

Redefining Value in Exploration: Harmonising Technology, People, and Process

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In this world of fast-paced technological change, we often forget that the most important asset in any company is its people. It is also true that the challenges facing today's workforce are greater than at any other time in history, due to the pressures of coping with these ongoing changes, and also the constant turmoil of changing management philosophies. In our profession, we also have to consider the negative effect of fluctuating oil prices, and the challenges that entails for both our current and future geoscientists. In my talk today, I want to step away from any economic considerations and take a look at the scientific future of our profession, and how we can redefine value in exploration through the harmonization of people and technology. Although I will be using examples drawn from my own experience in seismic exploration for hydrocarbons, I think that my ideas can be applied to any branch of applied geophysics, since these remarks concern the use and abuse of computer software in our industry. Many of these ideas are taken from my last President's page in the *Leading Edge*, in November 1999.

One of the most positive developments in our profession has been the use of interactive workstations to help us visualise the sub-surface geology that has been inferred from geophysical measurements. Although the heaviest use of these techniques has been in petroleum exploration, they are also finding increasing use in other areas of our profession such as potential field methods, electromagnetic methods, and near surface geohazard detection. In their most basic form, these techniques involve looking at brightly coloured vertical or horizontal cross-sections through the earth. At a more advanced level, we have seen the development of "interactive caves", where the geoscientists can actually walk inside the data, looking for anomalies. This is indeed powerful stuff. However, there is one big danger in all of this. We might actually start believing what we are seeing. Imagine, you are an exploration manager being walked through a reservoir

by one of your geoscientists, and encounter a highly porous sand at a given depth, and a given surface location vertically above this point. You may actually believe that this porosity really exists and that it is not simply a mathematically constructed image from a physical measurement made on the surface of the earth! (Actually, I'm being a bit hard on my colleagues, we know that this picture could be true.)

To get this point across, let me give you the hypothetical story of one particular voxel. We could call it "Sue" or "Billy", but I will simply refer to it as "The Voxel". Let's hear what "The Voxel" has to say for itself:

"My great grandparents started out in life as blast from an air gun array that was being towed behind this big ship in the Gulf of Mexico. After a long trip through the earth they came back up to the water again and were measured by a group of headphones, which were also being towed behind the same ship. There was a pretty rough sea that day, and they're not sure if the navigational equipment was able to get their locations measured correctly, but it was reasonably close. Anyway, all of my great grandparents and the information about them was put onto a high density tape and the tape was sent back to Houston. That's where the real fun started. They were jostled about, sorted and re-sorted, shifted and gathered and summed until they were transformed into my grandparents. (Some of the more educated members of my family mentioned terms like De-convolution and migration but I certainly won't bore you with those details.) Anyway, the next stage was pretty painful, and involved stacking, which meant that a lot of my relative "smashed" together to produce a lot fewer of them. (Something about improving the signal to noise ratio and reducing the volume). This produced my patents but that wasn't the end of it. To produce me, they applied what they called post-stack wavelet processing, and they even threw in some inversion and multi-attribute trans-

forms (whatever they are). Along the way they shrunk me, added a splash of colour. So. Here I am. I've been told that some geophysicist is going to now explain to his colleagues why I am related to a little cube of earth, ten thousand feet down. Good luck!"

OK. So I made the story up. But I think you get the point. The danger of modern visualisation techniques is that they bury all the hard stuff below the surface and make us work with only the finished product, somehow expecting us to believe that it is absolutely correct. However, I see in the ever-increasing storage capacity and power of our computers the ability to solve this problem. I look at it as an inverted telescope. Why not store every piece of the chain that I have just described in easily accessible form, so that the enlightened geophysicist can analyse it, probe it, and even change it, based on new information? Questions that this enlightened geophysicist may ask could include:

1. Show me the acquisition footprint of this data.
2. Show me the distribution of offsets and azimuths for each subsurface bin.
3. Show me the data before and after deconvolution.
4. Show me the velocity cube that was used for migration.
5. Re-migrate the volume using the following changes I am about to make on that velocity cube.
6. Show me the individual attributes that went into making this multi-attribute volume.

And so on

What I am describing is a geophysicist of the future who works very much like the geo-

physicist of the past. These pioneers of our profession did everything in the field, from acquisition through processing, and were able to take care in every step. Instead of analog methods, the geophysicist of the future will be using software techniques to achieve the same goal. Thus, the geophysicist of the future must be well versed in all aspects of acquisition, processing, and interpretation, have access to a very powerful interactive computer and a very good suite of software tools, as well as having a very creative imagination. (Sounds like a tall order!)

Am I asking too much of our future geophysical software developers and geophysical interpreters? I don't think so. I think that this is the path we have to take unless we want our profession to become just a collection of super specialists who can't communicate with one another. I have great confidence that our members will rise to the challenge and become just the type of geophysicists that I have been describing.

How does the preceding story fit with the theme of my talk? I believe that we run the risk of putting too much emphasis on the technology itself and not enough emphasis on the individuals in our organisation. It is important to have a good mix of both, and make sure that our workforce is fully trained on, and at harmony with, all of the hardware and software that we purchase. Only through this harmonization will we achieve the process that we desire, which is the effective discovery and development of our mineral resources. Furthermore, I think that my comments apply to geoscientists through the world, since the world is shrinking at a faster pace.