

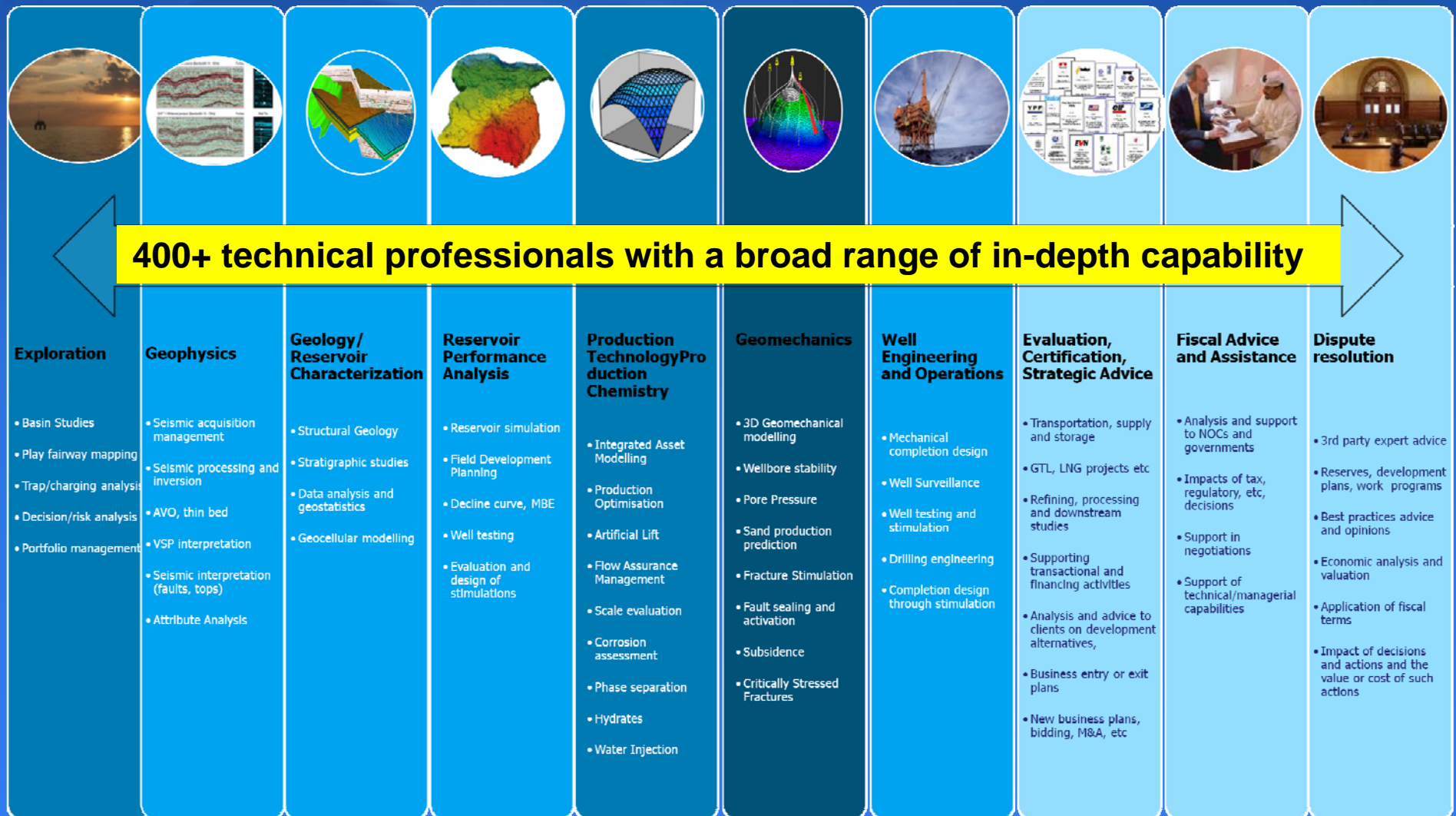
Advancing Reservoir Performance

Mature Field Optimisation

Rich Ruggiero
VP Field Development
Reservoir Development Services
Baker Hughes Incorporated



Reservoir Development Services



Real-World Experience from All Angles

■ Multiple Perspectives

- Government & Oil Company
- Operator & Non-Operator
- Buyer & Seller
- Lender & Borrower
- Private Sector & Public Sector
- Upstream, Midstream & Downstream
- Greenfield/Brownfield

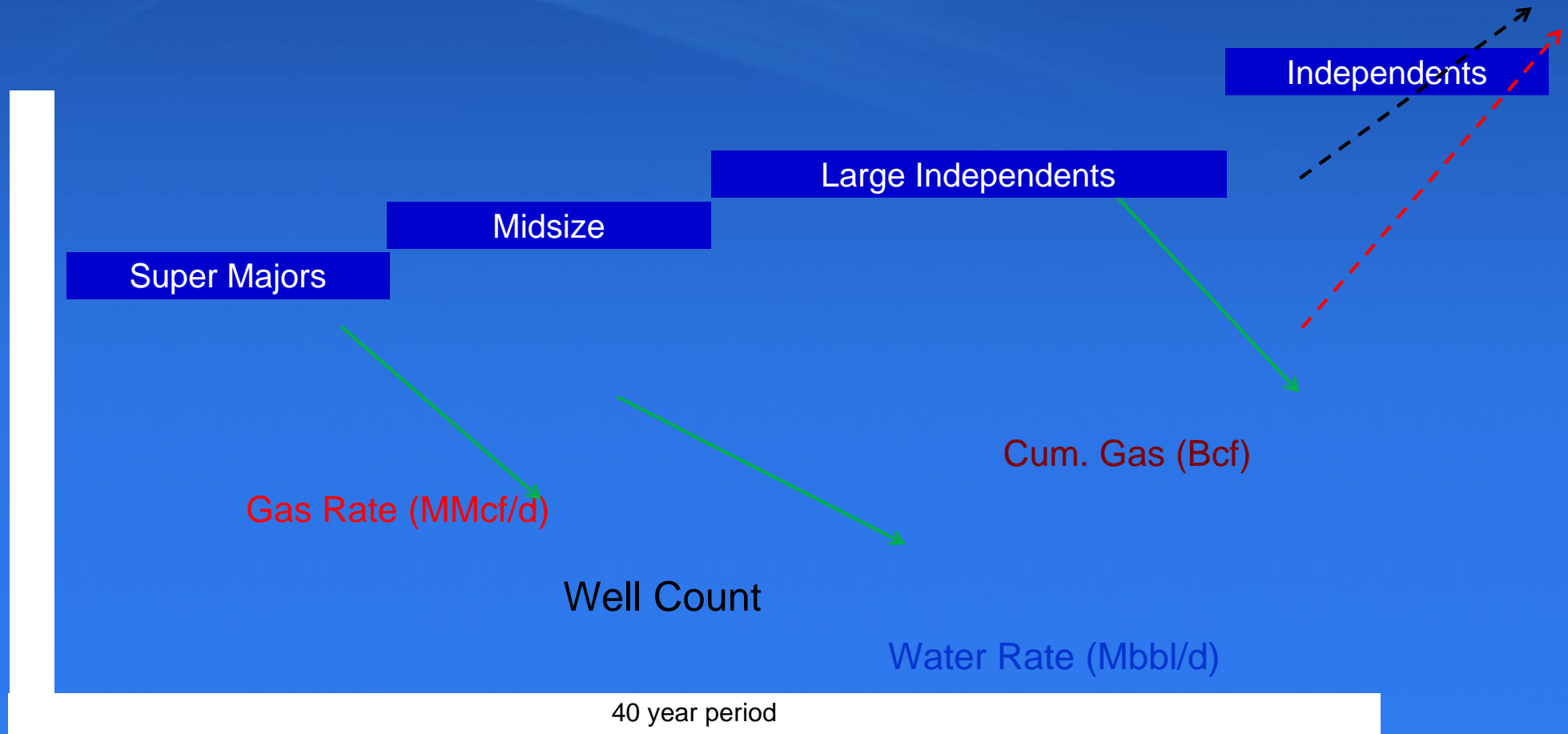


Optimizing Production Over Time

- 'Based on our experts' analyses oil and gas will run out in [pick a number] years'
 - Trace that back as long ago as pre WWII
 - Every decade or so we hear the same thing, just a few more years until supplies get dangerously low
 - Challenged, the oil industry has learned to adapt and grow
- Changing limits to find new hydrocarbons
 - Drill deeper (vertical, water depth); drill longer (horizontal)
 - Operate under ever increasing pressure, temperature
 - Real time data gathering and processing while drilling
 - Evaluation tools that 'see' deeper, further away from the wellbore
 - The 'Independent' approach vs. the 'Super Major' approach



The Natural Order of Things

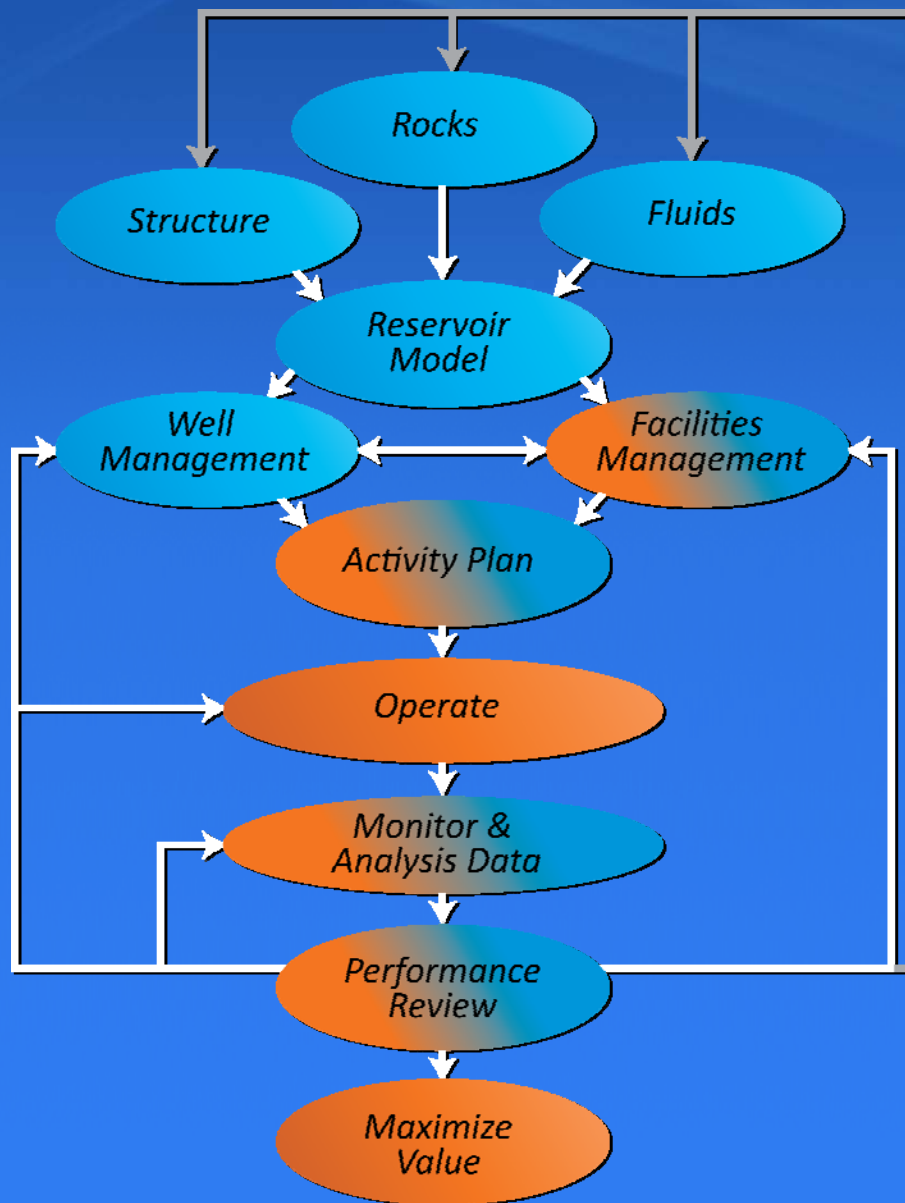


Entrepreneurship? Different Risk Profile? Technology?
or
The 'Pygmalion' Effect

Optimizing Production Utilizing Technology

- “Old School” Technologies still very much applicable
 - Review the data, ALL data
 - Challenge assumptions – bring in a new set of eyes
 - Know your physical set-up
 - Understand laws, regulations and contracts
- “New” Technologies can be game changers
 - 3D Visualization
 - Geology to Reservoir to Market linked models/simulations
 - Horizontal drilling
 - Fracture stimulation
 - Real time pore pressure

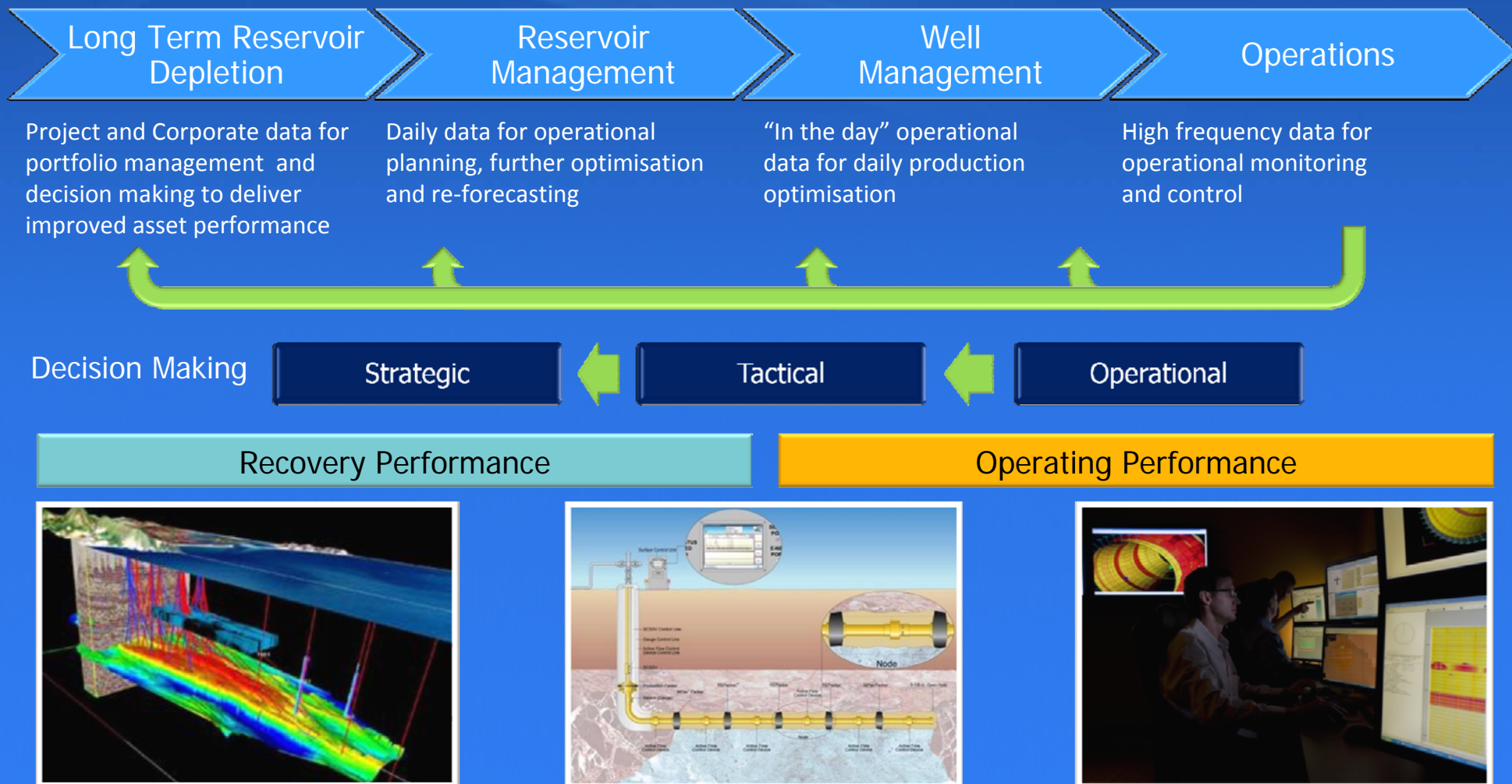
Process to Maximizing Asset Value



Integrated Study and Technology solutions enhance owner value by:

- Improving reservoir understanding
- Improving reservoir management
- Accelerating production
- Accessing bypassed oil
- Optimizing facilities
- Deferring abandonment
- Applying proper EOR solutions
- Managing market dynamics

Improving Decision Cycle Time



Old School West Texas Example: Increasing Production and Adding Reserves

Over a 3 month period:

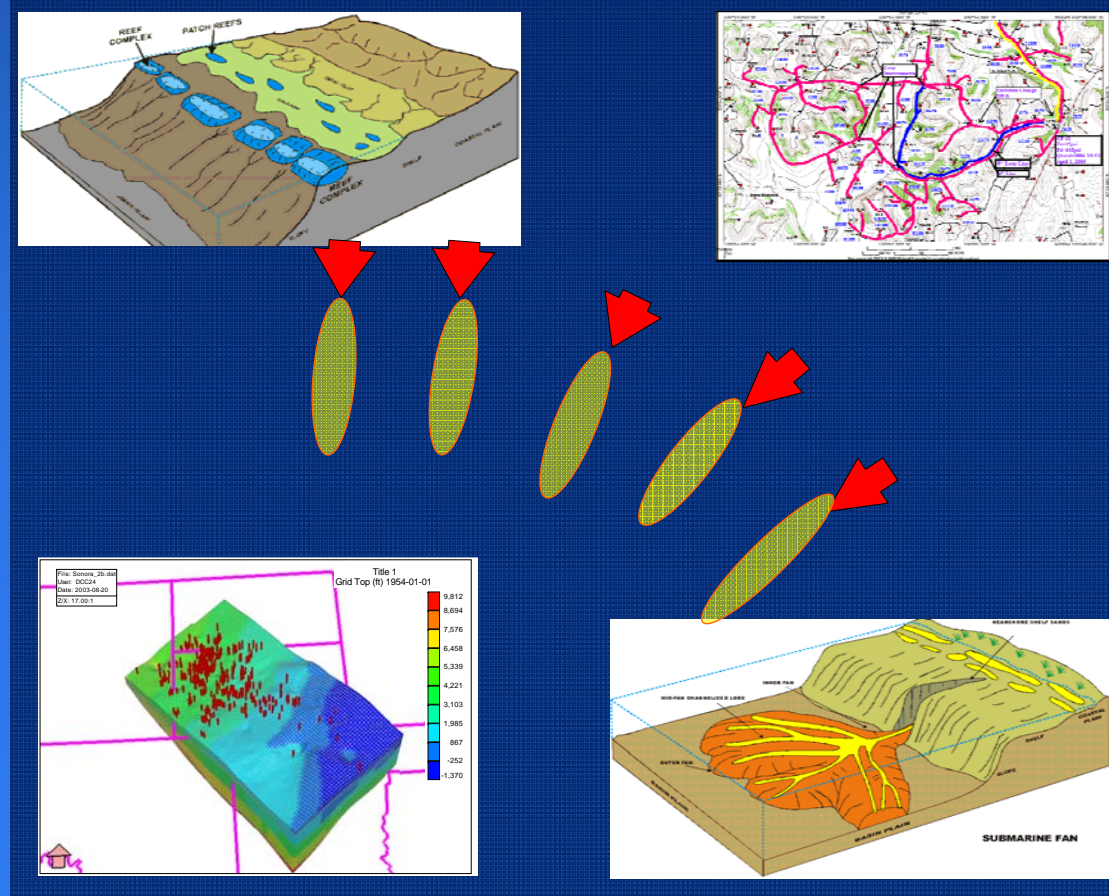
Digitized logs & production history for over 4000 wells. Built multi-mile cross sections for 7 reservoirs

Developed an in-depth understanding of completions, surface facilities, processing and markets

Built new geological and reservoir models

Identified a series of production optimization and drilling options

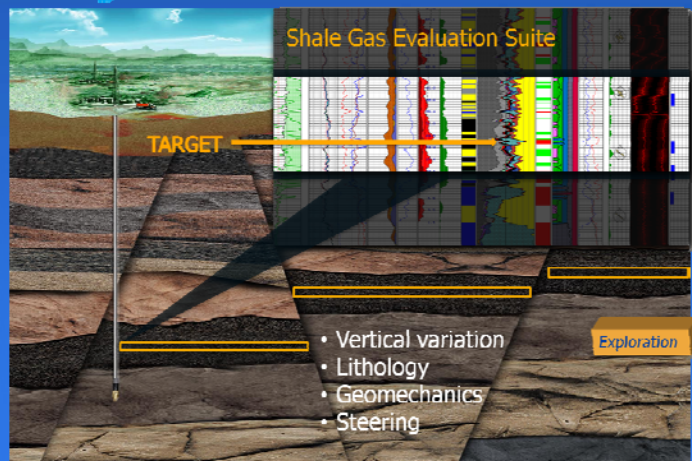
This included accessing new/bypassed hydrocarbons, infill drilling, horizontal re-drills, multi-stage fracs (before this was the norm) and facility reconfigurations



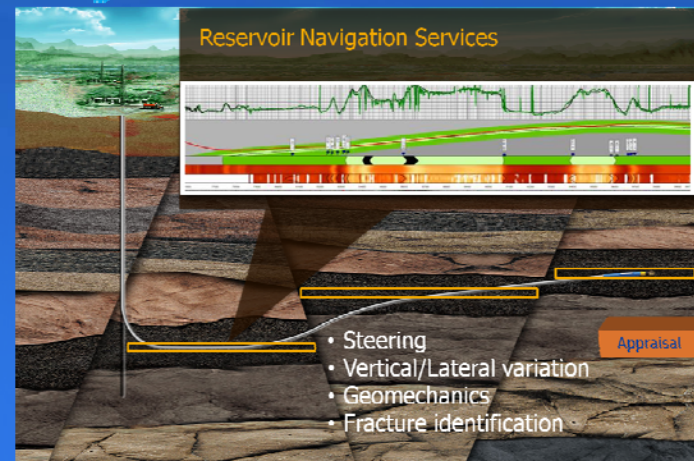
These results were delivered on a collection of fields which were thought to have been played out and under "care and maintenance" operations

New School Shale Example: Technology Addressing the Challenges

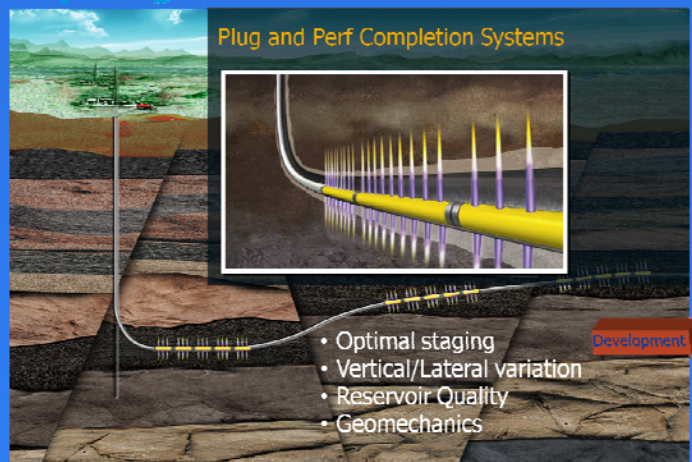
Landing the well



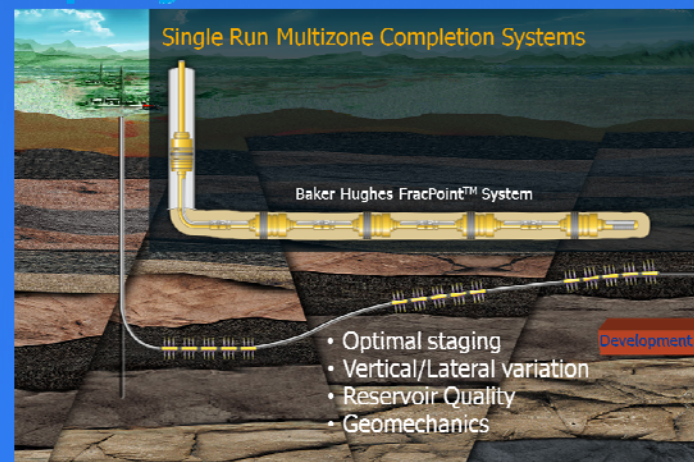
Placing the well



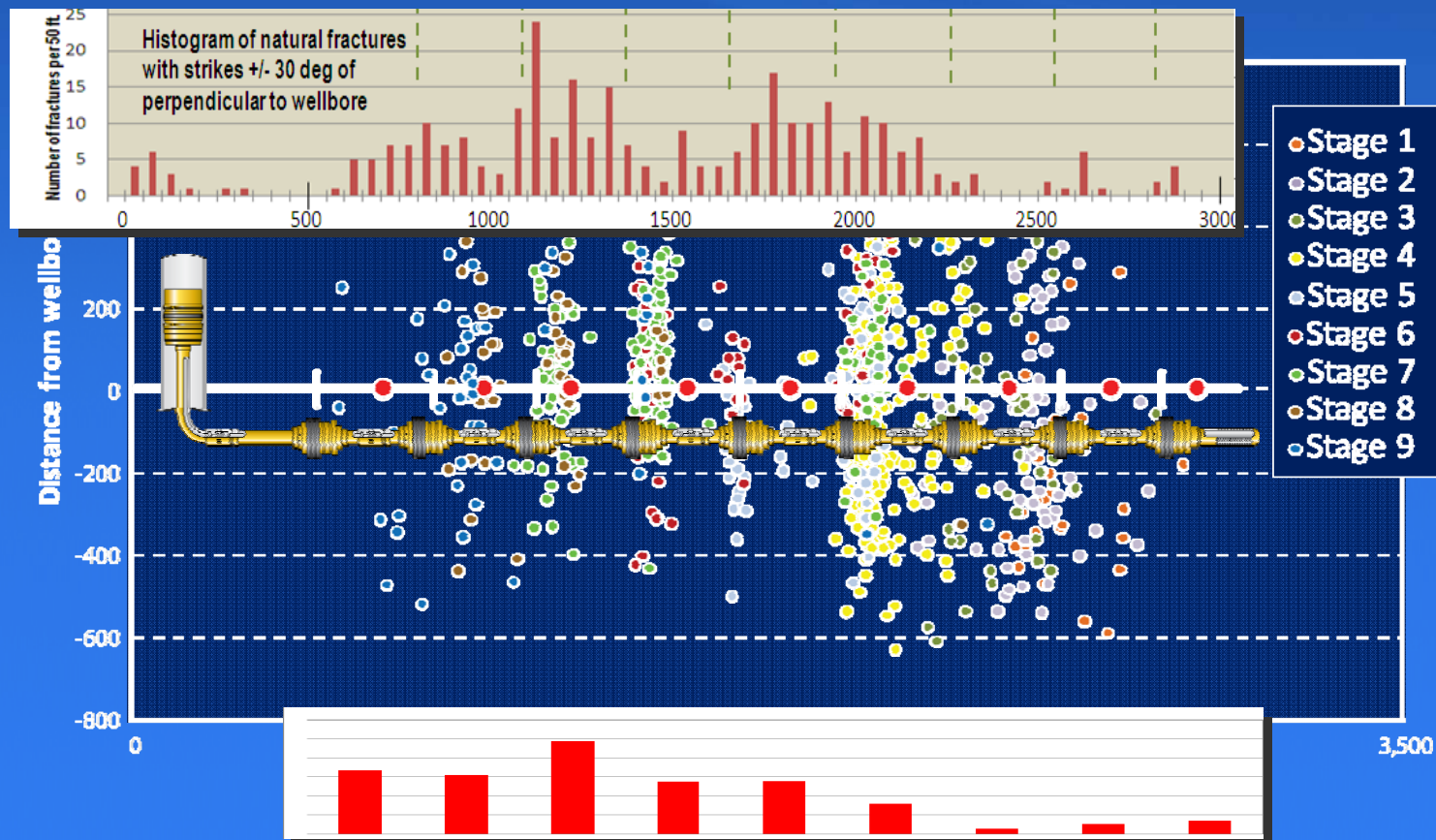
Completing the well



Completing the well



New School Shale Example: Understanding the production Source



- Microseismic events do not relate to production response
- Do all microseismic events relate to fluid presence?
- Production seems dependent on natural fractures

Infill Drilling: Doubling Daily Production and Additional Reserves

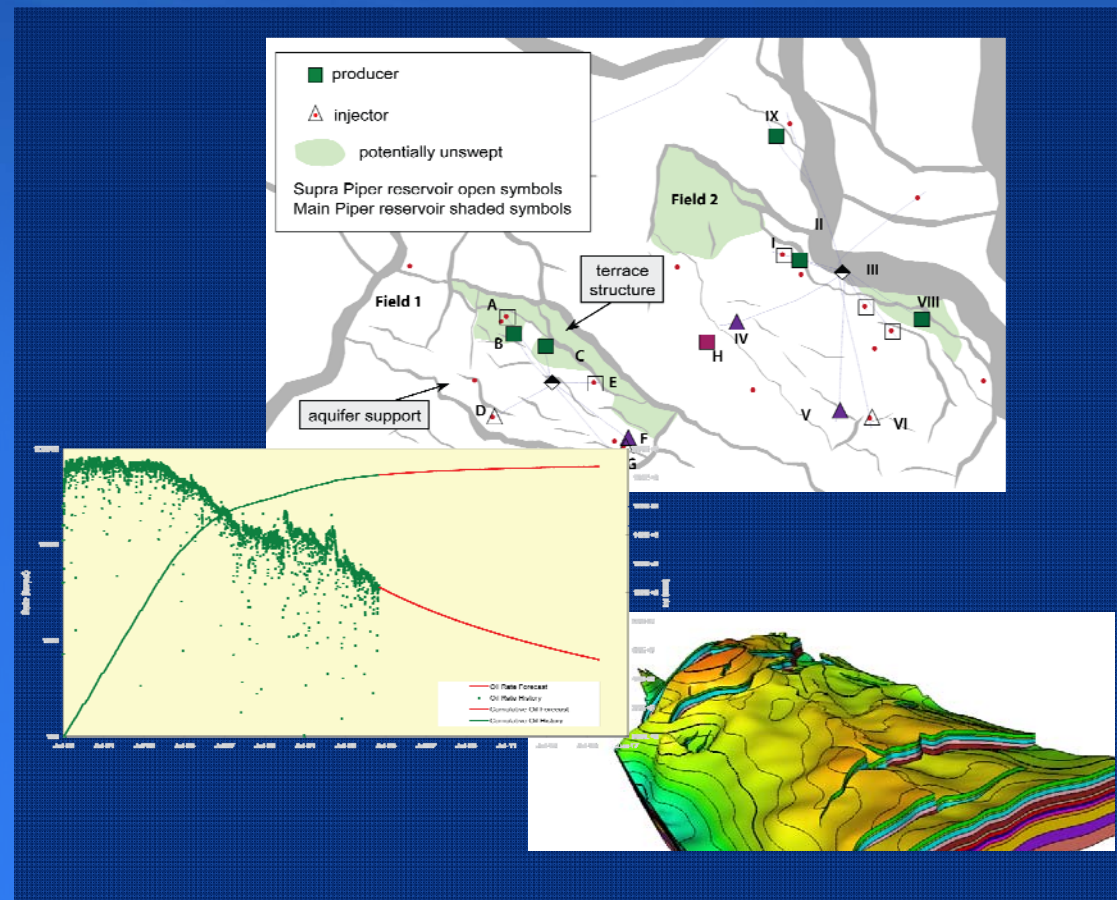
Provided a permanent subsurface team for client for 13-year period during significant asset divestiture

Developed an in-depth understanding of the subsurface architecture and field dynamic performance

Identified and developed a series of production optimization and investment opportunities on behalf of the client

This resulted in the client:

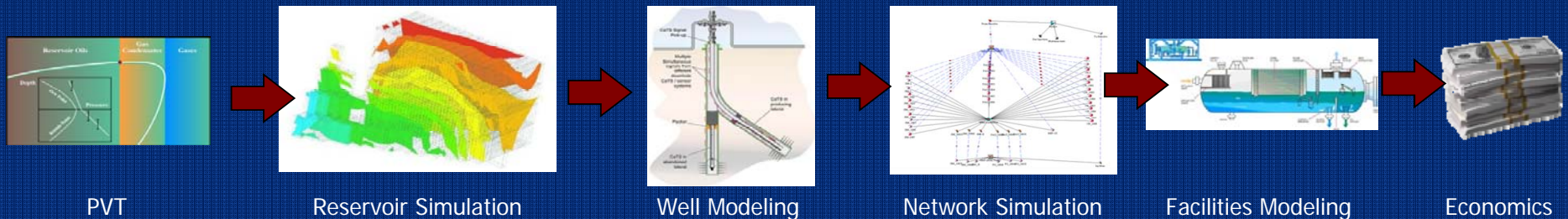
- Doubling daily production
- Accessing an additional 4 million bbls of reserves



These results were for a field being prepared for abandonment!

The Business of Energy – The right tool at the right time

Optimized the field development planning and phasing of capital expenditure for international gas fields in order to meet local gas demands over the next 30 years



Built an integrated subsurface-to-facilities model linking the three reservoirs in question

The fully compositional model had to optimize the production profile against several reservoir management and field operating conditions:

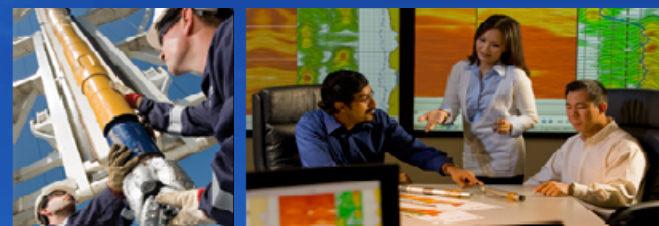
- NGL, Gas, Injection/stripping
- Wide ranging CGR's
- Separate concession contracts
- Drawdown constraints to avoid Condensate drop out and Sand Production & Erosion
- Corrosion restrictions
- Development schedule

The client is now using the tool to optimize capital investment decisions to manage the production profile.

Baker Hughes Today

DRILLING and EVALUATION

Drill bits,
directional drilling,
formation evaluation



COMPLETION and PRODUCTION

Completion, intervention,
intelligent well systems,
artificial lift



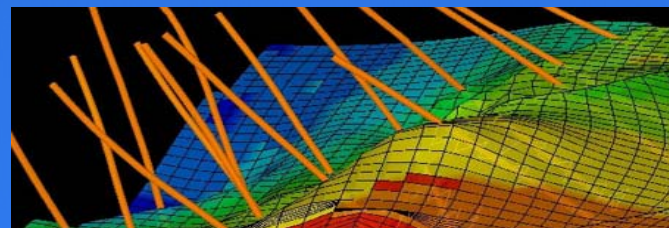
FLUIDS and CHEMICALS

Drilling fluids,
completion fluids, production
chemicals



RESERVOIR TECHNOLOGY and CONSULTING

Reservoir Development Services
Gaffney, Cline & Associates



PUMPING SERVICES

BJ Services



**BAKER
HUGHES**

- Energy Business Solutions
 - Exploration to Abandonment
 - Reservoir to Burner Tip
 - Primary/ EOR
 - Conventional/Unconventional

Advancing Reservoir Performance

Mature Field Optimisation

Rich Ruggiero
VP Field Development
Reservoir Development Services
Baker Hughes Incorporated

