“Bridging The Gap, an Engineer’s Historical Perspective”

Jim Gouveia P. Eng.
Rose Subsurface Assessment

Summary

Results, Observations, Conclusions

Since joining the oilpatch in the 1980’s I have been aware of the need to bridge the gap between engineers and geoscientists. A quick scan of the words “Bridging the Gap” in OnePetro finds over 200 papers with these words in their title or abstract. These papers identified gaps between engineering disciplines as well as geoscience disciplines but not surprisingly the gaps appear the widest between the engineering and geoscience disciplines.

The issue has not changed over the past 40 years nor has our ability to eliminate it. Today I provide a bit of my personal historical perspective and finish with recommendations for better bridging the current generation of geoscientists and engineers.

So why do these gaps exist? Simply put Engineers and Geoscientists see the world and approach problems with a different focus. This leads to distinct workflows and vernaculars which challenge effective cross discipline communication. The lack of common tools and methodologies often leads to data incompatibility or integration issues.

The awareness of the importance of collaboration between geoscientists and engineers led to the widespread introduction of multidisciplinary asset teams in the later 1990’s. The focus on the “Asset” led to increased integration and (hopefully) more profitability. This sets the stage for accelerating today’s dominance of unconventional resource plays in North America.

The asset team approach has been a major step forward, but gaps remain. The drive towards “assembly line” approaches in unconventional projects, combined with bottom-line focused leaders has exasperated the situation. G&G staff say they are viewed as glorified techs often asked to move out of the way. Commercially focused leaders are known to not appreciate how geoscience staff or technology can add value. In fact, some have asked why G&G staff are required in the development realm where we have AI that can make maps for us.

Rose Subsurface Assessment has been educating professionals on the perils of AI generated maps for decades. As an exercise we offer a series of identical base maps with data points and request contouring based on different depositional environments. Figures 1 to 4 present a few examples of how Geoscientists map the data based on a depositional model.

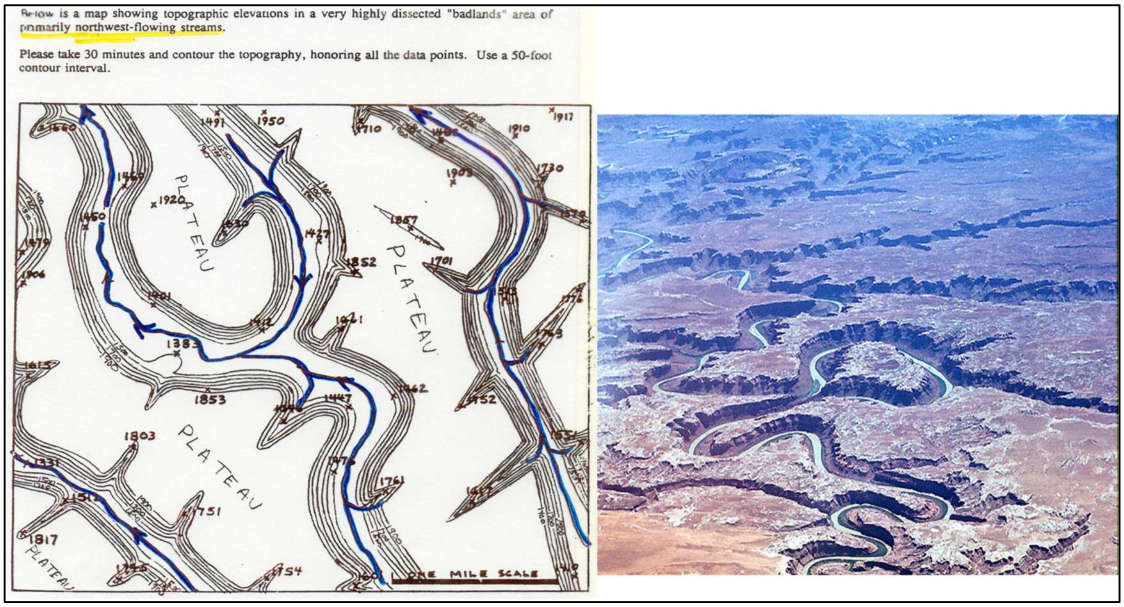

Figure 1 - Badlands NW Flowing Streams

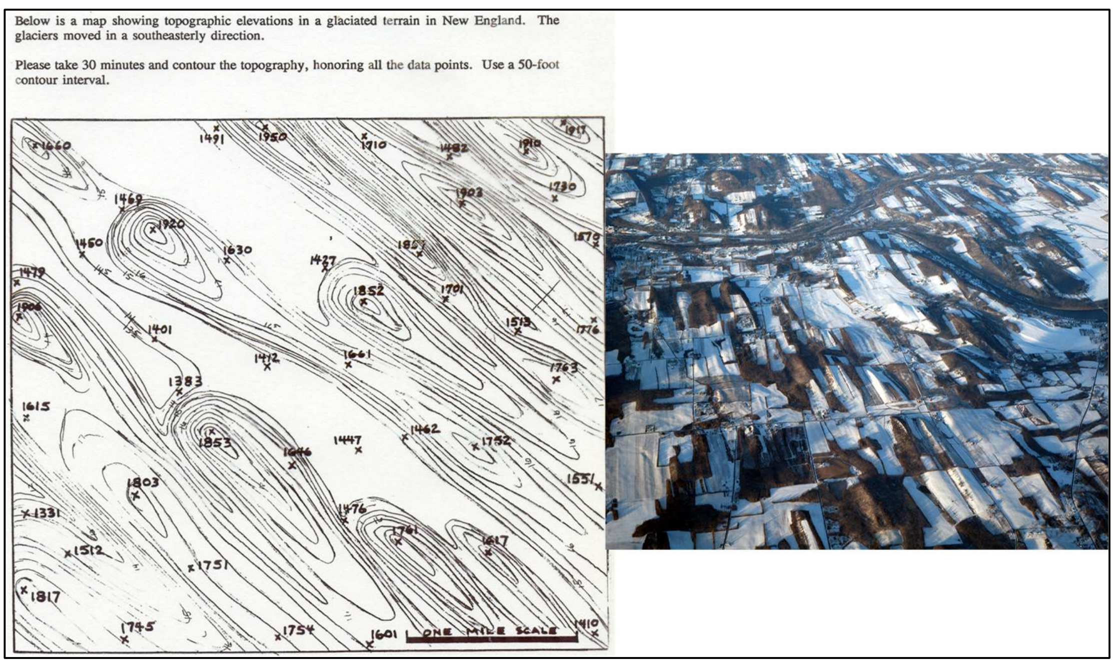

Figure 2 - Glacial Terrain

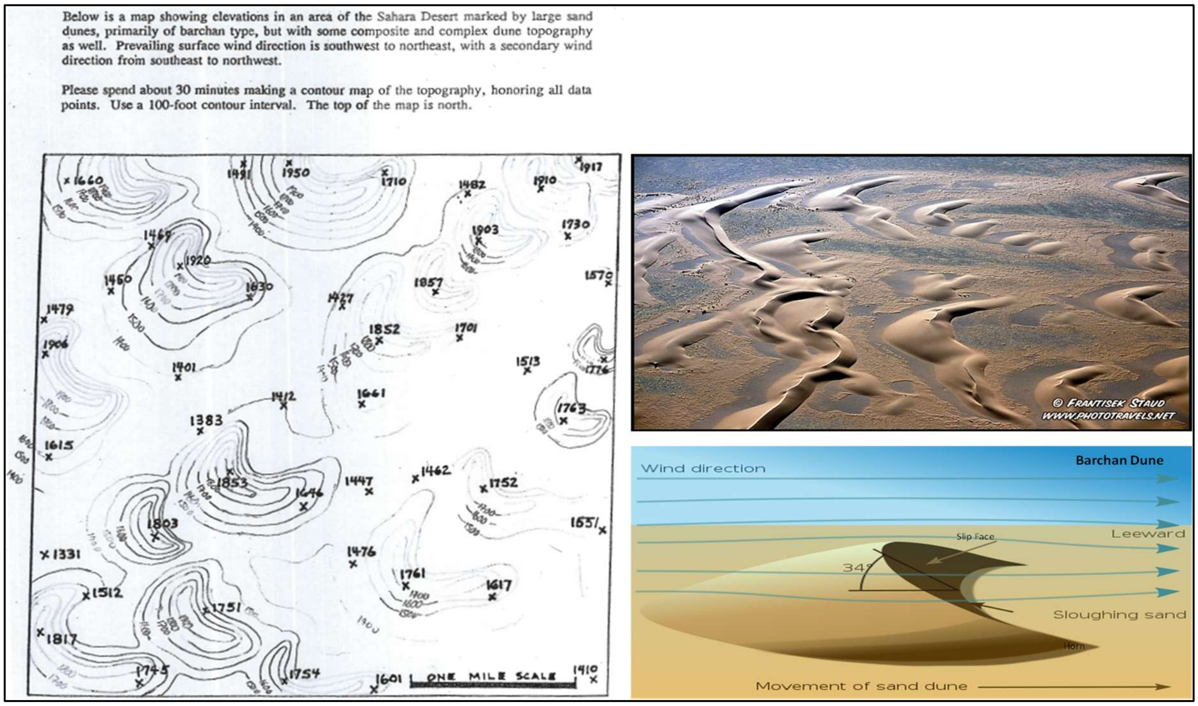

Figure 3 - Sahara Desert Barchan Dunes

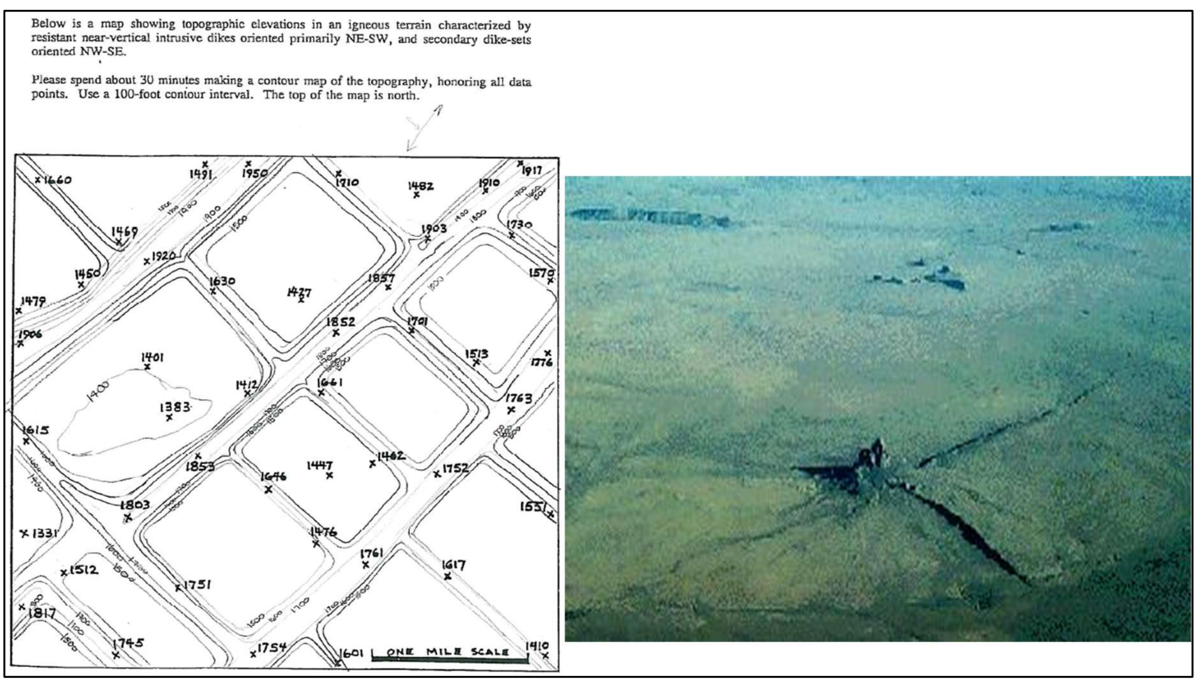

Figure 4 - Igneous Terrain

Figure 5 presents an AI generated map utilizing the same base map data. Not surprisingly the AI generated map appears the least informative.

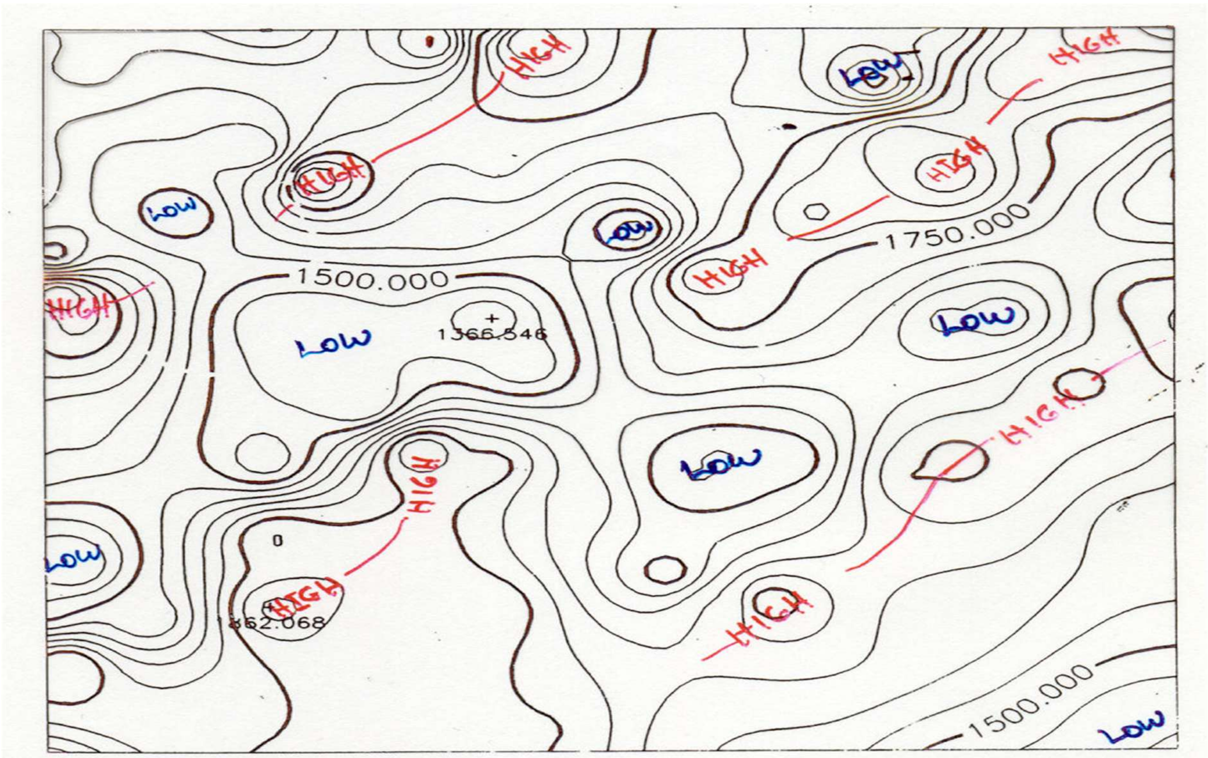

Figure 5 - AI Generated Topographic Map 50 ft Contours

The focus on "Asset teams" was not emulated in many companies' exploration efforts and as such we continued to experience "handoff" challenges likely exacerbated by interdisciplinary communication issues globally. In these firms the G&G and Engineering staff are in different teams, with different management structures, which leads to the development of different cultures. This structural division results in what we call silos. Our experiences in the late 1990's and early 2000's demonstrated that utilizing common metrics between these different management teams, combined with rigorous post appraisals, showed the need to change silo structures to ones that facilitate more integration. My observation is that often middle management does not support rigorous performance tracking, which in many cases illuminate poor decision making. Savy business-focused leaders have realized that the inherent risk in Exploration puts achievement of their metrics in jeopardy and thus have successfully pushed for metrics focused solely on what their Asset delivers. (Implicitly this implies centralization of exploration across assets, which has helped portfolio management efforts).

Amoco's drilling department in the early 1990's attempted to avoid a $50,000 cost to directional drill to a specific "shot point" (on a seismic line). The drilling department argued that if the prospect was big enough moving off the shot point by 100 m would not impact the result. To secure management's initial decision, they successfully argued that Amoco should not be in the business of drilling things so small that 100 m made a difference! It was an uphill battle but armed with a thorough statistical analysis, tied back to first principles, we showed that the optimal economic decision was to drill to the shot point. In most cases we seismically target the thickest reservoir and Darcy's flow equation supported the data that concluded that thicker pay gave us higher rates and quicker recovery of the EUR, which increased the expected value.

We thought this to be an industry norm, but to our horror, we had a European client that recently elected to drill a DHI in a play where productive reservoir areal extents average about 100 hectares. Drilling vertically from a surface location optimized for ease of access (rather than a direction well required to exploit the geological challenge) was authorized to save $50,000. This staggering lack of integration resulted in a wet well that penetrated the target reservoir about 50 meters outside the DHI anomaly.

So, who bears the responsibility for this dry hole? This is where Post Appraisals should come into play, but of late I have seen a real reluctance to conduct these fact-finding reviews. My 40 plus years of experience advises that these reviews clearly point out where bad decisions have been made. Is it a wonder that many middle managers do not support in-depth Post Appraisals? Fortunately, there are several publications that now address the design and execution of post appraisals to aid portfolio management.

In another example of silo-based execution, in SPE-176904 an Australian E&P operator assessed the value of geo-steering their horizontal Coal Seam Gas (CSG) wells and concluded that they should not. The Drilling department used, in a classic case of misuse, a Value of Information approach to justify their recommendation as the optimal decision. Unfortunately, as before, the focus was on optimizing drilling costs. In replicating their decision trees, but accounting for enhanced well performance when the lateral length was geo-steered into the coal seam, the lateral length drilled within a coal seam more than doubled. It is a sober truth that in today's world silos exist whose focus is optimizing a metric that they are solely accountable for rather than optimization of value to the firm. Bridging the gap between geoscientists and engineers is essential for more effective collaboration and optimal field development. Whilst acknowledging that these groups will often approach their work with different perspectives, end goals, and assessment methods, their collaboration is essential to creating an integrated solution.

Performance tracking, which itself integrates post appraisals with past and future assessments, of recent decades made a clear business case for a collaborative process. So how do we embed such in E&P firms today? It starts with developing a compelling business case for the change. This will require archiving and analyzing results relative to forecast of key metrics across the value chain that drive economic value. Key metrics, such as: components of cycle time (time from well approval to first sustained production), components of capital costs, success rate calibration and failure mode analysis by play type, volumetric EUR components, productivity (e.g. bopd/psi drawdown), on-line time, operating expenses, and net price realizations.

As illustrated in Figure 6, Trumpet plots deliver real-time performance tracking. An 80% confidence interval is representative of the range in outcomes between the P10 high side and the P90 low side outcomes. In a calibrated probabilistic forecast, we expect to land within this range 80% of the time. The 80% confidence intervals are represented in Figure 6 by the red and blue curves and the aggregate P50 with the green curve. The purple bars represent the actual well outcomes and the yellow diamonds and fitted purple line, the accumulating average outcome. We desire a program that is delivering within our 80% confidence interval, which we refer to as performing 'under statistical control'. During a program's execution, if the deliverables fall outside of our 80% confidence range we are "out of statistical control". In a value-driven company a mandatory review of the program's progress, with the authorizing leader(s), is conducted.

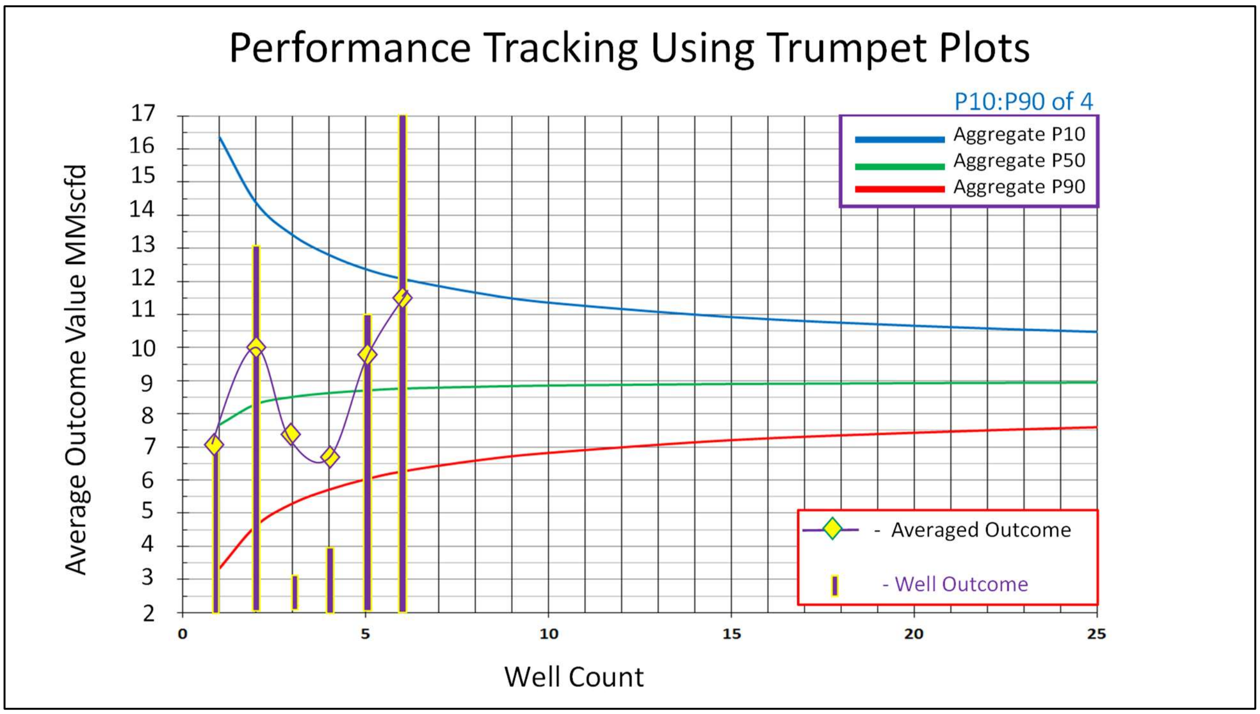

Figure 6 - Trumpet Plot of Average per Well Rate vs. Well Count

Let me conclude with a few recommendations to facilitate better integration:

1. Recognize that although we speak a similar language our jargon is different in different disciplines. Geoscientists talk about stratigraphic architecture and reservoir engineers talk about permeability architecture. Take the time in your asset teams to standardize jargon within a discipline and exchange those standards across disciplines. Geoscientists might not fully appreciate the engineering and economic constraints that affect the reservoir's development. Likewise, Engineers do not always understand the geological complexities that could influence their well's performance.

2. Utilize tools that integrate both G&G and Engineering data. In South America the growing use of a collaborative tool called "Sahara" is addressing this issue. Well logs, zone tests, completion history, production history, tops, geophysical maps, the ability to generate assorted isopach's, real time cross-sections, bubble maps, WOR vs time maps, and simple reservoir material balance studies support a one stop tool where different disciplines share their data and analysis in an integrated manner.

3. There is no "right" organizational structure. Hopefully management has addressed which structures best serve their goals and processes, but regardless the asset team must share and be accountable for the delivery of common goals and performance metrics. The goal is maximizing value to the shareholders, while assuring environmental stewardship and the safety of the public. The metrics we track and reward our leadership on must cross "organizational silos" to assure that all functions involved in the program are aligned to best deliver a successful program.

4. Create successful Program (different from asset teams?) teams by conducting team building exercises on a frequent basis. Consider the following:
    a. Field trips to outcrops of analogs the team is working on. From earlier: How does permeability architecture relate to stratigraphic architecture?
    b. Field trip to a producing asset, don't forget to invite your Production Accountant, Human Resources, Law etc. support professionals
    c. Conduct twice monthly education sessions, rotating amongst different professionals. The selected professional will present to the extended team
        i. How their work adds value to the program.
        ii. How can their skill sets be better used to enhance team performance.
        iii. What are the challenges they are experiencing and what can other team members do to help overcome them.
    d. Rotate the professional presenting at the session but include all salient disciplines in the rotation. Our goal here is to educate all team members on how different parts of the organization play an integral part in the ultimate success of a program.
    e. After a few months include a shared learnings session from your performance tracking.
    f. Regularly intermix a session to brainstorm solutions to key challenges observed. As the leader of the session, start by acknowledging the expertise of the different experts and respect their inputs. That means actively listening. Encourage extended team members to work together to develop and execute solutions. Collaborative decision making is the key to building the trust and respect often lacking.
    g. Promote interdisciplinary training: by offering joint training programs that cover both geoscience and engineering principles. These sessions are intended to help

individuals understand the language, tools, and methodologies of different disciplines. I cannot emphasize enough how my limited time cross training as a Geologist developed in myself a great respect for how geoscientists add value.

In conclusion, effective collaboration between geoscientists and engineers requires mutual respect, understanding, and the desire plus willingness to work together toward meeting shared metrics. Fostering interdisciplinary education via regular one-hour sessions will enhance teamwork, drive mutual respect, support clearer communications, and aid the integration of emerging technologies. I believe that the gap between E&P professionals can be bridged, which will lead to more innovative and sustainable solutions to the challenges our industry will face in the future.

Acknowledgements

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References

Xu, N., Weatherstone, P., Alam, N., Lin, X., 2015. "Value Optimisation of Future Coal Seam Gas Field Developments Using Horizontal Wells", Presented at the SPE Asia Pacific Unconventional Resources Conference and Exhibition, Brisbane, Australia, November 2015. SPE Paper 176904.

The author conducted a search on "Bridging the Gap" in OnePetro to determine what had been written but did not use any of the researched material in this talk.

Rose Subsurface Assessment Flagship course notes, "Risk Analysis, Prospect Evaluation and Exploration Economics".