodology: A Novel Approach to Forecast Production

Dr. Ibukun Makinde - Researcher - University of Houston

The oil and gas industry is in need of quick and simple techniques of forecasting oil and gas production. Existing traditional decline curve analysis (DCA) methods have been limited in their ability to satisfactorily forecast production from unconventional liquid rich shale reservoirs. This is due to several causes ranging from the complicated production mechanisms to the ultra-low permeability of shale. The use of hybrid (combination) DCA models (SPE-179964-MS) have been able to improve results significantly.

However, complexities associated with these techniques can still make their application quite tedious without proper diagnostic plots, correct use of model parameters and some knowledge of the production mechanisms involved. Therefore, the Principal Components Methodology (PCM) provides us with a way to bypass a lot of these difficulties. PCM is a data-driven method of forecasting based on the statistical technique of principal components analysis (PCA). A pictorial representation of the PCM workflow is shown below:



The procedure for forecasting production using PCM consists of the following steps:

1- Generate representative collection of well production data through simulation for time t_n and construct a m × n matrix Z from the representative data.

$$Z = \begin{bmatrix} q_1(t_1) & \cdots & q_1(t_n) \\ \vdots & \ddots & \vdots \\ q_m(t_1) & \cdots & q_m(t_n) \end{bmatrix}.$$

m – number of wells
n – length of production history (time)
q_i (i = 1…m) are the oil/gas rates of well i over time.

2- Apply principal components analysis to the representative well data through the use of singular value decomposition to obtain the principal components.

$$Z = USV^T, \qquad \text{Where } S = \begin{bmatrix} \sigma_1 & & \\ & \ddots & \\ & & \sigma_m \end{bmatrix}; \ \sigma_1 >> \ldots >> \sigma_m$$

(Singular values – in decreasing order from top to bottom of diagonal matrix S).

$$\text{Forecast} = \sum_{k=1}^{R} \hat{\beta}_k [v_k(t_{history}) \ldots v_k(t_{max})]^T.$$

R – number of sets of principal components (PCs) to be used in forecasting
β_k – PC multiplier

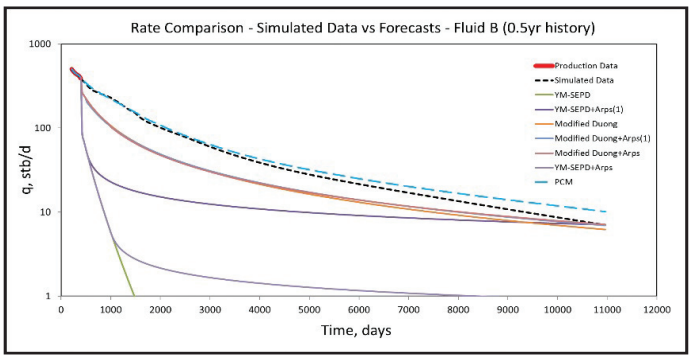
3- Given wells with limited production history, use the least squares regression method to identify best estimates for β_k (PC multiplier), which would be β_k, with the following formula:

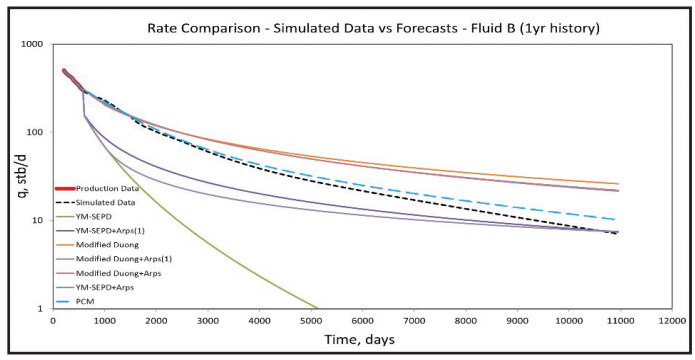
$$\min_{\beta_1,\ldots,\beta_R} \left\| [d(t_1) \ldots d(t_{history})]^T - \sum_{k=1}^{R} \beta_k [v_k(t_1) \ldots v_k(t_{history})]^T \right\|_2^2,$$

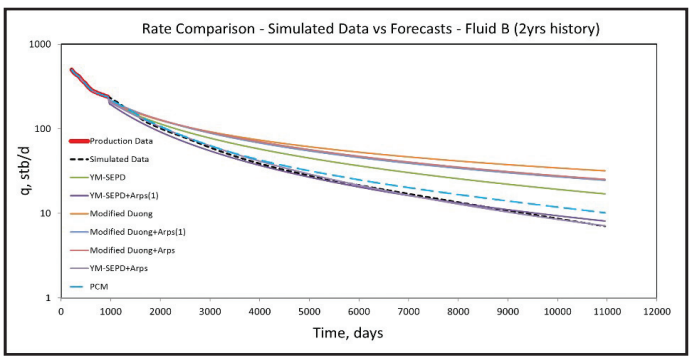
4- Production can then be forecasted using the formula below:

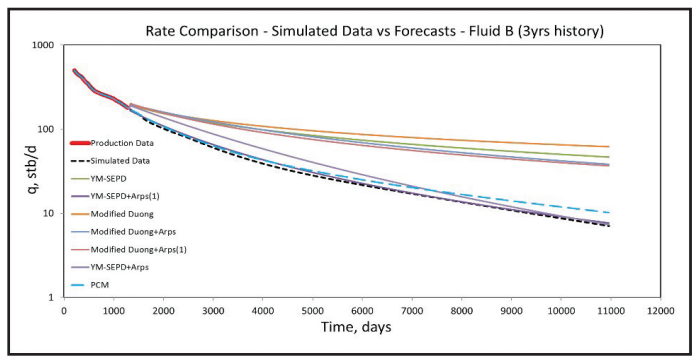
$$Z = \sum_{k=1}^{R} \sigma_k \mathbf{u}_k \mathbf{v}_k^T = \sum_{k=1}^{R} \beta_k \mathbf{v}_k^T;\ R<<m$$

An example of a PCM forecast (light blue dash line) in comparison to hybrid DCA model forecasts for multi-stage hydraulically fractured horizontal well with 6 months to 3 years of production history are shown graphically below:









From results, it is observed that YM-SEPD hybrid models severely underestimate production with production history less than 2 years. Also, Modified Duong hybrid models overestimate production in most cases. However, the Principal Components Methodology (PCM) forecasts are consistently good regardless of the amount of historical production data available.

Advantages of PCM over empirical and analytical forecasting methods are:

1. It eliminates the need to determine vital decline curve analysis (DCA) model parameters like the hyperbolic decline exponents (b values);

2. Diagnostic plots are not necessary prior to forecasting with PCM;

3. It avoids the complication of switching from one DCA model to another, as is the case with hybrid (combination) DCA models;

4. It does not involve complex and rigorous calculations;

5. It is possible to determine the time (point) of switch to Arps after careful analyses of the inverse MBT vs. time plot, the Yu plot and corresponding diagnostic plots - this time of switch may be the “true” start of boundary dominated flow;

6. The Duong model and its hybrid alternatives overestimate production in shale volatile oil reservoirs - overestimation increases with shorter production histories. These inaccuracies are a result of the nature of data due to early change from linear flow to transition flow regime, which contradicts the assumption of long-term linear (or bilinear) flow in the original Duong model;

7. The Duong hybrid models led to better forecasts than the original Duong model but still overestimate production (in most cases) in comparison to results from the YM-SEPD and its hybrid models;

8. The YM-SEPD hybrid models led to better production forecasts in all cases, but were limited by lack of production data beyond the minimum of 2-3 years required for best application of the YM-SEPD model. And the use of the Duong model to forecast 2nd and 3rd year pseudohistorical data to generate n and T, did not lead to «best» results (except when hybrid alternatives were applied) because of the limitations of the original Duong model;

9. Even though further research is needed in the area of solution gas production forecasting, it is possible to forecast solution gas production from shale volatile oil reservoirs with some measure of accuracy, provided there are sufficient data available;

10. A proposed Modified Duong model helps to alleviate the problem of serious overestimate of future production by the original Duong model. A hybrid model of Modified Duong and then Arps can lead to even better forecasts, but additional work (in progress) will be required to evaluate this model.

Recent Advancements in Temporary Diversion Technology for Improved Stimulation Performance

Dr. Mojtaba P. Shahri - Senior Geoscientist - Weatherford

Introduction

The aim of this study is to use advanced modeling approaches for optimizing different stages of fluid diversion through a comprehensive workflow. This would include slurry transport through the surface facility, displacement in the wellbore, jamming and sealing under downhole conditions and corresponding fracturing and production enhancement. The findings will have implications for acidizing, multistage hydraulic fracturing, and re-fracturing operations. The proposed workflow combines analytical and numerical techniques to optimize important parameters affecting each stage of the diversion process.

Comprehensive Design

This design enables us to create a seal over existing flow pathways that can withstand high differential pressures and yet can completely degrade all solids. To clearly identify the modeling tools and design strategy, There are four major steps that control and define the success of a fluid diversion operation:

- Slurry displacement efficiency.
- Jamming and sealing efficiency.
- Stimulation efficiency.
- Production efficiency.

The first important step is to make sure that the solid particulate slurry that is prepared on the surface keeps its integrity as it is transported downhole. That slurry properties might completely change during the transportation. Non optimized displacement can significantly disintegrate the solid particulate system and disperse them in the fluid during the transportation. Particle settlement occurs because of the inefficient drag force applied by the fluid system on the particles. On the other hand, a very high rate creates turbulence and agitations that might result in solid particulate dispersion. Analytical models are used to better understand the process controlling fluid diversion and pressure buildup. For use in engineering design applications, these models are calibrated against experimental and field data to generate operational guidelines. The ultimate goal of diversion operation is to maximize the fluid contact with the intact rock and to use the available horsepower to stimulate more reservoir volume.

Displacement Efficiency

CFD simulations can be used to capture the fluid movement during the transportation and how parameters control the efficiency of the process. Depending on the operational conditions, controlling parameters should be adjusted to ensure the efficient displacement required for successful sealing and diversion process. In more complex conditions, particle-particle interaction should be modeled as well to better capture the physics controlling the particulate system transportation. To do so, CFD simulations should be coupled with DEM simulations. In this study, The OpenFOAM® package (OpenFOAM, 2015) is used for CFD simulations and the LIGGGHTS, an open source software package for modelling granular material is used for Discrete Element Method (LIGGGHTS, 2015). As an example, Fig. 1 shows the application of coupled CFD-DEM simulations of particulate transport through a restriction. In this example, the particulate system passes through a ball seat before reaching to the perforations. Two scenarios are simulated and compared to show the importance of running these simulations for ensuring particulate system integrity before the sealing application. In Fig. 1a, flow rate is adjusted as the slurry passes through the sudden contraction/expansion to ensure that we can bring the slurry integrity back as close as possible to its original condition. The particles are coming back together after passing the restriction in this example. In Fig. 1b, high flow rate completely disperses the particulate system and loses its integrity after the restriction, which can be shown by comparing the solid particulate system integrity before and after the restriction. A coupled CFD-DEM simulator enables scientists to run the simulations under any operational condition and corresponding to any geometry. Once scientists ensure successful transportation of the particulate system from the surface to the downhole, the next step is to analyze the parameters controlling diversion and pressure buildup.

Jamming and Sealing Efficiency

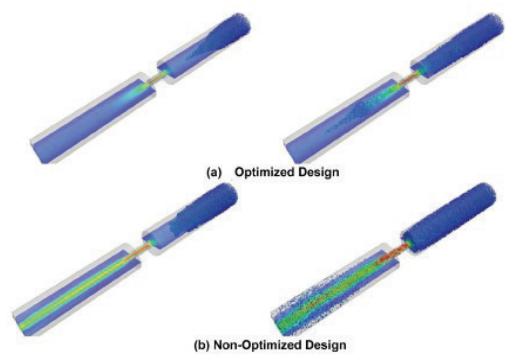


Fig.1 - Mininmizing solid particulate system dispersing during passage through sudden contraction and expansion; eg. Ball seat.

Two major mechanisms that control the success of the diversion process are jamming and sealing. In the first step of the diversion process, a stable, jammed structure should be formed that is mainly controlled by larger particles. In the jamming stage, an initial "stable" structure forms around an opening such that the jammed state refers to a configuration in which relatively large particles provide support for each other, remain stable and do not pass through the existing opening. Although the passing of relatively large particles is restricted in this stage, fluids and smaller particles can still pass through the open space between large particles. Therefore, jamming does not necessarily restrict

pressure communication. This structure will form the base for an effective sealing mechanism. During sealing, the remaining flow paths in the jammed structure are minimized by smaller particles for efficient pressure buildup and fluid diversion. To get the required pressure buildup, sealing should occur on the jammed structure. Smaller particles play an important role in this process, because they can form a layer cake between and/or on top of larger particles and seal any remaining porosity/open space. This way pressure communication is cut, pressure buildup occurs, and if desired, fracturing fluid is diverted away from existing perforations and the formation is fractured or re-fractured as planned. Using a coupled CFD-DEM modeling engines and experimental and field verifications; scientists have investigated and modeled different scenarios to optimize factors affecting diversion efficiency. Scientists' workflow optimizes engineering design parameters with data unique to each shale play to provide robust jamming and sealing guidelines for field operations. Once the numerical model has been verified against experimental data, it can be extended to investigate the effect of other parameters corresponding to more complex geometries. This also significantly reduces and eliminates the cost of experimental work. In addition to the single opening, numerical simulation can be used to model perforation scale geometries. An example of particles sealing the perforations is shown in a more realistic 3D geometry in Fig. 2. Designing the diversion process can significantly help economically and environmentally. Using learnings from advanced modeling capabilities (analytical and numerical) and extensive field and experimental data, scientists can optimize the required minimum concentration for a successful diversion process for each specific job, which would eliminate the excessive use of materials, which helps to reduce cost and the adverse effect of high concentrations on equipment.

Stimulation Efficiency

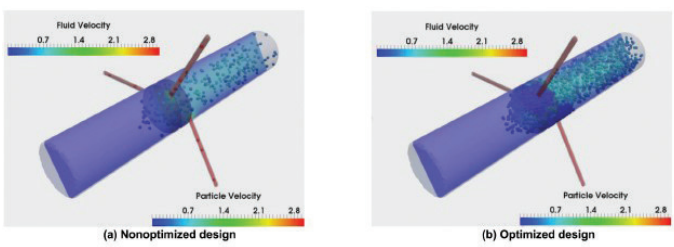


Fig.2 - Plugging optimization: perforation scale numerical simulations.

In the code, hydraulic fracture height growth is fully coupled with its horizontal propagation during the fracturing process. The layering effect is implicitly modeled by taking the vertical stress variation into consideration; hence, fracture height growth and containment can be assessed. The fracturing fluid flow within a fracture network is iteratively coupled with the resultant stress induced by the fracture deformation. Fluid flow within the wellbore can be dynamically distributed into each cluster and leak from fractures into formation and the mass balance is guaranteed. Multiple modes of mechanical deformation of the stimulated hydraulic and natural fractures can be determined, including opening, slip, or a combination of both. Induced stress shadow effects generated from the mechanical deformation of adjacent fractures and hydraulic-natural fracture mechanical interactions are considered. The turbulence flow and flow resistance for fracturing fluid across perforations and their associated pressure drop are taken into account. The simulator is capable of modeling multiple physical processes involved in hydraulic fracturing operations, including fracture height growth, stress shadow interference, perforation pressure drop, and HF-NF interactions (Huang et al., 2016). Three different stimulation scenarios are modeled by keeping the total injection Volume and rate the same, as follows:

- Plug and Perf: Complete mechanical isolation is applied on each stage after each stimulation step (-15minute sequential injection)
- Optimized diversion using solid particulate system: High pressure drop is applied only on the perforations that are taking the fluid after each stimulation step (-15minute injection)
- Optimized diversion (+in-stage) using a solid particulate system: Same as an optimized diversion except for adding diverting agent (additional pressure drop on the perforations that are taking fluid) after each 7.5 minutes of injection.

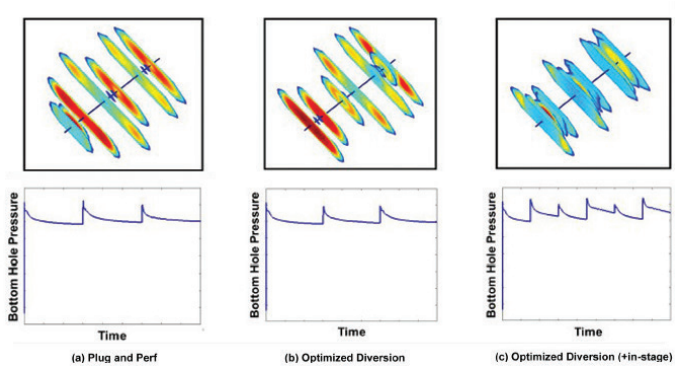


Fig.3 - Coupling diversion efficiency and perforation-scale pressure buildup to stimulate efficiency.

In Fig 3, This scenario corresponds to a mechanical plug isolating each stage during stimulation. In the case of optimized diversion and during the second stage injection, some of middle clusters in the first stage can start to initiate and propagate fractures because the solid particulate diverters only block two outer fractures in the first stage that are taking fluid.

Cleanup and Degradation Profiles

Polymer-based degradable diverters are temporary materials that are useful in some oil and gas operations, primarily to enable fluids to flow into areas of a reservoir where fluid dynamics would normally preclude them from going (Arnold and Fragachan 2014). The benefit of temporary degradable diversion systems is that they also work well for zonal isolation and do not need to be removed from the well mechanically after the intervention because they can degrade with time from a solid polymer state into a clear, non-damaging liquid monomer solution. Fig 4 shows the complete degradation of the plug to a non-formation-damaging liquid with no solids.

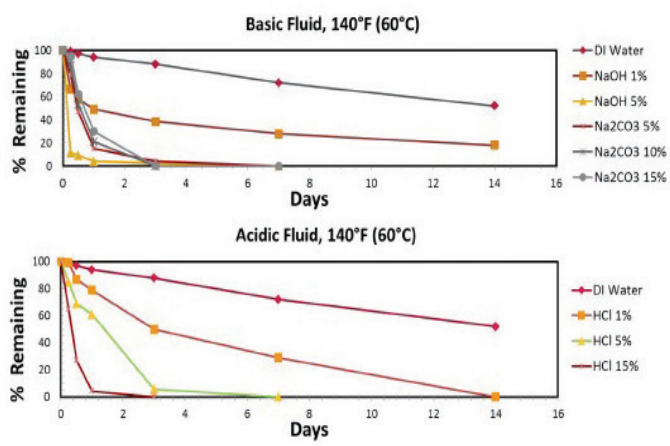


Fig.4 - Profile of solid particulate diverter degradation.

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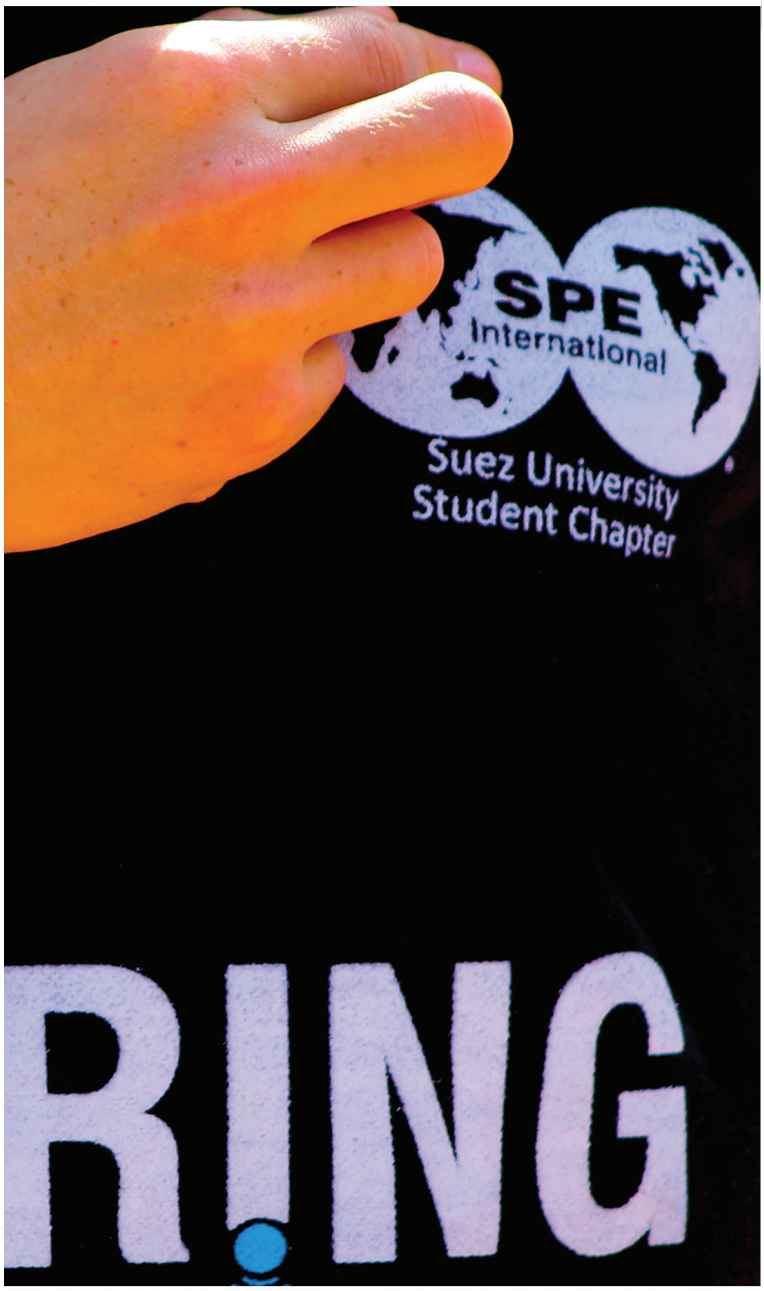
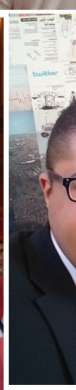
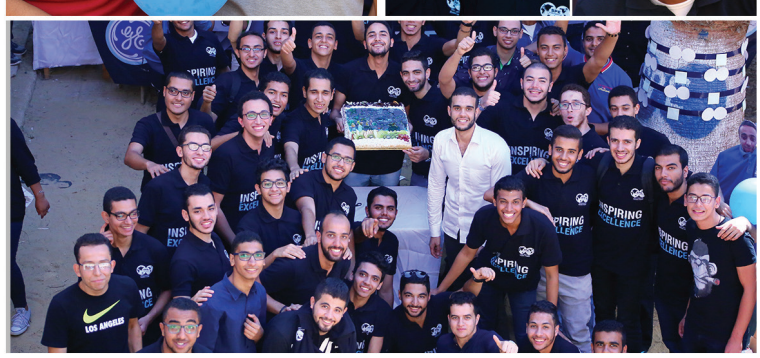
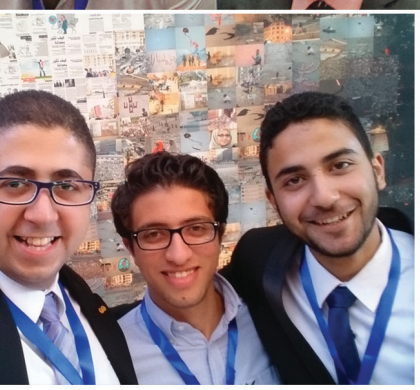


"SPE not only brings you into the professional atmosphere of the petroleum industry but more important, it is the preeminent environment to touch the noble power of volunteerism. When I talk about SPE, I see individuals full of enthusiasm committing themselves to volunteer on a consistent basis they have chosen to expend their time and energy to blithely serve others. This is the endowment of SPE."

Mohamed A. El-Kasaby – 2016 SPE Suez President







FROM A GREAT
HISTORY
TO A PROMISING
FUTURE

SPE International

Suez University
Student Chapter

Minimizing Environmental Impact: Exploration and Production on an Urban University Campus

Darcy W. Spady - Managing Director - Broadview Energy Asset Management

Introduction

A unique opportunity arose in late 2003, with the proposal by Columbia Natural Resources, LLC to the University of Charleston to use their sports field as a wellbore through which they could produce their own natural gas supply. This high profile location would demonstrate to the public the standard levels of environmental awareness and safety that our industry consider. Gas wells had been drilled in close proximity to the University of Charleston's Blackwell Field since the discovery of gas in brine well drilled in 1815. Other cities across North America and around the world routinely have oil and gas development drilling, so the task, although arduous, was not an operational impossibility.

Location stability and Civil Engineering

Two critical geotechnical factors were necessary to consider; surface and subsurface stability. The base of the field was close to the river. Essentially, the fill, probably saturated with water, could slump or slip toward the riverbank due the vibrations generated from the drilling process. To stabilize the surface of the drill site, it was designed utilizing some 1,600 tons of compacted stone resting on a geo-textile soil stabilization fabric (Fig.1). An 8" compacted layer of stone was initially placed over the geo-textile, containing some 1000 tons of #3 crushed limestone, followed by a 4" compacted layer of 600 tons #467 washed limestone. Straddling the actual wellhead location, 2 large timber crane mats measuring 8' by 20' were used to further support the rig load and maximize load distribution. Also, specific potential for failure was in the immediate vicinity of the borehole. The Drilling Engineer proposed a solution, which required the use of a concentric drilling rig "installing" a conductor pipe without any near wellbore disruption on the surface (Fig.2). A 16" conductor pipe is fitted with the concentric bit system that consists of a bit tooth ring and bushing welded to the first joint of pipe. A mated drill bit is then lowered through the inside of the conductor, and it locks with the ring and bushing assembly. At the rock face, both the bit and the ring/bushing assembly rotate, but the conductor pipe above the bushing does not. The rig pushes the conductor pipe into the ground as the bit face creates a hole and there is no circulation up the outside of the conductor. The internal bit, however, has holes in it, allowing circulation of fluid from the bit face back into the annulus of the 4 ½" drill string and 16" conductor. When one joint of conductor is drilled, a connection is made by welding another joint of 16" onto the top of the first joint, and the bit and internal assembly is run back into the hole to lock into the bit tooth ring and drilling is continued. Using this system, hole stability around the rig and sealing any encroachment of water from the river bottom or down hole erosion in the conductor setting process is achieved.

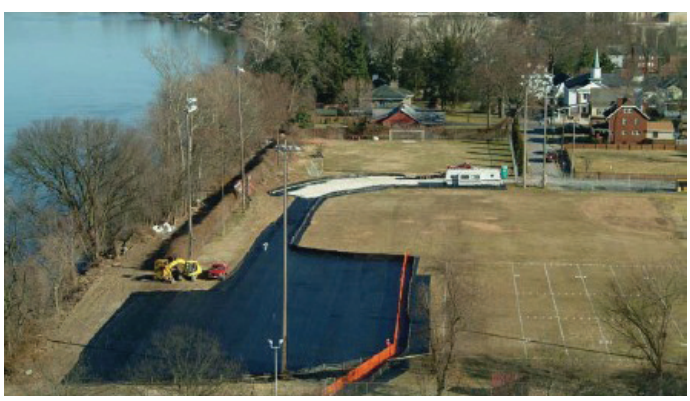


Fig.1 - Geo-textile soil stabilization fabric placed on access road and planned drill pad.

Fig.2 - Concentric drilling rig on location drilling and setting conductor.

Materials handling, storage and removal

Large quantities of location aggregate needed to be moved over the city streets and across a soft playing field to the drilling location. The challenge of transporting some 1,600 tons of stone was solved by using the river via a barge instead of trucking (Fig.3). A stone driveway was constructed in the same manner as the main pad, extending from the entrance gate of the sports field to the barge offload area, and across this road the excavator and dozer were moved in order to spread the stone once offloaded from the barge crane. The process was very successful. An above ground steel pit system was designed to ensure no discharge of drilling fluids to the pad, catching and processing of cuttings, the management of flow back liquids, and dust control. The cuttings and liquids were then collected for disposal. One of the other critical factors was the placement of tanks and the berming of the location. Two 400 bbl tanks were spotted for working fluid and placed as far away from the riverbank as possible. A more complicated situation occurred during drilling of the well a significant flow of water was encountered, causing the need for an additional 2000 bbls of storage on location. The two 400 bbl tanks were relocated to the east side of location, directly in front of the pipe racks. This crowded the location sig-

nificantly, but kept the footing of the tanks secure. In addition to strategic placement of the tanks, the location was also diked to ensure secondary containment of liquids would be caught in the case of a tank rupture or tipping, containing the fluid before it could get to the riverbank

Fig.3 - Taking advantage of being close to the Kanawha River, bulk materials were delivered via barge.

Environmental Aspects relating to population, location access and local compliance

There was a need for a zoning variance if a well was drilled within 500 feet of a residence (Fig.4). Before the building permit could be granted, a 30-day appeal period was given, just before the end of it; a resident filed an appeal with the Charleston Planning Department appealing to the Board of Zoning Appeals to reverse the December 3rd approval of the Planning Commission. The appeal stated the following 6 reasons for the case against the project: Potential danger to families, homes, and students who use Blackwell Field, Noise Pollution, Possible environmental impact, Declining property values, increased liability for property owners as well as the University of Charleston and Establishment of a precedent for future drilling in other residential neighborhoods within city limits.

After a lot of research, it was found that there were a reasonable number of operating oil and gas wells near residential areas in the region, all of which were relatively un-noticed by the public. Unfortunately, there is not a lot of onshore drilling and production data or research from a nationwide perspective that was in presentable format, so statements and descriptions of typical practices had to suffice. The activities on the field had to flow in an efficient manner, as it was stated in the hearing that the process would take approximately 22 days with no breaks, if things went as planned. The operation of the 24-hour drilling process was discussed at length at the hearing, so the efficiency of getting through that process was of key concern. Since the site was in an urban area, it was promised to the public at the hearing, that the site would have 24-hour supervision once the drilling commenced. In addition, special consideration was given to the rig and field perimeter fencing, to ensure no passers-by could inadvertently trespass. A pre-spud meeting was planned to review all of the aspects of the job. All aspects of the operation were discussed including safety, environmental considerations and management, logistics and neighborhood awareness. Also discussed was the type of vehicles allowed. To reduce the amount of road traffic on 19th Street, the location stone was brought and removed by a barge via the Kanawha River adjacent to the location. For lighter traffic, including all supervisors, rig crew and visitors, access was granted in the adjacent office-building parking lot. Also, the age and condition of a 24" clay sanitary storm sewer pipe and city services that ran beneath the 19th Street access, which was the entrance to the drilling location, was considered. A video camera was run through the pipe before the project, and the pipe was deemed capable of withstanding the load. Also, a quotation was made for the replacement of the paved surface on 19th Street, to cover any expenses incurred if the street needed to be repaved. At the entrance to the field from 19th Street, two large ¾" thick 5'x 10' steel plates were placed as to reduce stress around a sewer at the entrance gate area. In the pre-spud meeting, it was also re-iterated that there should be no stopping or parking in front of this gate. Noise studies were also carried out on the location. Were there any noise, noise reduction devices would be needed. However, it was found that any component of a drilling rig or construction activity was below 70 dbA at 200 feet, ensuring the noise level well below the ambient levels between 48 and 85 dbA outside of the sports field perimeter.

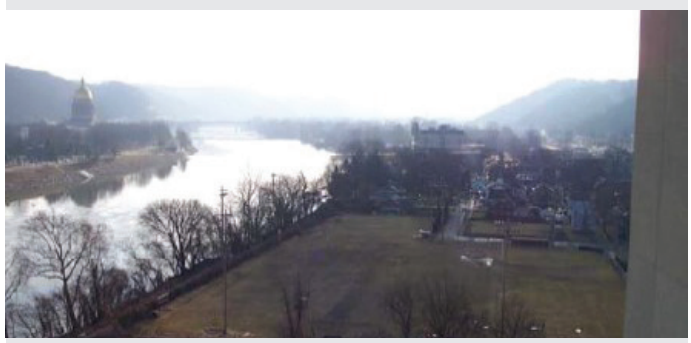
Fig.4 - Arial photo of the rig drilling 12 3/8" hole.

Co-operation with the public

A key part of the project was a good relationship with the public near the well and the community at large. Initially the project was met with strong opposition from the community. Over the course of the project and through two town meetings and a large amount of dialogue, the local residents became quite impressed with the operation.

Conclusions

This project demonstrated to the public that our industry routinely operates in a mindset of "Best Management Practices". It was proven in this particular example that our operations can be easily and successfully moved into the public eye with excellent results. (Fig. 5)



Before (August)

After (January)

Fig.5 - the Blackwell Field project with the West Virginia State Capitol in the background.

Successful Execution of First Coiled Tubing "Shoot and Pull" Underbalance Perforation in Pakistan

Saad Fahim - Senior Field Engineer - Schlumberger Seaco Inc.

Abstract

Over the past 80 years, various perforation systems have been developed to cover wide range of perforation applications and demanding reservoir conditions. Clean and effective underbalance perforations have a direct influence on reservoir performance. New perforation technologies and conveyance methods have been developed, including Coiled tubing CT perforation. OMV had a requirement to perform additional perforations on one of their land wells, which was produced from a depleted zone. Well head shut in pressure had dropped down from an initial pressure of 3000psi to 1400psi. The pressure zone of interest was in a range of 4700psi, which entailed that an underbalance at time of perforation would be more than 2700 psi. With such a high value of static underbalance, conventional wireline perforation application had its limitation and CT perforation seemed to be an ideal solution. OMV and Schlumberger experts collaborated to execute the high underbalance perforation with CT as the conveyance method. This execution required meticulous job design and planning as well as fabrication of a customized platform to safely run and retrieve guns in live well before and after perforations. Schlumberger CT firing head with 2.88" high shot density guns were used to perforate the zone of interest with a high underbalance of over 2500 psi. This underbalance marked successful execution of first CT shoot and pulled perforation job in Pakistan, where perforation guns were successfully conveyed and pulled to surface without killing the well, followed by well cleanup and testing. Post perforation results were very encouraging as OMV observed significant production increase where all objectives were met with no HSE/SQ incident.

Introduction

Coiled tubing has wide range of well intervention applications and it has been used widely for perforation purposes. Coiled tubing perforation comes with various advantages including, but not limited to, high static underbalance applications, long gun string perforation, deviated wells accessibility and deplo ment / reverse deployment on rig / rigless operations. This paper discusses the first application of underbalanced shoot and pull perforation in Pakistan with coiled tubing, without killing the well.

Background

OMV was producing gas from one of their wells in southern Pakistan. The production, started in February 2013, began to deplete over the passage of time until it decreased by overwhelming 66 % in late 2014. Trying to revive production, OMV decided to perform additional perforations on this well above the existing perforations, with minimal formation damage due to the weak nature of formation. Schlumberger's experts were requested to design an underbalanced perforation job to be performed in live well without killing it.

Challenge

The target formation had a pressure in the range of 4700 psi, wellhead shut in pressure was 1400 psi and gas hydrostatic was 600 psi, so this situation entailed the high value of static underbalance of 2700 psi. Perforation through conventional wireline was not possible with this value of high static underbalance as wireline is limited to maximum of 500 – 800 psi underbalance. The alternate job design had to be considered and eventually perforation through coiled tubing was finalized as CT can handle higher underbalance values in the range of 3000 psi. This specific well posed major challenge for CT shoot and pull perforation; some of the challenges were the design of perforation job to be performed in high static underbalance, high bottom hole temperature up to 330 °F, rigless guns deployment & reverse deployment without killing the well to minimize formation damage, guns correlation, perforation in gas environment and special design of tower platform for guns deployment and retrieval. It was decided to run CT firing head with deep penetrating gun system to achieve maximum productivity.

Solution

Coiled tubing perforation has two basic configurations:

• Shoot and drop perforation: Long gun string can be run in cased hole and dropped after perforations hence ruling out the need of killing the well to minimize formation damage, although there must be a sufficient rat hole to accommodate the gun string.

• Shoot and pull perforation: This method is useful in case of live well and insufficient rat hole to drop the guns. But this method is more complex compared to the former method. The reasons of its complexity are: deployment and reverse deployment of guns in live well, arrangement of double well barrier, extensive surface safety measures and massive surface setup to accommodate gun string while rig up and rig down. This target well was a live producing well and there was not enough rat hole available to drop the guns and hence the Shoot and pull perforation was favorable. Some inherent advantages of this perforation were as follows:

• Possibility of circulation in both directions before and after the guns fire. This design consideration was discussed, if the well had to be cleaned or offloaded after the perforations.

• The CT firing head is a pressure balanced system and insensitive to water-hammer effects and vertical drops. This incident provided optimized run times and facilitated achievments of the well objectives, while ensuring the safe operation.

• A well can be perforated in an overbalanced or underbalanced condition or when existing perforations are present in

live or kill condition. The target well was live with existing perforations. CT firing head provided the pressure isolation between the existing perforations and surface applied nitrogen pressure while firing the guns.

• Depleted wells where drawdown is insufficient, nitrogen can be circulated to lighten the overall fluid column, increasing the drawdown at the zone of interest. Post perforation acid treatment to clean the perforations is also possible through CT firing head. This feature gave the possibility of well intervention, in case the well had not flowed or the target well objectives were not met.

Job execution

Perforation bottom hole assembly (BHA) comprised of the following components (Fig.1), from bottom to top:

- 2.88" deep penetrating guns
- 2.88" Safety Spacer
- CT Firing Head
- Swivel
- Crossovers
- 2.88" Motor Head Assembly
- Coil connector and Coiled Tubing

Well had to be perforated in live condition with the surface shut in pressure of 1400 psi. Total of 7.5 meters of interval was to be perforated. Total BHA length was around 45 feet, which posed a challenge to accommodate the whole BHA in the risers above coiled tubing BOP. 50 feet of risers were rigged up. Special scaffolding was designed for the coiled tubing rig up and deployment / reverse deployment of guns. 45 feet of scaffolding was installed above xmass tree with three platforms at tree level, 10 feet level and 45 feet level. This scaffolding design was massive as compared to the conventional CT perforations, which made this job complex. A visual comparison can be seen in (Fig.2).

Guns were run one by one using crane and handling equipment. CT firing head was installed with swivel for easy make up of coiled tubing with gun assembly. After perforation, guns were then pulled to surface without killing the well. Whole BHA was pulled in CT risers and x-mass tree valves were closed and after bleeding the pressure to zero, guns were laid down and coiled tubing equipment was rigged down.

Results

Immediately after the retrieval of the gun string at the surface, well was opened for clean up to flare pit. Post perforation results were very encouraging. The production was doubled from early depleted rate of 13 MMScfd to 26 MMscfd. The overall job design and execution was highly successful and marked the first underbalanced shoot and pull coiled tubing perforation in Pakistan. All OMV's objectives were met with zero NPT, full HSE compliance and optimum job time.

Abbreviations

CT — Coiled tubing.
HSE — Health, Safety and Environment.
SQ — Service Quality.
NPT — Non-productive time .
BHA — Bottom hole assembly.
BOP — Blow out preventer.
MMscfd - Million standard cubic feet per day.
OMV - Österreichische Mineralölverwaltung.

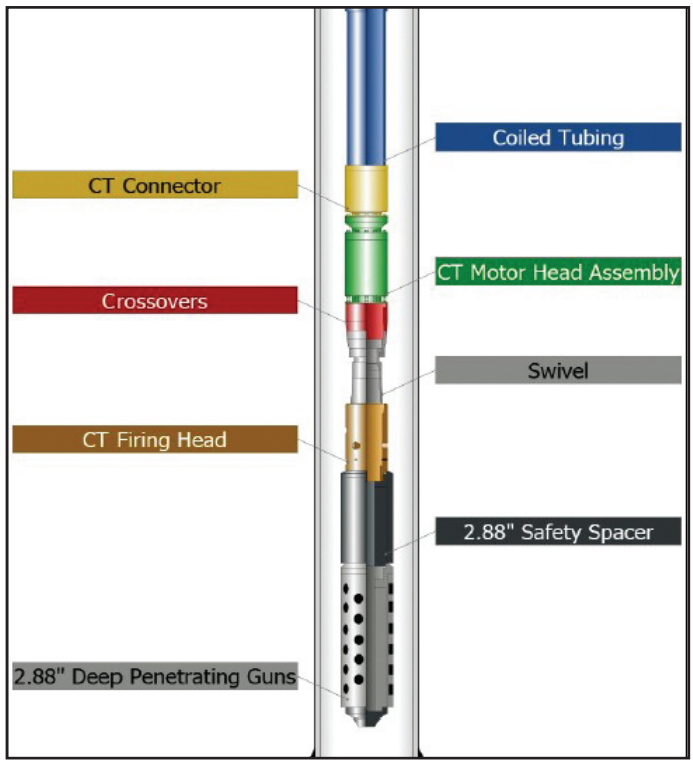


Fig.1 – Perforation BHA

Conventional CT Shoot & Drop Perforation

Shoot & Pull CT Perforation

Fig.2 – Comparison of scaffolding design for conventional CT shoot & drop perforation and shoot & pull CT perforation.


Methodology for Constructing Stochastic Decision Trees for Decision Making Under Uncertainty and Risk

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Abstract
The purpose of the proposed methodology is the generation of predictive models based on stochastic decision trees for effective decision making, covering the spectrum of risk and uncertainty; this way the uncertainty and decision variables are modeled integrally to solve a given objective function. The methodology can be described in three general steps:
1- Data exploration and analysis.
2- Stochastic predictive model construction.
3- Results visualization and analysis; through these steps knowledge is acquired from the data as well as information for the decision making process.

Introduction
The high levels of uncertainty and risk present in the oil and gas industry, demand detailed studies and utilization of tools that support the decision making process.
Through history different theories and tools have been developed that partially answer the need to optimize and strengthen the decision making process. The decision trees technique, for instance, was used initially in the probabilities theory but it has a great impact in decision theory. Most decision trees have associated, by its nature, probability values that generally are assigned by expert's judgment or the researcher's subjective values, declaring in such way the decision trees as a deterministic tool with static variables that do not allow covering the uncertainty spectrum much less to represent the reality dynamics. The methodology proposed in this paper was developed taking into consideration three main phases:
1. Data exploration and analysis
2. Predictive stochastic model construction
3. Results visualization

Data Exploration and Analysis
a. Problem formulation (Logical Framework Method). The aim is to understand the central problem that the stochastic decision tree model wants to solve (objective function). By understanding the central problem, its causes and effects, the problem is delimited. It is necessary to elaborate the problem tree to focus the efforts on eliminating and/or mitigating the causes and reduce the impact of the consequences. It is important to formulate the problem through an investigation question that allows confirmation of the hypothesis. The following kind of questions can be considered:
• What is the value in terms of NPV, IRR, EFI or earned value of petro technical information in oil assets?
• What is the contribution of petro technical information in the asset´s development?
• Is it viable to acquire and/or reprocess seismic data in the assets?
b. Search, analysis and preparation of data for the model
At this stage, all information allowing identification and understanding of uncertainty, decision and performance variables must be looked for. This information must be analyzed with the involved persons to define the scope, logics, limitations, correlations etc. of the decision tree and the data model feeding such a tree.

Stochastic Predictive Model
a. Variables identification and objective function
In this stage, the researcher aims to define the uncertainty, decision and performance variables as well as the objective functions of the model with the purpose of characterize them and subsequently associate them to the nodes of the decision tree; in this way a collection of typified variables are generated to build the stochastic model that provide a solution to the objective function.
b. Model conceptualization (decision tree + data model).
By a brainstorm and understanding the identified variables, a first draft of the decision tree is structured with the purpose of generating the input for structuring the data model allowing solving the objective function.
c. Data model and decision tree building
i. Model's logic definition. Upon the brainstorming exercise, organize logically the model with the defined software, perform logic tests and when required, depending on the degree of difficulty and number of variables, perform a sensitivity analysis (tornado and dispersion diagrams) on the uncertainty variables, with the purpose of identifying those variables with the greatest impact on the model's objective function.
ii. Identification of probability functions for each uncertainty variable. Define the probability function that better correlates with the variable data, which can be defined by means of historical data and experts' judgment.
iii. Data model construction and shaping of the decision tree. It consists of constructing a model that contains the formulation of different equations, parameters, functions and probability distributions and Bayesian inferences, etc. Once the data model is constructed a simulation is carried out choosing the sampling type to work (i.e.: latin hypercube and Montecarlo) on the earned value; from this simulation the resulting parameters of the data model are obtained with which the stochastic decision tree is shaped.
iv. Model calibration. It is the revision of the variables characterization, the model´s logic and the answers obtained.
d. Stochastic decision tree simulation and model optimization. It focuses on analyzing the scenarios and resulting distributions of the simulation carried on the objective function within the stochastic decision tree for solving the formulated problem. Optimization is the search for an optimal decisions scenario for solving the objective function

Results Visualization
It refers to the graphical organization of results, where by obtaining the simulation data base, an executive visualization of key

information is achieved by means of specialized software to analyze the decision making (i.e: Decision grafo).

Example

Following a practical exercise illustrating the methodology proposed in this paper.

1- Data exploration and analysis

- Difficulty sustaining initiatives acquisition of seismic data
- Ignorance regarding the reduction of risk and uncertainty in the elements of trap and reservoir by drilling wells and 3D seismic programs 2D
- The seismic data is not ensured
- Failure to take advantage of the total seismic information

Lack of quantification (ignorance) the value of the seismic data

- High level of difficulty in assessing the contribution of the technical information in the development of active
- Mechanisms have not developed for the quantification of information
- Loss and leakage of information

Fig.1 - Problem formulation. The figure shows the problem approach to be developed as example

2. Stochastic predictive model

Uncertainty Variables	Risk	Decision Variables	Out put or performance variables
Drilling cost	Confirm trap	Seismic acquisition	Earned value by acquiring seismic
OOIP per structure	Success for drilling	Drill	Earned value by oil
Recovery Factor			Oil distribution
Oil price			
Lifting cost			
Seismic cost			

Table 1 Model variables. The table resumes identified variables for the decision tree and data model (Risking matrix).

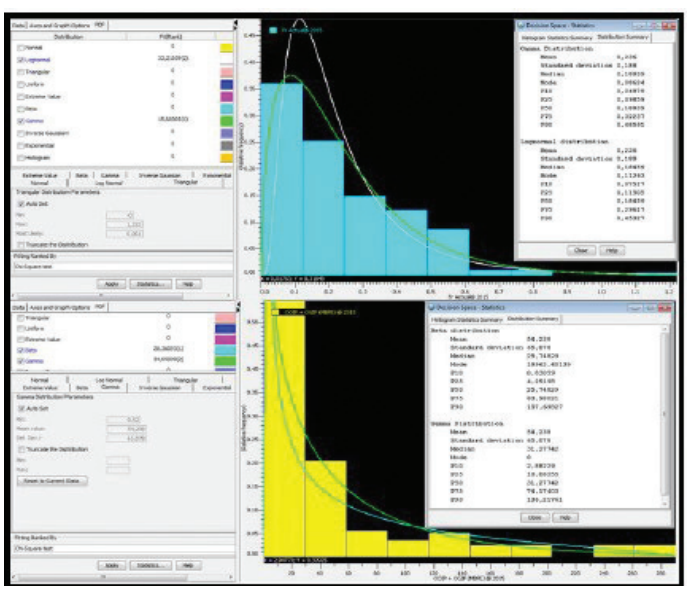


Fig.2 - Probability functions identification

Once the data model is worked out an the parameters and basic input for the simulation runs are generated, the stochastic decision tree in configured; in this stage the probability functions for uncertainty variables are included, seeking coherence in logics and exercise results. The configured decision tree is shown in Fig.3

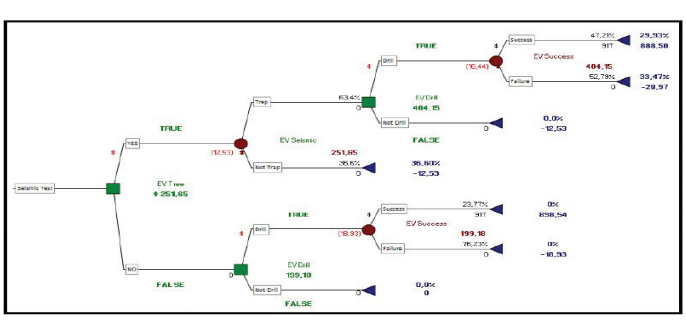


Fig.3 - Decision tree configured

3. Results visualization

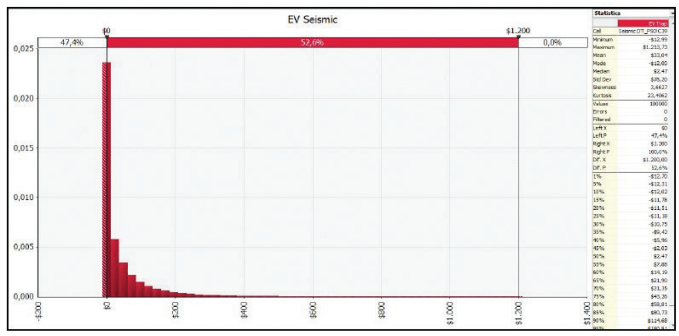


Fig.4 - Earned value (EV) distribution of seismic acquisition (Y)

Fig.4 shows that %47,4 of the occurrences take place within an earned value of acquiring seismic (Y) negative range of 14- to 0 MUS$. It is concluded that VOI is equal to 0. For %52,6 of the iterations the positive earned value of acquiring seismic (Y) is in a range between 0 and 1200 MUS$, therefore Y=VOI which means that the probability of having VOI>0 is %52,6. According to this, the probability of destroying value with the seismic acquisition and drilling of an exploratory well is %47,4.

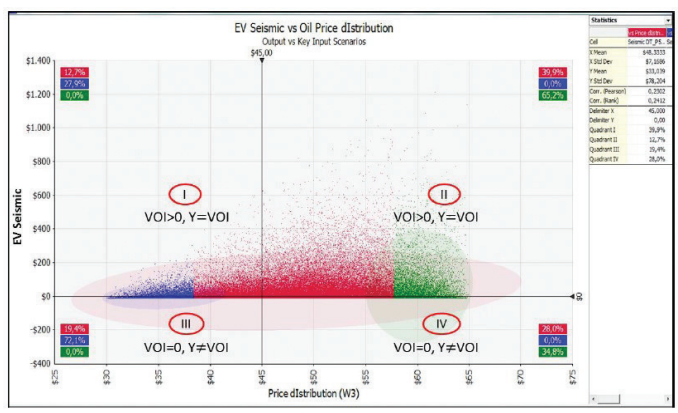


Fig.5 - Dispersion plot. Blue dots are Y scenarios between P1 and P10. Red dots represent all iterations and green dots Y values in the P80 - P90 range. Quadrants I and II show VOI >0 scenarios.

Conclusions

1. The methodology allows building stochastic predictive tools that support the process of decision making, by solving an objective function through the use of different mathematical, statistical and computational techniques.
2. With the example a solution was obtained for the objective function (Y) to be solved, which was determined by the earned value of acquiring seismic information.
3. Along the investigation and development of the proposed method a high degree of impact and application in other fields as medicine, precise agriculture, financial, etc, was identified.
4. This work permits generating inputs and new windows of investigation about decision trees in the scientific context for development in the machine learning and artificial intelligence areas, where a large part of the logics in these models of automatic learning are based on decision tree algorithms.
5. The method does not differ nor disagree from the BI, BA, Big data tools among others; it was inspired as a complement for the other tools looking for logic, mathematical, statistical and computational coherence in the analysis and decision making process in an organization.
6. The main contribution to knowledge offered by the method is provided in two large complementary areas: data science and decision theory. What the authors search for is to create scientific culture in the decision making process based on data science with different levels of complexity for any organization.

Egypt Focus

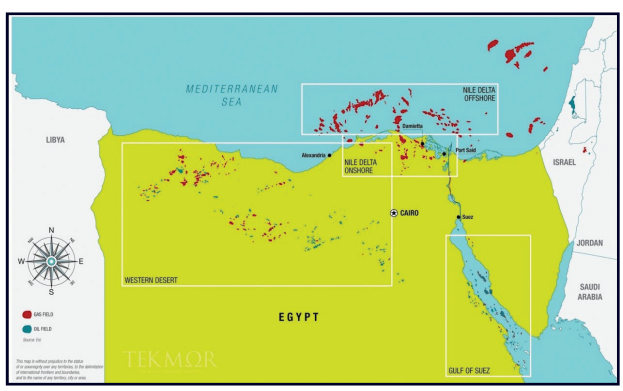
Eni to Extract 200mcf/d from Zohr Field by October

Italian Eni will start producing 200mcf/d of gas from Egypt's Zohr deep water field in the Mediterranean by October 2017, through a temporary ground gas processing station, reported Daily News Egypt. A source at the Egyptian Natural Gas Holding Company (EGAS) stated that Eni will rent a temporary station until it completes the establishment of the permanent treatment plant. Eni plans to complete the first phase of the treatment plant with a capacity of 650mcf/d of gas by the end of 2017. The source further pointed out that Eni completed the drilling of six wells ahead of scheduled time and will be linked to the treatment facility by the end of 2017. The treatment plant's investments were estimated at at $4b. The plant will have a total capacity of 2.7bcf/d of gas.
The total investments in the Zohr field amounted to $12b and are expected to reach $16b throughout the life of the field. The estimated cost of drilling one well in Zohr field is around $100m.

Egypt and Iraq Sign Oil Exports Agreement

The Iraqi ambassador to Cairo Habib Mohamed Hady Al-Sadr said that the Iraqi Oil Marketing Company (SOMO) has signed a contract for oil exports with the Egyptian government, El Ahram informed. Al Sadr added that SOMO forwarded the contract to the Egyptian Petroleum Ministry and Mineral Resources for final approval. The first batch of oil, estimated at 1mb, will be exported to Egypt by the end of March 2018. Meanwhile, Egypt, Iraq and Jordan are preparing for a major strategic joint energy project, he added. The three countries will extend oil and natural gas pipelines from Basra oil field.

Egypt to increase gas production up to 50% by mid-2018



Egypt's Petroleum Minister Tarek El-Molla said that Egypt is aiming to increase its natural gas production up to 50 percent by mid-2018, as well as completing the infrastructure development projects of Misr Fertilizers Production Company (MOPCO) and The Egyptian Company for Ethylene Production (ETHYDCO) petrochemicals factories. El-Molla's statement came during his participation in the Egyptian-British business council meetings held in London.

BP builds position in one of Egypt's biggest gas fields

Subject to approval from the Egyptian government, BP said it spent $375 million to take a 10 percent concession in the Shorouk complex from Italian energy company Eni. The Zohr gas field, the largest discovery made in the Mediterranean Sea, is within the area in question. "This interest in a truly world-scale asset will complement our existing Egyptian business," BP CEO Bob Dudley said in a statement. Eni was granted a development lease for the Zohr offshore field in early 2016. Development is potentially slated to start by the end of next year and production could reach about 500,000 barrels of oil equivalent per day by 2019.
more words here .....

Aramco Confirms $7bn Deal with PETRONAS

The Malaysian Prime Minister, Najib Razak, announced that Saudi Arabia's state oil company Saudi Aramco will invest $7b into an oil refinery and petrochemical project in Malaysia's southern state of Johor, Free Malaysia Today reported. As informed by Channel News Asia, Aramco will take a 50% stake in select ventures and assets in the Refinery and Petrochemical Integrated Development (RAPID) project developed by Malaysian state-controlled Petroliam Nasional Berhad (PETRONAS). Furthermore, Aramco will supply up to 70% of the crude feedstock requirement of the refinery, with natural gas, power and other utilities to be supplied by PETRONAS. Aramco's CEO, Amin Nasser, stated that "Malaysia offers tremendous growth opportunities and today's agreement further strengthens Saudi Aramco's position as the leading supplier of petroleum feedstock to Malaysia and Southeast Asia."

Rosneft Drills its First Well in Iraq

Rosneft group started drilling of the first exploration well at Block (12) in the Republic of Iraq, Your Oil and Gas News reported. According to Energy-pedia, the Salman-1 well will be drilled to a measured depth of 4,245 meters through the Kurra Chine target horizon to be followed by further testing of five prospective targets. The company plans to complete drilling in July 2017. The prospective oil-bearing Block 12 is located in the Najaf and Muthanna provinces, approximately 80km to the southwest of the city of Samawa and 130km to the west of the city of Nasriya. The Block is a part of the Western Desert, an unexplored region having the biggest oil potential in Iraq. It has an area of 7,680km². Exploration works on Block 12 are considered 'low risk' due to its prospects. Iraq has huge proved and undeveloped oil resources, so exploration in the country is an important step in implementing the Rosneft strategy to expand competences in the area of hydrocarbon exploration and production outside of Russia. Rosneft acts as the operator and ZPEC as the drilling contractor.

China's CNPC Buys Stake in $22 Billion Abu Dhabi Oil Venture

China National Petroleum Corp. bought a stake in Abu Dhabi's largest oil concession as the Middle Eastern emirate with 6 percent of global crude reserves looks increasingly to Asia, its biggest market, for investment to raise output capacity. Abu Dhabi National Oil Co. awarded CNPC an 8 percent stake in the onshore venture in return for a $1.8 billion signing bonus, Adnoc said in a statement. State-run CNPC is the venture's third Asian partner, joining Japanese and South Korean companies alongside BP Plc and Total SA.

Shell Approves New Gulf of Mexico Project, First since 2015

Royal Dutch Shell has given the go-ahead to develop its Kaikias deepwater field in the Gulf of Mexico, the first such project the oil and gas company has approved in 18 months. Shell said the Kaikias oil and gas project, located some 210 kilometers (130 miles) from the Louisiana coast, will start production in 2019 and generate profits with oil prices lower than $40 a barrel after the company slashed its costs by around 50 percent due to simplified design plans. The project is estimated to contain more than 100 million barrels of oil equivalent recoverable resources.

SPE Research School Project

One of the lifelong dreams that SPE Suez had always tried to achieve is making research and practical work available to every student who has the passion to enter that promising field. This year SPE Suez managed to create SPE Research School through introducing sessions instructed by young and experienced researchers as Mr. Mostafa Elmahdy who came third in the 2016 regional paper contest and under supervision of Prof. Dr. Ahmed Gawesh, Head of PE department and Dr. Adel Salem. Then we took a further step; a research project was organized under supervision of research pioneers from AUC and FUE (Future Univer-sity in Egypt) sponsored by one of the most reputable companies in our field: Kuwait Energy. The project aimed at qualifying more students to 2018 SPE regional paper contest through providing more sessions and scientific labs for supporting the researches with practical experiments and results which clearly increase the chance of winning the competition.

Unconventional Reservoirs Conference

SPE Suez decided that this season should be a special one. Wide scoped mega events were the most efficient way to achieve that goal. In collaboration with SPWLA BUE, a student chapter concerned about recent technologies in well logging and its analysis, SPE Suez managed to organize one of the biggest events ever in Egypt, concerning unconventional reservoirs and the new techniques used in exploring and producing shale oil and gas and other unconventional resources. Sponsored by Shell and Halliburton, the conference made a huge success with a total number of attendees exceeding 300 students from different universities. The conference aimed at telling the students the whole story of an unconventional reservoir, starting by its definition and evaluation, getting through its special methods of drilling, and finalizing by its production and well completion processes. Moreover, competitions were organized with valuable rewards as summer trainings at reputable drilling companies in Egypt.

Energy4Me … For All

Believing in SPE international's vision in widening the knowledge of pre-university students about oil and gas and renewable energy resources, Our E4ME team organized more than a school visit. They visited Badr International School in Suez, and Saint Fatima Language School in Cairo under the supervision of SPE Egypt. Interesting presentations were given to primary-grade students in both schools. Interacting was increased through competitions with exciting rewards, workshops, and practical experiments. The students were very happy as it was their first time to know about petroleum in such interesting manner. Both schools invited us to repeat our project again as they were impressed by our team's skills.

SPE Mega Drilling Course

As our field of industry is much related to drilling, SPE Suez had organized a drilling course that lasted for 3 weeks. Instructors form various drilling companies as Aramco, British Petroleum, Qatar Petroleum and Kuwait Oil have been invited to give valuable sessions about different drilling topics. The topics were chosen to be technically strong and interesting as well. Drilling problems and operations, cement programs and drill string design are some of the topics covered in course. The feedback from students was satisfying after all.

Halliburton Coiled Tubing Forum

One of the sustainable goals that SPE Suez tries to focus on, is reducing the gap between the academic studying and the practical work. Halliburton coiled tubing forum was organized to introduce our students to the latest technologies that a pioneering company as Halliburton has invented in a very interesting field as "coiled tubing and its applications". SPE Suez chose coiled tubing as it has various applications. It's used to carry well logging tools or perforating guns. It has further uses in several production processes. The number of attendees exceeded 100 students, proving that a high level of satisfaction was achieved. So SPE Suez decided to organize more sessions and forums in order to satisfy the students' technical need about such an interesting and important topic as well.

GE Yard trip

After being merged with Baker Hughes, General Electric wanted to prove itself as a pioneering company that knows well the importance of experience transfer to future engineers. In collaboration with SPE Suez, a yard trip was organized for 10 students to increase their knowledge about various topics as an introduction about well heads and pressure control methods through presentations and sessions. After that, the students were introduced to real BOPs (Blow Out Preventers) and pressure control rooms where those BOPs can be tested through various safety tests before being returned to be operated again on drill sites. Needless to mention the importance of the BOP in maintaining the desired pressure during drilling to prevent any possible disasters

Halliburton Baroid Mud Lab Visit

Clearly, mud tests are very important in our field as it is thought to be the primary control method over blowouts in drilling any well. Considering its importance, SPE Suez has organized a visit to one of the most important mud labs not only in Egypt, but also in the MENA region; which is Halliburton Baroid mud lab. Twenty students had the opportunity to see some of the latest test devices that Halliburton uses to calculate various mud properties as viscosity, gel strength, shale content and more. It's noteworthy that the devices at Baroid mud lab can't be found at any other mud lab in Egypt and it makes mud tests not only for formations in Egypt but in Arab and North African countries as Yemen, Libya, Tunisia, Jordan and more.

ACS Model ... Development Is Inevitable

Coaching models are vey important for giant structures as SPE Suez to maintain the integrity between various committees with large number of members to guarantee that all of them are sailing in the same direction. First step is assessment. Through widely used personality tests as Belbin and MBTI, assessment was achieved throughout the season, to be aware of the members' needs and their points of strength and weakness. After all members are assessed, challenges were set up to differentiate them according to their skills and what they are capable of. Support was then provided through evaluated feedbacks to keep the member on track and to ensure he is directing towards his goal. This system succeeded in providing the best journey a student can ever have while joining a student chapter.

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