

## Can add value, will add value

*Satinder Chopra*

It was with great expectation that I attended the SEG workshop on '*The role of geophysics in unconventional hydrocarbon resources*', which was spread in two parts over Thursday and Friday, the 28<sup>th</sup> and 29<sup>th</sup> Sept, 2017, respectively. I was hoping to hear some of the senior managers from some oil companies at the kick off meeting on Thursday, share their experiences about how geophysics was being used for characterization of shale resources at their companies. But I was quite disappointed to hear a different narrative from the panel members.

*1. Time is a resource, not an excuse. Let's manage our projects so that we plan for the time and activities that are required.*

A comment made by one of the panel members was that 'we want to do good science'. Now that is a positive comment. The same panel member followed up by saying that they do not always have the required data, there are deadlines that have to be met, the land lease has to be kept in mind, there is no time to wait for acquiring the 3D seismic and its processing, etc. etc. So, they do not use much seismic in their shale resource characterization. Perhaps, time is an excuse here. Oil companies definitely need to plan better for the time and activities that they are engaged in. If this is to happen, it will be primarily because geophysicists lay out and communicate their strategies for adding value along with the associated timelines.

As a comment, when a suggestion was made from the audience that a good rock physics model is required to understand the shale formations of interest, the same panel member said 'we do not have the data/information to construct a rock physics model'.

Another panel member said that he was not sure why densely spaced 3D seismic data is not being shot in the Permian.

I understand that all oil companies like to work in a way that they remain profitable, so that some dividend trickles to the shareholders every quarter. I certainly do not have a problem with that.

But I definitely have a problem when someone says that '*geophysics is no help in unconventional shale plays, or that it does not result in value-addition*' At this workshop, I am not sure if it was said exactly in these words, but I came out with this impression after the first half of the workshop on Thursday. Thereafter, I made it a point to emphasize the importance of adequate input data for any reservoir characterization exercise in my talk on Friday morning, as did a couple of other speakers.

*2. In a new business paradigm, value is added by using the science differently.*

How are we going to understand the large variability in well performance in the wells drilled in different shale formations, without the use of seismic? This question should be on the minds of all people associated with shale resource exploitation. There is no doubt that shale resource characterization has led to a new paradigm in the global energy resource development, that has both business and scientific connotations. But it is also true that in the new business paradigm, value-addition can result by using science differently. This is a call for geophysicists to consider

the business as it is now, rather than as it was formerly, and find creative and new ways to add value.

To remain profitable, many oil companies are cutting corners when it comes to acquiring seismic data or well data that could be used for characterizing the formation of the interest.

I hear oil companies all the time, asking for toning down the specifications of 3D surveys, just to reduce the cost. When 20x20m or 25x25m bin size is suggested to them, they want to go with 30x30m, because it costs less, and there will not be an appreciable difference in data quality. But I have seen appreciable difference in data quality when a closely spaced 3D data (7.5 x 7.5m) is shot, the example in reference being a 3D shot by a company in the oil sands in Alberta sometime back, and I got the opportunity to compare it with an earlier conventional 3D seismic with bin size (25x25m). There was a huge difference in the imaging of the features. Coherence run on the data showed the definition of the channels in all their clarity, compared with the traditional data volume. I do not think, in the long sweep of things, acquiring the data with the right specifications is more expensive than drilling a few dusters.

So, what is stopping them from using such a dataset in the Permian, even on a test basis, so that the added value could be assessed? Apparently, it has come down to a business decision all the time.

An oil company executive might react to this by saying that in the present times, where \$50 a barrel is perhaps the new reality, acquiring 'expensive' 3D seismic surveys could be a difficult decision. But we are all aware that oil price was not always \$100, and such surveys were acquired earlier for conventional resource exploration and exploitation. Perhaps the mindset of oil companies got raised with the \$100 a barrel price tag and higher profit levels, and may take some time to adjust to the new reality. Having said that, the point being emphasized is not solely about the cost, but should instead be about the cost-benefit, or value, of seismic. The articulation of a proper value argument for the shooting of seismic data can at first seem daunting, however, if we geophysicists do not make the argument, no one will. Lee Hunt wrote an article about the subject of articulating the cost-benefit of shooting 3D seismic for resource plays. His method and examples can be found in the references (Hunt, L., 2013a) below.

I do know of a company that could afford the cash, but the top boss would urge not to be thrifty about expenditure towards exploration. 3D seismic took a long time for its adoption in the company due to contradictory views from colleagues and seniors. This ignorance and arrogance of 'the powers that be' led to irrevocable losses, with many drilling locations not being optimally placed and resulting in dry or poor yielding production wells.

Such business decisions could be an example of a false economy, wherein we geoscientists have not provided the advice required to make a properly informed decision. In fact, there have been many times when the basic analysis required for the characterization of the shale formations is simply not provided.

I can cite examples:

1. Spectral gamma ray curves, shear log curves are not available, in many cases especially small companies, core data is not available, geochemical data is not available, mineralogical data (XRD) is not available. You determine TOC with Passey's method, but there is no core data/geochemical data for validation.
2. Lab measurements on cores are required for determination of static YM and PR, so that these quantities derived as dynamic parameters can be calibrated for geomechanics analysis. But these measurements are not forthcoming.
3. More often than not, the data we need for accurate calibration of our results is not available, and so the service companies do whatever they can and supply their results to oil companies, needless to mention with large error bars. Now this is not the best scenario in which the geoscientists should be operating. All this brings a bad name to seismic data or geophysics that we practice.
4. We as geophysicists have demonstrated that multicomponent seismic data adds value to our analysis. We have seen that prestack joint impedance inversion provides superior results to prestack simultaneous impedance inversion. How much, depends on the quality of the data. But the oil companies have taken their time in adopting this technology, which is why it has taken 25 years and still multicomponent seismic is a step child. But now it has evolved and should be embraced.
5. We need to determine brittleness from seismic data, for which we use Young's Modulus (stiffness) and Poisson's ratio (strength). Low strength and high stiffness mantra which was demonstrated way back in 2008 for the Barnett shale is no longer valid for many of the other plays. To determine Young's Modulus from seismic data, we need density information. To determine density from seismic data we need long offset data.

*Oil companies are cutting corners all the time.*

I am not suggesting that the oil companies should acquire the 'IDEAL' 3D seismic volume, have the full suite of all possible curves in every single one their wells, and all the possible lab and geochemical measurements. Rather, what I am suggesting is that analogous to the fact that if the basic ingredients in a pudding are not in the right proportion, it does not taste good; the basic data should be there for carrying out the characterization of the shale formations of interest. With that we will be able to lower the uncertainty in our analysis, and also look good in the eyes of our engineer colleagues.

Over the years umpteen case studies have been published to demonstrate the role of geophysics in unconventional shale resource plays. These include the determination of

- Subsurface stress
- Fault/fracture orientation and intensity as well as fracture barriers
- Reservoir sweet spots
- Pore pressure
- Rock and mechanical properties
- Stimulation effectiveness and optimization

Given all these applications, I am very skeptical when someone from an oil company comes up and says that seismic data does not add value to the characterization of the shale formations. As a point of process, I would want to know if all the relevant value adding possibilities have been properly considered.

### **Sought viewpoints**

1. I first approached my very good friend in Calgary, Lee Hunt, who has been working in the Canadian oil industry for a very long time and has had a very successful career, to gauge his viewpoint on what I have said above. His response in first person is appended below. He provides some references below to add context to the remarks.

“Don’t mistake the fact that you *haven’t* added value with geophysics with the possibility that value *could* have been added.”

It is certainly possible that there could be a scenario for a particular play where there is no value to be added from geosciences. I have heard people suggest this, but never seen it to actually be true. I have never found myself in a position where I could not add value, and usually (but not always) with geophysical data. The arguments against value adding I have heard, and you have conveyed from the workshop, sound weak. With proper project management, there should be enough time. The generation of the important properties and attributes are not generally of material expense. Funnily enough, I have heard these arguments before, and they speak to the real failure of geophysics in unconventional resources, and that is a general failure of the geophysicists to communicate what should be done and why, and to manage their projects according to the time available. When I hear some VP Geosciences (or line professionals for that matter) say they cannot add value, I must consider the possibility that the problem may well be with them, not the science. Allow me to restate my position as constructively as possible: changes in the business model have brought about real challenges to the effective use of geophysics in resource plays, but these challenges should not be treated passively. These challenges are better viewed as inspiration for us all to do better. We are the experts in our own field, and we are the only ones capable of solving our own problems. I hope that in the next workshop on value addition, we see more discussion on solutions. A good understanding of the business and the science, coupled with creativity, effective communication, and determination should result in a better outcome.

*Hunt, L., 2013a, Estimating the value of Geophysics: decision analysis: CSEG Recorder, 38, 5, 40-47.*

*Hunt, L., 2013b, The importance of making conclusions and frameworks in reasoning: CSEG Recorder, 38, 7, 56-60.*

*Hunt, L., 2015a, Articulating the time, cost, and benefits of a seismic reprocessing project: CSEG Recorder, 2015, 3, 28-31.*

*Hunt, L. 2016, Value Thinking from the Classical to the Hyper-Modern: Feb 2016 CSEG Technical Luncheon Talk. <https://cseg.ca/technical/view/value-thinking-from-the-classical-to-the-hyper-modern>*

2. Next, I forwarded this write up to my mentor back in India (who retired from a senior executive position in ONGC, the premier national oil company, and now functions as a Petroleum Consultant), to seek his views on it. Hereunder is the response I received from him.

There is absolutely no doubt that a 3D survey shot with a tight bin spacing lends itself to more detailed subsurface information. When the subsurface targets are small and subtle, especially in anisotropic and heterogeneous shale rocks hosting hydrocarbons, such survey are valuable. The reason a tight 3D survey has not been shot in the Permian so far could be one of that the cost-benefit ratio is not favorable, and it also depends on (mis)trust of the operators in seismic capabilities.

You are right, the oil companies are cutting corners all the time, as there must be a trade-off; additional data is welcome, but what is the additional information and at what cost? Incremental value addition may be ignored by the exploration manager, but then who is the right person to evaluate the cost-benefit analysis?

Lee Hunt's views could not have been better expressed. Throughout my professional career, I have been saying that if geophysics failed in providing a solution, it is because of the geophysicist and not because of the science. If we cannot do better, we as geophysical practitioners may more quickly be replaced than the science itself. Most of the time the problem with interpreters is that they offer quick-look high sounding opinions with jazzy PP presentations without getting into the roots of the problems. And that is why I try to differentiate between interpretation and evaluation, the latter really attempting to add value. The onus is on the interpreters as to how best they take up the challenge to create, and add value to the project. I would urge interpreters to be more investigative and exercise greater patience, to "stay longer on the problem for a solution", a quote from Einstein.

*(Disclaimer: The views expressed in the article above are my own and do not represent the company that I work for.)*