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geoLOGIC NEWS

A publication of Subsurface Consultants & Associates, LLC

Who is Left to Do Quality Assurance?

A message from our President, Hal Miller

Oil and gas companies have long relied on their most experienced and successful technical experts to conduct peer reviews and ensure functional excellence. In some larger companies, function heads lead corporate departments staffed with technical advisors who serve on quality assurance teams. Working across organizational boundaries, these teams provide independent, global perspective, test the quality of interpretative work, review estimated resources and reserves, and cross-fertilize best practices.

During the recent downturn, and the resulting slowdown in the pace of exploration programs and sanctioning of major capital projects, the oil and gas industry has encouraged many of its most experienced technical experts in the engineering and geoscience disciplines to move into retirement. Deep knowledge and experience in key disciplines supplied by central technology expert groups are diminishing internally. Even the largest companies are experiencing key gaps in their functional disciplines due to the ongoing wave of retirements.

With the inevitable return of a more stable price environment, companies restarting exploration programs and resurrecting dormant capital projects will understandably be reluctant to begin hiring experienced staff after having just downsized. The remaining, highly capable but generally less experienced staff who will shoulder the responsibility of stepping up activity levels often lack experience in executing large and complex projects. The few enduring, highly experienced staff are already stretched thin, and are lacking the support of technical advisors with deep skills in specialty disciplines needed to conduct effective quality assurance. See P7 for reasons to consider outside resources like SCA to provide quality assurance experts to fulfill this role.

in this issue:

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New Courses Focused on Unconventional Resources

SCA's instructors have years of industry experience, knowledge, and the skills required to address today's challenges in developing unconventional resource plays

Rajan N. Chokshi

Artificial Lift and Real-Time Optimization for Unconventional Assets

Unlike conventional production, unconventional production is highly dynamic. Traditional approaches to artificial lift applications are inefficient or even unsuccessful. The artificial lift life-cycle is different for unconventional wells. Production dynamics requires rethinking of the application of real-time downhole and surface sensing. This three-day course will help attendees understand and appreciate these facets while providing them with applicable solution paths. The course gives an overview of artificial lift and related issues that are applicable to unconventional and tight oil/gas wells. Production optimization is also discussed, particularly real-time measurements and optimization techniques that are required to understand and manage dynamic production scenarios.

John C. Lorenz, PhD

Characterization of Naturally Fractured Conventional and Unconventional Reservoirs

This hands-on course is anchored by a 50-piece teaching collection of natural and induced fractures in core that students will work with during class exercises. With pre-planning, in-house courses can utilize client core, image logs, and CT scan data. The class provides insight into fracture mechanics and the origins of fractures, and then uses those concepts in a very applied approach to impart an understanding of natural fractures and their potential effects on conventional and unconventional reservoirs.

Scott Cooper

Ursula Hammes, PhD

Shale Reservoir Workshop: Analyzing Organic-Rich Mudrocks from Basin to Nano-Scale

Choose between pre-set modules of this unique two, four, or five-day training course that is customizable based on your staff's skill needs. Topics addressed include reservoir characterization, sedimentology, facies, sequence stratigraphy, petrophysics, fractures, and geochemistry of shale-gas/oil bearing mudrocks. There is a focus on rock-based interpretation of mudrocks from basin to nano-scale. Participants will learn how to use core, cuttings, geochemical, and petrophysical data to characterize mudrocks and apply mudrock depositional, sedimentological, sequence stratigraphic, geochemical and petrophysical principles to exploration areas and production assets in shale basins. Subsurface data from a variety of oil and gas shale plays will be examined.

Shale Reservoir Core Workshop: Sedimentologic and Stratigraphic Assessment of Organic-Rich Mudrocks

This two-day core workshop is comprised of classroom sessions, core viewing, and core description exercises with a focus on rock-based interpretation of mudrocks. Participants will learn how to apply mudrock depositional, sedimentological, and sequence stratigraphic principles while incorporating classroom lectures with core examinations. A primary learning objective is to develop an understanding of geochemical, petrophysical, geomechanical, and fracture classification principles for exploration areas and production assets in shale basins. There will be examinations of subsurface data from a variety of oil and gas shale plays.

Robert 'Bob' Barba

Refrac Candidate Selection, Execution, and Performance Evaluation

Participants of this two-day course will learn a methodology that accurately characterizes reservoir properties to evaluate the effectiveness of an original hydraulic fracture treatment with production data. This enables a determination of the cause of poor production performance, whether it be a function of a poorly designed or executed completion or poor-quality reservoir rock. Techniques are presented to effectively access these reserves with refracturing treatment(s) if the remaining volumetric reserves are adequate.

Amy Fox, PhD

Reservoir Scale Geomechanics

The course is focused on conveying an understanding of why an accurate geomechanical model is necessary and how it can inform decisions made by various stakeholders within an oil and gas organization. A wide range of data types and analyses are discussed and prioritized. Class time is split between lectures, examples, and hands-on exercises. Learning outcomes of the course include: relevancy of geomechanics throughout the reservoir life-cycle, knowledge of the kinds of data that can be used to build a geomechanical model, and applications of the principles of geomechanics to solve real-world problems and reduce risk.

Steve A. Sonnenberg, PhD

Reservoir Characterization for Mudrock Reservoirs

This course provides an introduction to mudrock resource plays. A wide range of topics will be covered to familiarize the participant with the important nuances of both successful and unsuccessful mudrock plays while using the petroleum system approach. A key emphasis will be to show the important elements and processes for continuous oil and gas accumulations. Participants will learn screening techniques (check-list) which may help identify continuous types of accumulations.

Unconventional Resource Plays - Workshop

Learn sound evaluation techniques used in choosing and developing unconventional resource plays with this three-day workshop. It combines geology, reservoir engineering, reserves evaluation, economic forecasting, and the concepts of multivariate analysis to develop skills that help predict productivity in oil and gas systems. The workshop covers gas and oil plays in shale and stacked tight sands that are developed with horizontal and vertical wells, and completed and stimulated with hydraulic fracturing.

Jennifer Miskimins, PhD

Hydraulic Fracturing: Theory and Application

Take an in-depth look at hydraulic fracturing with this course. Approached from a theoretical viewpoint initially, a discussion of how the theory translates into application of the technique follows. The course starts by covering the goals of hydraulic fracturing and the economic justifications that go along with them, and then transitions into a dissection of reservoir characteristics such as in-situ stresses, rock mechanical properties, and their impacts on hydraulic fracture behavior.

Leo Roodhart, PhD

Well Stimulation: Practical and Applied

In the drive towards more technically challenging completions and the development of unconventional reservoirs, not enough attention is paid to the details of inflow performance optimization. This can result in poor or less than optimum production. Asset managers, advisors, and engineers involved in the planning, execution, and evaluation of well completions need to have an understanding of possible situations using modern well stimulation techniques and tools. The course includes acidizing and fracturing design, quality control, conducting a treatment, analyzing pressures, and other critical parameters during and after treatment.

Gerrit Nitters

Enhance Decision Quality with Uncertainty and Risk Management

by SCA's Vice President of Engineering, Susan Howes, PE, PHR

Members of multi-disciplinary project teams identify key technical, mechanical, geological and commercial risks, and develop mitigation plans to address these risks. These teams resolve key uncertainties associated with their responsibilities for managing exploration portfolios, building regional exploitation strategies, managing capital projects, and maintaining robust asset development plans. Value is added with the appropriate level of uncertainty resolution and risk mitigation, and decision quality is enhanced in alignment with key principles.

A key first step for multidisciplinary teams is to understand the differences between risk and uncertainty. In SPE-174932-MS[1] entitled "***Uncertainty and Risk Management Plans are Critical for Team Alignment and Better Decision Quality***", we compared the definitions and contrasted various aspects of uncertainty and risk with this table:

	Definition	Ranking	Handling	Measure
Uncertainty	Lack of information about a range of potential outcomes and factors that influence them	Impact on Key Decisions	Resolution Planning	Expressed as a range of values for a variable resulting in a range of outcomes
Risk	Probability of success or failure relative to defined objectives or targets	Impact on Project and Business Objectives	Contingency and Mitigation Plans	Probability of occurrence and magnitude of loss

"***Guidelines for Application of the Petroleum Resources Management System (PRMS)***"[2] provides an additional source for definitions of uncertainty and risk:

- Range of Uncertainty: The range of uncertainty of the recoverable and/or potentially recoverable volumes may be represented by either deterministic scenarios or by a probability distribution.
- Risk: The probability of loss or failure. As "risk" is generally associated with the negative outcome, the term "chance" is preferred for general usage to describe the probability of a discrete event occurring.

The current version of PRMS was released in 2011 and is presently undergoing additional revisions in 2017 by these sponsoring organizations:

- Society of Petroleum Engineers (SPE)
- American Association of Petroleum Geologists (AAPG)
- World Petroleum Council (WPC)
- Society of Petroleum Evaluation Engineers (SPEE)
- Society of Exploration Geophysicists (SEG)

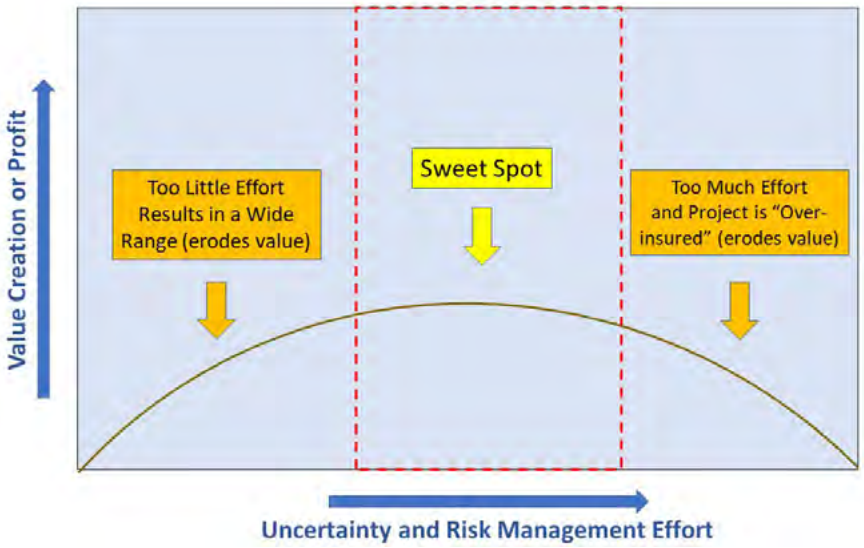
"***Technical Report: Guidance for Decision Quality for Multi-Company Upstream Projects***"[3], issued by SPE and the Society of Decision Professionals (SDP) in 2016, provides these additional perspectives on definitions for uncertainty and risk:

- Uncertainty: The lack of certainty. A state of having limited knowledge so that it is impossible to describe exactly the existing state, a future outcome, or more than one possible outcome. Uncertainty can be represented

by a range (e.g., from offset-well data, the field oil/water contact is between 2500 and 2600 m). In principle, the range can have a specific probability distribution assigned to it if there is an adequate technical basis for assessing the range.

- Risk: Can be defined as the probability that a hazard or discrete event will result in a specified level of loss or failure. This is an event that may or may not happen (e.g., a delineation well may or may not penetrate the field oil/water contact).

Once a multi-disciplinary team understands how to describe the uncertainty and risk associated with their projects, they need to reach consensus on the appropriate level of uncertainty resolution and risk mitigation to assure value creation. To accomplish this consensus will require effort towards achieving improved cross-disciplinary communication between team members, their managers, and field personnel. We included the following diagram in SPE 174932-MS to describe how to reach this sweet spot between expending too little effort and being over-insured with too much effort, both of which results in value erosion.



The Society of Decision Professionals (DSP) has developed a Decision Maker's Bill of Rights, which is reprinted in its entirety in their technical report issued jointly with SPE "***Technical Report: Guidance for Decision Quality for Multi-Company Upstream Projects***." These six principles to achieving enhanced Decision Quality are paraphrased here:

1. Developing a Relevant Frame – are we addressing the right problem in the context that's relevant?
2. Generating Creative and Doable Alternatives – do we have a good set of creative alternatives that provide distinct choices?
3. Using Relevant and Reliable Information – are the inputs representative with the appropriate ranges? What biases are involved?
4. Assessing the Consequences of Choosing Different Alternatives – have we defined the potential results of the choices?
5. Applying Logical Analysis – can we draw meaningful conclusions from which we can reach a clear action plan?
6. Committing to Action – are we ready to execute the decision?

In order to develop Uncertainty Resolution Plans, the team must manage uncertainties through taking the following actions:

- Characterize Uncertainties as a range of values for a variable resulting in a range of outcomes. Some teams use P10, P50 or P90, and others use a High, Medium, Low to describe the ranges.
- Prioritize Uncertainties according to their impact on the decisions and the resolution required. A high, medium, low or no impact designation is commonly used to set priorities associated with various decisions.

- Develop Uncertainty Resolution Plans with the appropriate resources of funding, personnel, time, milestones and triggers.
- Recommend and implement the appropriate suite of Uncertainty Resolution Plans to add value.
- Track progress in resolving uncertainty.
- Update Uncertainty Resolution Plan when appropriate.

With respect to developing Risk Mitigation Plans, often teams start by identifying various types of risk, including subsurface integrity, technical, mechanical, geological, commercial and other. Here's a table that we developed in SPE 174932-MS to describe these types of risk:

Risk Type	Examples
Subsurface Integrity	Shallow hazards, Shallow faults, Reactivations of faults, Breaching seal, Wellbore integrity, H2S and CO2 contaminants
Technical	Production, Estimated Ultimate Recovery, Quality and Connectivity, Oil/water contact, Gas/water contact, Aquifer
Commercial	Contracts, Concession extensions, Joint Venture Partner Alignment, Government Approvals, Public Relations and Support, Rig Availability, Costs
Mechanical	Drilling problems, Completion Problems
Other	Weather, Trade Unions, Security and Unrest

As you can see from the wide variety of risk types, developing a Risk Mitigation Plan will require input from personnel from other departments in addition to the subsurface multi-disciplinary team. To develop Risk Mitigation strategies, this broad group of personnel will need to follow these steps:

- Detail and group risks into categories including subsurface integrity, technical, mechanical, geological, commercial and other.
- Prioritize risks according to their impact on the decisions. Dependencies between risks are identified that when combined could be catastrophic.
- Develop Risk Mitigation Plans with the appropriate resources of funding, personnel, time, milestones and triggers.
- Recommend and implement the appropriate suite of Risk Mitigation Plans.
- Track progress in mitigating risk .
- Update Risk Mitigation Plan when appropriate.

By following these protocols toward developing multidisciplinary plans to resolve uncertainty and mitigate risk, project teams can achieve enhanced decision quality. Updating these plans regularly in association with asset management plans is a best practice that extends beyond the capital project development and execution phases throughout the life of the asset. Organizations that make high-quality decisions, make them quickly, with optimal effort, and then translate those decisions into action effectively create more value for their stakeholders.[4]

References:

1. "Uncertainty and Risk Management Plans are Critical for Team Alignment and Better Decision Quality", R. Sawiris, S. Howes, J. Rodriguez and W. Foley, Chevron, September 2015, SPE Paper # 174932-MS
2. Guidelines for Application of the Petroleum Resources Management System - 2011
3. Technical Report: Guidance for Decision Quality for Multi-company Upstream Projects. SPE & SDP, March 2016. Society of Petroleum Engineers. SPE Paper # 181246-TR
4. Edward W. Merrow, founder and CEO of Independent Project Analysis, quoted in Technical Report: Guidance for Decision Quality for Multi-company Upstream Projects.

Quality Assurance

SCA's Quality Assurance service ensures technical excellence

We provide teams of expert consultants with global experience in quality assurance to conduct reviews at the corporate strategy, play assessment, prospect portfolio, or major capital project sanctioning level. These reviews can help identify technical flaws or failures of logic (example: a prospect that appears reasonable but does not fit the geologic context) as well as reduce uncertainty, mitigate risk, enhance decision quality and instill functional excellence. SCA's experts can provide:

- Independent perspectives that may identify internal technical or strategic bias
- Personal experience with global analogs and best practices
- Industry recognized expertise in specific disciplines
- Training classes to upgrade internal skill bases
- Mentoring to ingrain key skills or supplement teams on a short term or periodic basis

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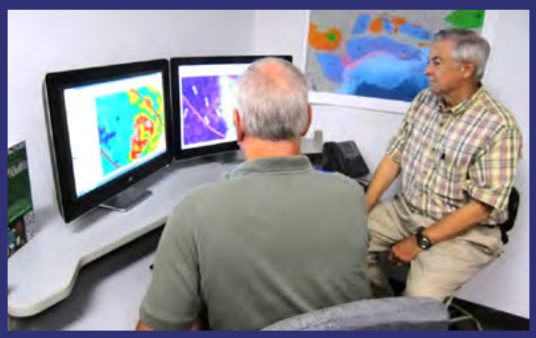

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Upcoming Training Courses

JULY	07/10-12/17	Unconventional Resource Plays
	07/10-14/17	Applied Subsurface Geological Mapping
	07/17-19/17	The Practice of Seismic Stratigraphy in Deepwater Settings
	07/31-08/04/17	Applied Subsurface Geological Mapping (Dallas)
AUGUST	08/06-12/17	The Book Cliffs of Utah - Field Trip
	08/07-11/17	Basic Petroleum Geology
	08/07-11/17	Applied Subsurface Geological Mapping (Denver)
	08/15-16/17	Introduction to Risk and Uncertainty Management NEW
	8/28/17	Basics of the Petroleum Industry
	08/29-09/01/17	Structural Styles in Petroleum Exploration and Production
SEPTEMBER	09/02-03/17	Structural and Sequence Stratigraphic Field Course (Hill Country)
	09/05-08/17	Characterization of Naturally Fractured Conventional and Unconventional Reservoirs NEW
	09/05-08/17	Practical Interpretation of Open Hole Logs
	09/11-15/17	Practical Seismic Exploration and Development
	09/18-22/17	Sequence Stratigraphy Applied to O&G Exploration
	09/25-29/17	Basic Petroleum Engineering Practices
	09/25-29/17	Applied Subsurface Geological Mapping

All courses are located in Houston unless noted otherwise.

These SCA textbooks are foundation works for accepted practice in oil & gas exploration and development. Taught and sold around the world!

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About SCA

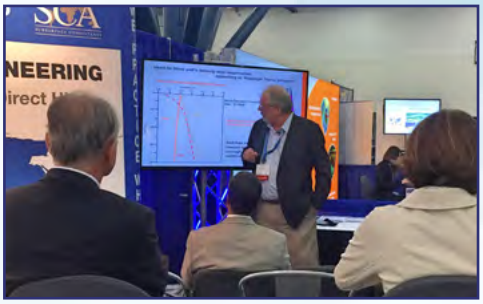
Subsurface Consultants & Associates, LLC provides upstream consultancy and training to professionals in the oil and gas industry. Founded in 1988 by Daniel J. Tearpock, SCA's four primary services are geoscience and engineering consulting, upstream projects and studies, training services, and direct-hire recruitment.

SCA is considered an industry leader in subsurface exploration and development interpretation and mapping. We provide the personnel, technology, and proven methodologies that foster success by enabling better business decisions.

AUTHORIZED IACET PROVIDER

We have been accredited as an Authorized Provider by the International Association for Continuing Education and Training (IACET), authorizing SCA to offer IACET CEUs for its programs that qualify under the ANSI/IACET Standard. Professionals who are required to maintain their state, federal or society licensing, registration or certification can fulfill their requirements by attending SCA training courses.

The People & Activities of SCA



SCA enjoyed the opportunity to connect with industry professionals at this year's AAPG ACE 2017 Annual Convention & Exhibition in April. Pictured above is our team in front of SCA's booth (left to right: Matt Nowak, Mary Atchison, Hal Miller, Susan Howes and Tim Riepe). A handful of our instructors presented samples of their courses during the convention. Pictured (from top left): Robert Shoup (Avoiding Dry Holes), Steve Sonnenberg (Unconventional Resource Plays), John C. Lorenz (The Influence of Fracture Type in Unconventional Reservoirs), James Granath (Salt & Shale Tectonics), and Susan Howes (Risk & Uncertainty).

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