Burlington Resources
Canada-MIT Alliance

By: Chen-Wen Huang & David Miller
BRC is headquartered in Calgary with a staff of 700 employees. It is one of the major producers in the Western Canadian Sedimentary Basin, which provides about 15% of North America’s natural gas.

Major acquisition in 01 and 02, 800 wells planned for 03, and 5%~8% growth rate target.

The basin is maturing, which means declining reserve. Yet profitability is still healthy due to high gas prices and improving technology.

Q: **proactive measures** that can help them weather possible **limitation to growth** in the near future

(Courtesy of Burlington Company. Used with permission.)
Our Contacts

■ The People
  ■ George: Consultant and system dynamicist
  ■ Roy: Manager, Reserves
  ■ Jeff: Head of Planning
  ■ Colleen: Commercial Analyst
  ■ Rob: Head of Engineering
  ■ Tom: Management Team

■ The Process
  ■ Weekly conference call, along with web-based conferencing

(Courtesy of Burlington Company. Used with permission.)
The Most Valuable Pieces of Information
BRC walks away with:

- To increase the number of licenses for drilling, you need to apply for fewer licenses.

- The more months of inventory you try to create, the fewer resources you need to do so.
What are they afraid of?

“Don't see fear really happening … WCSB still has ‘a sh*tload’ of gas economically recoverable (90 Trillion Cubic Ft).

(Courtesy of Burlington Company. Used with permission.)
But, how hard will it be to obtain licenses to drill?

- Fear
- Hope
- Expect

Barriers to Development (e.g. effort per well to get license)

- BRC continues to follow industry average
- BRC makes mistakes and increased barriers erode competitive advantage
- BRC substantially outperforms industry

1950 2004 2020
More or Better?

- Burlington has $15+ Million to invest in “improvement activities”
  - Where/how to invest it?
- Choices:
  - Opportunity Development ➔ greater inventory of potential sites ready for license application
  - Process Improvement ➔ better internal process for license application
- Which would lead to lower Barrier to Development? (reduced effort per well to receive license)

(Courtesy of Burlington Company. Used with permission.)
Loop Description of the Problem

- Desired Application Rate
- Desired Resource Utilization
- Error Rate
- Error Count
- Licensing Time
- Rig-Ready Inventory
- Rig-Ready Shortage
- Resource Capacity

Symbols:
- "R" indicates a variable.
- "error delaying approval" and "error reducing capacity" annotates the flow of variables.
Policy lever: ‘Diligence’

- First discussed in detail during 6th week
  - “Each non-diligence increases enforcement regulation”
  - “As you exceed company’s capacity, errors increase”

- ‘Diligence’ is about quality over quantity
  - Taking more time to do environmental studies
  - Working slower, but better
Loop Description of Strategy #1:

- Desired Application Rate
- Resource Capacity
- Error Count
- Error Rate
- Reputation
- Licensing Time
- Rig-Ready Inventory
- Rig-Ready Shortage

Diligence

Error delaying approval
Error reducing capacity
The number of wells drilled depends strongly on season. (ground condition, soil condition, environmental regulations)

This translates to fluctuation in the Rig-Ready Inventory
Loop Description of Strategy #2:

- Desired Rig-Ready Inventory
- License Expiration
- Error Rate
- Reputation
- Error Count
- Resource Capacity
- Time to fulfill shortage
- Diligence
- Desired Application Rate
- Desired Resource Utilization
- Error delaying approval
- Error reducing capacity
- Error Rate
- Reputation
- Time to fulfill shortage
- Diligence
- Desired Application Rate
- Desired Resource Utilization
BRC Takes the Advice to Heart:

- “Never, ever, ever decrease your diligence, esp. when under pressure”

- “Appropriate for licensing group to have rules oriented culture”

- “Have to be very cognizant of forward look to get inventory where you want it”

- “I want to go show this to x in service”
Consulting Process:

<table>
<thead>
<tr>
<th>Standard Method</th>
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• Reserve Distribution (over time)
• Oil Company Profits
• Commodity Price
• Production Decline
• Royalties
• Drilling cost per meter
• Completion Technologies
• Drilling Technology
• Seismic Technique
• Visualization Technologies
• Proven Reserves
• Drilling Rig Availability
• Gas Storage Potential
• Transportation Cost
• Pipeline Capacity
• Infrastructure Cost over time
• Infrastructure Density
• Environmental Considerations
• Public Opinion
• Access Difficulty
• Approval Time
• Price of byproducts
• Kyoto
• Federal & Provincial Politics
• Carbon Taxes
• Tax incentives
• Alternate Methane Sources
• US/Can Exchange Rate
• US Protectionism
• Demand for Natural Gas
• Seasonality
• Cost of Substitutes
• Geographical Distribution of remote reserves
• Concentration of mineral rights
• Industry concentration
• Area concentration
• Explore vs. Harvest mentality
• Rate of Acquisition
• Finding & Development Cost
• Cost of LNG
• Capital Stock turnover
• Climate Change
• Market perception
• Skilled labour supply
• Public Opinion (for investment)
• Resources for R&D
• Resources for Marketing
• Resources for…..
• Regulatory overhead (&oversight)
• Terrorism
• Alternate Energy supply & cost
• Non-hydrocarbon energy sources
• Conservationism
• Price volatility
• Deregulation
• Basin connectivity
• Switching cost
• Diversion of Natural Gas from Market to Oil Production
• Energy Efficiency Technologies
• Public expectation of comfort
• Geopolitical forces
• Cost of Mineral Rights
• Cost of finding reserves vs. buying companies
• Barriers to Development
• Global Impact
• Cost of Steel
• Cost of waste disposal
• Water Consumption
• Process Efficiency
• General & Administrative Costs
• Share Price
• Cost of Capital
• Company Revenue
• Company Profit
• ROCE
• Corporate Structure
• Nationalism
• Security of Supply
• Market share of Natural Gas for Energy vs. Petrochem feedstock
• Fuel Switching

More than enough variables…
The Ever-Evolving Reference Mode—modification made after tracing the causal loops constructed.

Feb 25

Profits

- Profits have been healthy, but cyclical due to commodity cycle.
- Profits spike due to short term high prices, then a profitability squeeze caused by demand decline and high F&D costs.

March 15

BRC Profits from WCSB

- BRC in WCSB and its predecessors POCO and Cdn Hunter.
- Strategic investments secure high & relatively stable profits.
- BRC suffers setbacks, falls behind local competitors, exits WCSB.

Expected

Hope

Fear
Homemade Remedy to Complexity—Rank the Importance of the Sub-Loops Bringing the Clients Back to Focus
<table>
<thead>
<tr>
<th>Reference Mode</th>
<th>Sub-Loop</th>
<th>George</th>
<th>Roy</th>
<th>Jeff</th>
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<tr>
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It became clear that our clients had their focus on factors which they could not control; this brought everyone’s attention back to relevant AND controllable policy levers against errors !!!
We Learned from the Client Reception of the Different Generations of Models that…

- Model need not reflect operational details of client. In fact, our clients resisted model version 1.0 initially due to too much operational detail.

- At the end, we had to remind the clients that the model is not reality and should not be used to generate magical numbers for policy-making.
Finally…

It's hard letting go of our baby at the end!
Last but not Least...

“I would like your mailing addresses so we can send you a small token of appreciation.”

-George Coppus

May 12th, 2004