BIAS

#16 Engineers

Although I am an experienced geoscientist and assurance expert, I succumb to the biases outlined in the earlier articles in this blog series more often than I'd like to admit. When I started my career, I was told by a well-meaning individual, "You geologists are always overoptimistic and overconfident. We engineers are the realists at the party." Is this true? Are engineers less prone to bias? I thought I would reach out to two of my engineer colleagues, Mark Schneider and Doug Weaver, to get their perspectives.

Mark is a Partner at Rose & Associates with 40 years of diverse industry experience. He is a reservoir engineer who has spent over half of his career trying to improve uncertainty characterization and reduce the impact of biases in evaluations. He has been a member of both exploration and development assurance teams at the corporate level. He lives in Jakarta and coordinates R&A's business in Southeast Asia

Doug is a Partner at Rose & Associates with 43 years of diverse industry experience. He is a petroleum engineer, having spent over half of his career evaluating the resource characterization and economic value of exploration and development opportunities. He has been a member of a corporate level exploration assurance team. Doug lives in Houston, working with R&A clients headquartered in North and South America.

***INTERVIEW***

**Marc:** Mark and Doug, welcome to my Understanding and Overcoming Bias blog. I appreciate you taking the time to give our readers some of your insights on engineers and bias.

1. **Marc:** Let's get straight to the point, are engineers biased?

   **Mark:** *First, thank you for inviting me to give an engineer's perspective to your bias blog. When you look at the large body of literature plus my personal experiences as an instructor and consultant, and add the experiences of my colleagues at Rose & Associates, the evidence overwhelmingly concludes that we are all biased to some degree, including all engineers. That is why the R&A course you helped develop and your bias blog are so important.*

   **Doug:** *Sure, we all are. As with any of us, our biases are just a function of our background and experiences.*

2. **Marc:** Ok, no surprise. So, do you see the biases manifest themselves differently from exploration geoscientists?

   **Mark:** *You might be expecting me to say yes, but I am going to answer no. I believe the biases that manifest themselves the most often and with the greatest impact in subsurface evaluations are the same for geoscientists and engineers. These biases would include*

*anchoring, availability, confirmation, and overconfidence, among others. What is different is that exploration geoscientists are dealing with a lot more uncertainty in assessing resources and chance of success for an exploration prospect than an engineer or development geologist is dealing with for development planning and production operations.*

**Doug:** *I'm sure they do. Engineers have been trained to evaluate projects quantitatively, geologists qualitatively. (Sorry I know I'm generalizing a great deal). Both are prone to bias, maybe with different routes to get there, but bias, nonetheless.*

3. **Marc:** Do you consider that geoscientists are biased to the optimistic?

   **Mark:** *With regards to exploration resource estimation, the literature and experience I mentioned in my response to your first question suggests that geoscientists are optimistic. But remember, companies applying best practices will have an engineer on their exploration teams, so he must share some of that biased optimism too. And not all need be lost, with performance tracking and applying mitigation strategies, the bias can be minimized.*

   **Doug:** *No. If you discuss the quantification of a variable with a development geologist and an exploration geologist, you may get quite different answers and approaches. So, I wouldn't characterize this as engineer vs. geologist; rather explorationist vs. non-explorationist. Recognize that historically, many explorationists have been trained to push big numbers into their prospect evaluations. This creates a motivational bias – "If everyone's doing this, I better do it as well or my wells will never get drilled". This is one of the many reasons' assurance is critical to evaluation consistency.*

4. **Marc:** If so, does this influence the bias to the conservative for engineers?

   **Mark:** *From the wording of your question, it sounds like you are asking if engineers are intentionally biased to the conservative to offset their perceived optimistic bias in geoscientists. This might be true for some engineers, but I do not think it is true overall. In fact, I think the evidence shows that engineers are biased to the optimistic too. Referring to the literature studies and my own experience again, most large development projects are shown to have significantly overspent budget, come on stream much later than planned, and with initial production estimates larger than actually achieved. Looks like engineers are not exempt from being optimistic too.*

   *I'd like to address the myth of all optimistic geoscientists and all conservative engineers further. I believe this perception began when geoscientists saw their resources estimates slashed when the engineers made initial reserves bookings. It might help with an example. Suppose an exploration team, after initial appraisal of a significant discovery, hands it over to the development engineers with Mean EUR of 302 MMBO. The engineers book Proved reserves of 100 MMBO and the geoscientists scream out loud that their discovery got smaller. But what has actually happened? The exploration team's post-appraisal EUR evaluation was P90 = 100 MMBO and P10 = 600 MMBO. The engineers accepted the post-appraisal EUR evaluation with no changes. However, they followed SPE PRMS guidelines and the reporting regulations of the country. So, the initial reserves booking was based on P90 = 100 MMBO for Proved reserves, P50 = 245 MMBO for Proved + Probable reserves, and the P10 = 600 MMBO for Proved + Probable + Possible reserves. The implied Mean EUR is 308 MMBO, which is a little more than the exploration team's estimate. Maybe your geoscience audience will take it a little easier on their engineers next time they book reserves for a new discovery. If there is no bias in the post-appraisal estimate, then the initial Proved reserves booked will increase about 90% of the time.*

**Doug:** *You're suggesting engineers are trying to compensate for geologic optimism. If we assume geologists control inputs such as pay and area, and engineers control inputs traditionally in the engineer's domain, it's not much of an issue, pay and area drive the vast majority of prospect uncertainty and value. Years ago, I was responsible for the physical generation of resource estimates for a major oil and gas company working in the Deepwater GOM. Knowing that explorationists try to push the high side in estimates, when I recognized this was happening, I would suggest an even bigger number. This snapped reality back into play.*

5. **Marc:** Who do you think better understands and embraces uncertainty - geoscientists, engineers or a combination working as a team?

   **Mark:** *I strongly believe an integrated multi-discipline team will perform better than discipline segregated teams; so, I select your option #3, a combination of geoscientists and engineers working as a team as the one who better understands and embraces uncertainty. Now if you were asking to compare the disciplines, I would say exploration geoscientists embrace uncertainty better because they are evaluating prospects with much of the direct evidence missing and must rely more on analogs and geologic models. This requires them to do probabilistic evaluations all the time with more uncertainty than even the engineers who embrace uncertainty, but already have constraining data reducing the remaining uncertainty that must be understood and characterized.*

   **Doug:** *Neither unless they've been trained in how to address the issue.*

6. Do you see any bias with deterministic models, an often-used approach by engineers?

   **Mark:** *Yes, deterministic models can have a lot of bias because it is basically not possible to choose the correct input value for all parameters to match the scenario being evaluated. A deterministic estimate is still prone to all the biases that are endemic in our industry. And without a probabilistic distribution, it is harder to do performance tracking and get better calibrated for future evaluations. So, I personally like to apply probabilistic evaluations to even mature producing fields.*

   **Doug:** *Deterministic models should be avoided when decisions are being made. We're using one value to represent a range of outcomes which isn't correct. They do have value in creating "comfort levels" in project evaluations. If I multiply a specific area by a specific net pay by a specific yield, I generate a specific resource. In other words, they can reduce the "black box" concerns many folks have when dealing with probabilistic models.*

7. **Marc:** What do you see as the biggest obstacle for engineers to overcome cognitive biases?

   **Mark:** *The biggest obstacles are not necessarily hard to implement. I think it starts with awareness that bias exists in your evaluations, then have a mitigation strategy for all the most common biases in our industry and any other biases you see in yourself, finally compare actual results to predictions for all your estimates to become better calibrated for the future.*

   **Doug:** *Again, same as everyone else, we need to recognize that biases exist, we all have them, and that acknowledging this doesn't mitigate them. We need to take active steps such as using data driven analysis and creating alternate solutions to drive bias out of our evaluations.*

8. **Marc:** Any final thoughts you would like to share?

> **Mark:** *Though perfection is unattainable, it is not necessary for good decision-making. A realistic goal is to use mitigation tools to minimize bias in individual evaluations and to achieve an overall unbiased position for the portfolio of your evaluations. Achieving this will help your company to deliver on its promises.*
>
> **Doug:** *Yes, addressing the downside is the biggest issue we face when evaluating uncertainty. While we're happy to describe how big something can be, we're reluctant to account for how small something can be. This can be true even when obvious answers glare at us from data. There seems to be an overconfidence bias that blocks our ability to correctly address the downside; or perhaps, the thought that chance will take care of the issue. Either way, this is the culprit that leads to the poor performance most companies have regarding prediction.*

**Marc:** Mark, Doug. Thank you for participating in this interview and sharing your thoughts.

***UNTIL NEXT TIME***

The next article in this series will address alternate scenarios, one of the major mitigating strategies for our biases that we so often struggle to implement.

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Stay safe and healthy.

*Marc Bond*
*Rose & Associates*

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