Frac Diagnostics

Lyle V. Lehman

Founder

BIOGRAPHY

Lyle Lehman founded Frac Diagnostics, LLC in May of 2016. The company was created after Carbo Ceramics decided to vacate the expert stimulation consulting arena, thus giving the business to Lyle to grow and continue to serve clients. The Carbo firm was called "StrataGen" and was a product of Carbo's sale of frac mapping business lines in Pinnacle Technologies to Halliburton in 2008. Much of what StrataGen was, Frac Diagnostics is today, and Lyle shaped both companies consulting offerings.

While at StrataGen and continuing with Frac Diagnostics, Lyle leads a team which utilizes workflows geared toward improving client's cash flows. In today's environment, there are two types of operators: Those who wish to develop reserves and sustain their company and those interested in improving initial production – generating interest so that their company can be sold and developed by others. Frac Diagnostics serves both types of clients.

Lyle's responsibilities also included scoping and performing projects as an expert consultant in design, evaluation and optimization of: matrix and fracture acidizing treatments; hydraulic fracturing and unconventional reservoir field development. Lyle is sought by many clients for his ability to solve complex problems and is considered to be an out-of-the box solutions provider. His experience includes the optimization of fracturing treatments in tight oil and gas reservoirs in many areas of the U.S., managing tight gas production in Central-West Texas, high perm matrix acidizing, data mining using linear and non-linear analysis of cause-and-effect relationships as they pertain to completion optimization, and many other International-based low-permeability stimulation issues. Lyle is considered to be an expert at frac model usage to understand and evaluate reservoir characteristics which lead to fracture optimization. Lyle is also considered an expert in stimulation fluid systems, their effect on conductivity and high-pressure/high-temperature environments. Before joining StrataGen Engineering in 2007, Lyle's career was with Halliburton Energy Services, most recently as North American Regional Practice Manager for the Drilling and Completions Optimization Practice. His responsibilities included managing the profit and loss of the practice as well as growing the business and career development of the consultants. Lyle has co-authored numerous technical papers and currently has nine active patents all in the field of fracture stimulation.

PROFESSIONAL EXPERIENCE

Frac Diagnostics, LLC, Houston, Texas – Founder May 2016 - Present

As stated above, Lyle founded Frac Diagnostics as a descendent firm from StrataGen and Pinnacle Consulting Group.

StrataGen, Inc., Houston, Texas

Director, Fracture Design and Evaluation April 2007 - May 2016

- Led StrataGen's Principal level, office-based Global consulting practice, providing technical support to consulting projects.
- Managed design, evaluation and optimization of hydraulic fracturing treatments on global scale. Workload was focused on low permeability oil reservoirs both matrix and fracture-based permeability types.
- Developed a technique using stimulation data to determine the degree of non-matrix permeability in unconventional reservoirs.

- Advised Clients in the Middle East, West Africa, Australia and Latin America clients, as lead project consultant, to restructure their stimulation practices to successfully improve hydrocarbon production well above historical levels in Belize, Dubai, Angola, Colombia, Australia and Argentina to name a few.
- Active in the Bone Springs play and Wolfcamp plays in the Delaware Basin – primarily in improving completion design based on lateral landing depth and pay coverage.
- Initiated a patent on modeling fracture geometry growth in naturally fractured shales, such as the Barnett.

Halliburton Energy Services (HES), Houston, Texas

Regional Practice Manager, Drilling and Completion Optimization January 2004 - April 2007

- Recruited and retained consultants in the areas of expert well design, principally in high-pressure, high-temperature environments, and real-time drilling visualization and drilling data management.
- Helped achieve double-digit growth in 2006 and retained more than 96 percent of his employees during a period of unprecedented market demand.
- Organized recruitment from non-energy sectors to build staff in drilling data management implementation utilizing a *Fast Track* program.
- Project managed several engineering cases that required non-linear data mining to analyze reservoir response to completion practices as well as geomechanical-based expert drilling issues in Brazil and offshore Campeche (Mexico) areas.
- Served on the external intellectual property screening committee for Halliburton, representing the Landmark Division and the Halliburton stimulation product service line.

Product Manager, Stimulation Business Unit 2002 - 2003

- Managed the product-and-service portfolio for more than $1.6 billion (2003 dollars) annual business in Halliburton's stimulation business unit, including managing Halliburton's proprietary stimulation-based software portfolio.
- Generated 12 patent applications for new stimulation products (10 in development before 2004).
- Established and coordinated the alliance to co-develop treatment well tiltmeter devices for hydraulic fracture measurement with Pinnacle Technologies.
- Served as Product Development Manager in Acoustic Stimulation, using ultra high frequency (16-35,000 hertz) and high-power (2 KW downhole) tools.
- Wrote the key SPE paper that developed the groundwork leading to 2005's HES Conductivity Endurance campaign to both stop proppant flowback and increase highly conductive proppant in the hydraulic fracture.
- Developed three patents on recycling the only re-usable frac fluid currently on the market.

Champion, Real-time Reservoir Solutions July 1999 - 2001

- Worked on a multi-discipline team that created strategies in real-time reservoir management and decision making for the Stimulation and Completion Products business units in Halliburton.
- Focused on internal improvements in operations with real-time capacity as well as external marketing and positioning.
- Helped establish satellite remote data transmission protocols and essential systems for key data integration and workflow.
- Selected as Subject Matter Expert in Artificial Neural Network data mining.
- Served as the first chairman for the Stimulation Technical Interest Group in the Society of Petroleum Engineers (SPE) for six years.

Technical Analyst, Mid-Continent Technology Team May 1996 - June 1999

- Served as stimulation expert for the Mid-Continent client base.
- Solved stimulation issues in the Bossier field by identifying multiple fracture issues due to isotropy.
- Shared Hart's Mid-Continent award by evaluating and redesigning Morrow Sand Completions in Sherman County for Phillips Petroleum.

C.W. Kelley, Jr. PE & Associates, Pampa, Texas
Stimulation Specialist 1995 - 1996

- Performed field work using FracproPT to design, evaluate and execute in real time and then analyze and improve future treatments on tight gas wells in Texas, Oklahoma and Wyoming.
- Used FracproPT as a tool to analyze old frac treatments and determine fracture effectiveness as a means of acquiring properties.

Service Fracturing Company (Serfco) Liberal, Kansas and Pampa, Texas
District Manager/Director of Engineering 1988 - 1995

- Managed two districts (Liberal, Kansas, and later Pampa, Texas) for Serfco before the company was acquired by Nowsco of Canada.
- Handled profit and loss of these districts, sales, engineering development and technical sales.
- Held training sessions in the general stimulation theory for Liberal, Kansas-based clients.
- Served on the Well Completions Committee for SPE and held the Office of Chairman for two chapters of the API.

Lehman Management Group, Abilene, Texas
Proprietor 1984 - 1988

- Built and grew a small consulting firm by designing the drilling and completion of ~70 wells in West-Central Texas.
- Served as expert witness in stimulation "malpractice" lawsuits involving gas operators and stimulation service companies.

Thomas-Powell Royalty, Inc., Abilene, Texas
Vice President and General Manager 1981 - 1984

- Served as an officer for this small West-Central Texas operator.
- Supervised, designed and managed the production from ~50 oil and gas wells.
- Supervised the drilling of a 15-well water-flood project, including early production.

The Western Company of North America, Mineral Wells, Texas
Technical Sales Engineer 1976 - 1981

- Started as technical trainee in Rankin, Texas.
- Succeeded as service supervisor in Rankin before being promoted to District Engineer and transferring to Breckenridge and later Mineral Wells, Texas.
- Designed and analyzed completion practices in tight gas formations in the Fort Worth Basin.
- Mentored by Bob Hannah – member of the Frac "Hall of Fame."

EDUCATION

- **Bachelor of Science in Chemistry (Qualified Program)**, University of Oklahoma, 1976

PROFESSIONAL AFFILIATIONS

- Society of Petroleum Engineers
  - Distinguished Lecturer Selection Committee 2013 - present
  - Member of Steering Committee for European Tight Gas Forum, 2004
  - Member Program Committee for "Hydraulic Fracturing in The Americas," 2008
- American Petroleum Institute (Lifetime Honorary Member)
- American Chemical Society, 2006

AWARDS AND HONORS

- 2001 Top 100 Inventions of 2001 by *R&D Magazine*
- 2001 Top New Product Award for FracTrac-TW™ by Hart's Publications
- 2000 Best Paper Award for SPE 51063 – Eastern Regional, Pittsburgh, PA.
- 1999 Top New Product Award for SandWedge® by Hart's Publications
- 1997 Top Re-completion Processes of the Mid-Continent by Hart's Publications

PUBLICATIONS

- "Unsung tools for boosting profitability of unconventional wells", Hart Energy E&P July 2019.
- "Can "Too Close" be ill-advised in fracture spacing?" World Oil, November 2018.
- "Big Data Yields Completion Optimization. Using Drilling Data to Optimize Completion Efficiency in a Low Permeability Formation", paper SPE 181273, presented at the Annual Technical Conference and Exhibit held in Dubai, UAE, 26-28 September 2016.
- "Delaware Basin Bone Springs. A Study of the Evolving Completion Practices to Create an Economically Successful Play", paper SPE 176828, presented at the SPE Asia Pacific Oil and Gas Conference and Exhibition held in Brisbane, Australia, 9 - 11 November 2015.
- "The Bone Springs – State of Play pt. 2", a Carbo White Paper, 2015.
- "Appraising Shale Gas Reservoirs using Stimulation Data", paper SPE 171548, presented at the SPE Asia Pacific Oil and Gas Conference and Exhibition held in Adelaide, Australia, 14 - 16 October 2014.
- "Source Rock Stimulation: Does This Require More Art Than Science?", paper SPE 171432, presented at SPE Asia Pacific Oil and Gas Conference and Exhibition held in Adelaide, Australia, 14 - 16 October 2014.
- "The Utica – State of Play", a Carbo White Paper, 2014.
- "The Bone Springs – State of Play pt. 1", a Carbo White Paper, 2014.
- "Completion Optimization with Ceramics Provides Step Changes in Horizontal Performance for the 2nd Bone Springs – A Southeastern New Mexico History", paper SPE 170720 presented at the 2104 SPE Annual Technology Conference and Exhibition, 27 - 29 October, Amsterdam, The Netherlands.
- "Development of Brittle Shale Fracture Network Model – Part 2: What is the Value of SRV?" paper SPE 166441, presented at the SPE Annual Technology Conference and Exhibition, 30 September - 2 October 2013, New Orleans, LA, USA.
- "Net Pressure Trends: Is it Permeability, Complexity or Just Fluid Response? A Workflow to Determine Stimulation Effectiveness in Naturally Fractured and Matrix-Based Permeability Reservoirs," paper SPE 163858, presented at the Hydraulic Fracturing Conference, 4 – 6 February 2013, Woodlands, Texas, USA.
- "Development of the Brittle Shale Fracture Network Model," paper SPE 163829, presented at the Hydraulic Fracturing Conference, 4 - 6 February 2013, Woodlands, Texas, USA.
- "The Case for and Against Ball-Drop Multistage Fracturing Systems in Unconventional Horizontal Wells," paper SPE 145634, presented at the Canadian Unconventional Resources Conference, 15 - 17 November 2011, Alberta, Canada.
- "Survey of over 1000 Frac-Stage Database with Net Pressure in the Barnett Shale, parts 1 and 2", papers SPE 138277 and 143330, presented in 2010 and 2011.
- "Adding Value with Data Mining," Oil and Gas Investor, January 2011.
- "Making Unconventional Gas More Conventional," *Hart's E&P*, April 2005.
- "Making the Perfect Well," *Hart's E&P*, August 2004.
- "Holistic Field Evaluations Improve Prospect Opportunities," paper SPE 88530, with B. Shelley and B. Grieser, presented at the 2004 Asia Pacific Oil and Gas SPE Meeting, Perth, Australia.
- "Conductivity Maintenance: Long-Term Results from the Use of a Conductivity Enhancement Material," paper SPE 82241, with B. Shelley, J. Tiffin, *et al.*, presented at the European Formation Damage Conference, The Hague, Netherlands, 2003.
- "Calibrating Fracture Models with Direct Diagnostics: A Necessary but Humbling Experience," paper SPE 77904, with L. Weijers, *et al.*, presented at the 2002 Asia Pacific Oil and Gas SPE Meeting, Melbourne, Australia.

- "Spotlight on Energy Services: Don't Forget the 'Service' Component in Your Product Development Process," *Visions Magazine for Product Development and Manager's Association*, July/August 2002.
- "Real-Time Fracture Mapping from a 'Live' Treatment Well," paper SPE 71648, with C. Wright, *et al*., presented at the SPE Annual Technical Conference and Exhibition, New Orleans, Louisiana, 2001.
- "Proppant Conductivity: What Counts and Why," paper SPE 52219, with M. Parker, *et al*., presented at the Production Operations Symposium, Oklahoma City, Oklahoma, 1999.
- "Investigation of a New Fracturing Fluid and Conductivity Enhancement Technology on Coalbed Methane Production," paper SPE 52193, with M. McCabe and L. Robert, *et al*., presented at the Production Operations Symposium, Oklahoma City, Oklahoma, 1999.
- "Desorption Enhancement in Fracture-Stimulated Coalbed Methane Wells," paper SPE 51063, with M. Blauch and L. Robert, presented at the Eastern Regional SPE Meeting, Pittsburgh, Pennsylvania, 1998.
- "Hydraulic Fracturing of the Frontier Zone in West-Central Wyoming: A Case History," paper SPE 39958, with J. Yaritz and R. Natvig, presented at the Low Permeability Symposium, Denver, Colorado, 1998.
- "Continuous Improvement Stimulation Program Generates Excellent Results in the Morrow Sandstone of the North Texas Panhandle," paper SPE 37430, with T. Harrington, presented at the Production Operations Symposium, Oklahoma City, Oklahoma, 1997.
- "Etiology of Multiple Fractures," paper SPE 37406, with J. Brumley, presented at the Production Operations Symposium, Oklahoma City, Oklahoma, 1997.
- "Economic Ranking of Applications Which Directly Benefit Fracturing Optimization in a Moderate Permeability/Multi-Layered Environment," paper SPE 35258, with Chuck Kelley, presented at the Mid-Continent Gas Symposium, Amarillo, Texas, 1996.
- "Fort Worth Basin Stimulation Techniques and Practices," Dallas Geological Society publication, 1979.

U.S. PATENTS – Issued

- "Re-use of Treatment Fluid," patent number 6,913,080, July 2005 (Lehman, Haley, Weaver and Slabaugh).
- "Mitigating Risk by Using Fracture Mapping to Alter Formation Fracturing Process," patent number 6,935,424, April 2005 (Lehman and Wright).
- "System and method for scale removal in oil and gas recovery operations," patent number 7,213,650, May 8, 2007 (Lehman, Birchak, Venditto, *et al*.).
- "Re-use of Treatment Fluid," patent number 7,311,145, December 2007 (Lehman, Haley, Weaver and Slabaugh) Divisional Application of Prior patent.
- "Re-use of Treatment Fluid," patent number 7,331,389, February 2008 (Lehman, Haley, Weaver and Slabaugh) Second Divisional Application of Prior patent.
- "Methods to increase recovery of treatment fluid following stimulation of a subterranean formation comprising in situ fluorocarbon coated particles," patent number 7,595,281, September 2009 (McDaniel, Slabaugh, Lehman and Weaver).
- "Methods to increase recovery of treatment fluid following stimulation of a subterranean formation comprising in situ fluorocarbon coated particles," patent number 7,723,264 May 2010 (McDaniel, Slabaugh, Lehman and Weaver). Second Divisional Application of Prior Patent.
- "Compositions and Methods for Improving Proppant Conductivity," patent number 10,035,950B2 July 2018 (Lehman and Cannan).
- "Tagged Chemical Diverter." Patent number 2018/0180762 A1 Jun 2018 (Lehman, Todd and Conkle).