Technology to the Rescue in a World of Low Oil and Gas Prices

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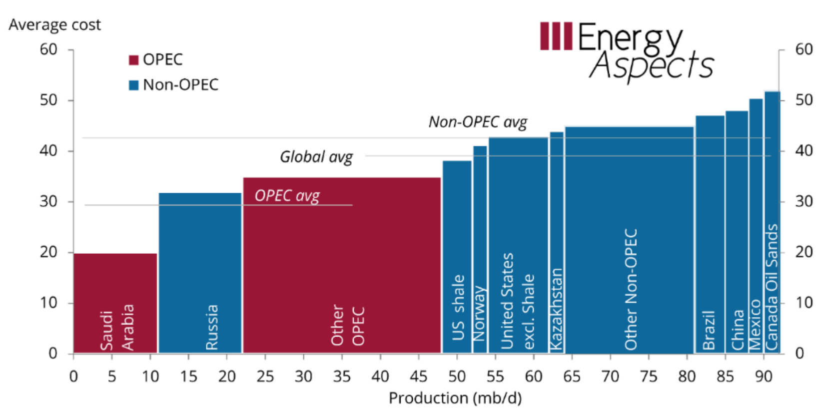
NON-OPEC SUPPLY EX-US (6/7)

Costs are coming down fast but this is cyclical

Global cost curve
$ per barrel



Current crude prices are below cash costs in most of the world. Currency, over-capacity in the service market and a focus on propping up near-term production has played a large role in reducing operating costs across 2015 and 2016.

Source: Company data, Energy Aspects analysis

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Process & Efficiency Improvements US Shale and Tight oil plays

Increasing Costs	Decreasing Costs
Play margin delineation	Derisked geology
Drilling/completion/ stimulation surprises	More efficient drilling/ completion/stimulation
Competition for leases	Consolidation of leases
Supply chain bottlenecks	Supply chain optimization
Infrastructure bottlenecks	Infrastructure buildout
Service cost increases ○ Equipment shortages ○ Personnel shortages	Service cost discounts ○ Amortization of CAPEX ○ Service efficiencies ○ Increased competition

Early in development cycle
Late in development cycle

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Downturn-Driven Efficiencies US Shale and Tight Oil Plays		
Asset High Grading	▪ No more exploratory drilling ▪ Ultra sweet spotting ▪ Completing DUCs ▪ Only the best rigs and crews	Intelligent Downsizing
Technical Innovations		
Pad Drilling	▪ Site construction efficiencies ▪ Well construction efficiencies ▪ Creeping rigs ▪ Supply chain simplification	Factory Mode
Super Fracks	▪ Longer laterals ▪ Tighter fracture initiation points ▪ More water ▪ More proppant	Even More Brute Force

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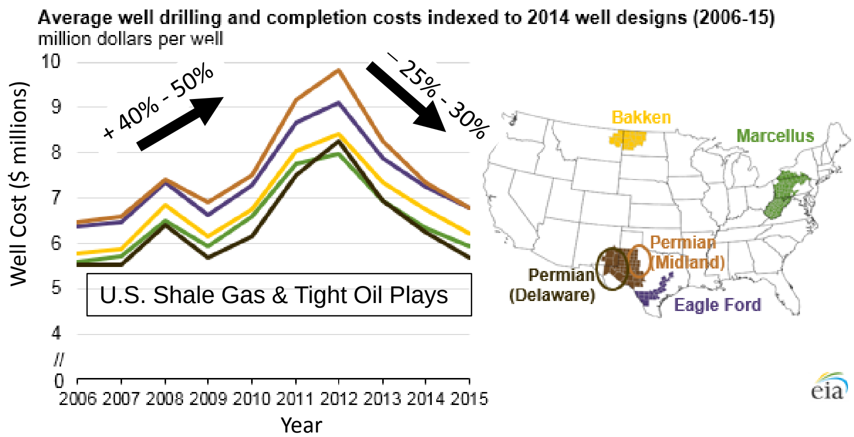
Process and Efficiency Improvements are
"Every Day Innovations" that Continue Through Business Cycles



https://www.eia.gov/petroleum/weekly/archive/2016/160602/includes/analysis_print.cfm

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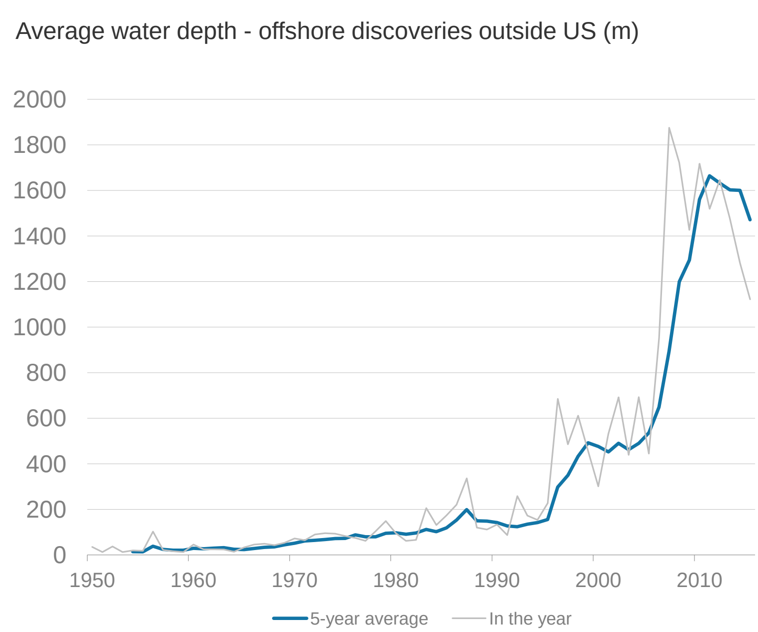

Source: Rystad Energy

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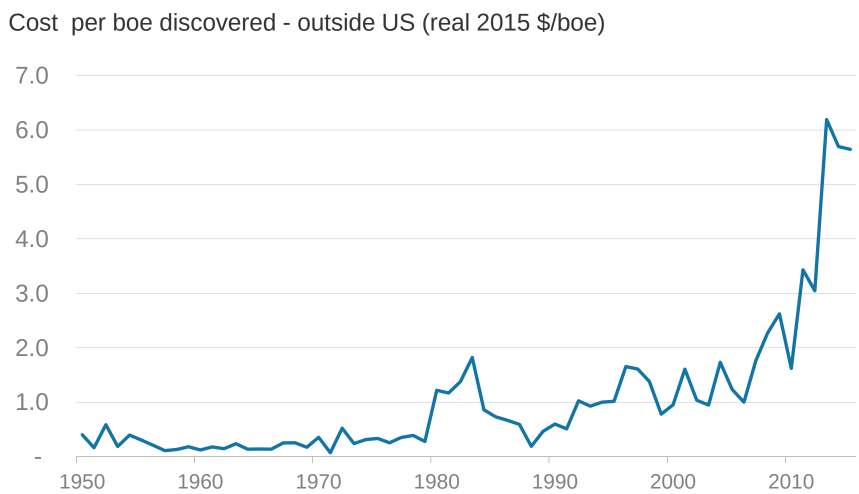

Source: Rystad Energy

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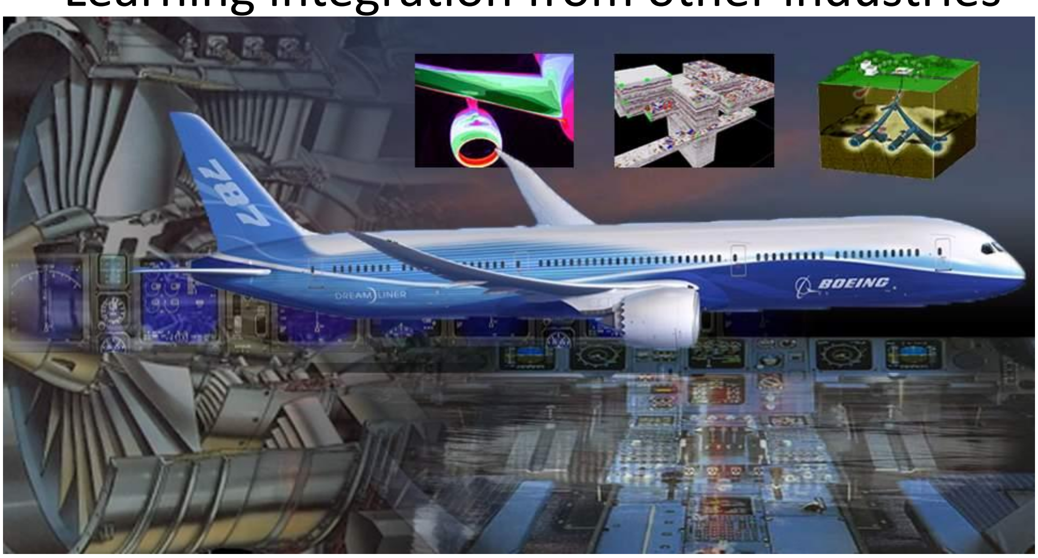
Learning integration from other industries



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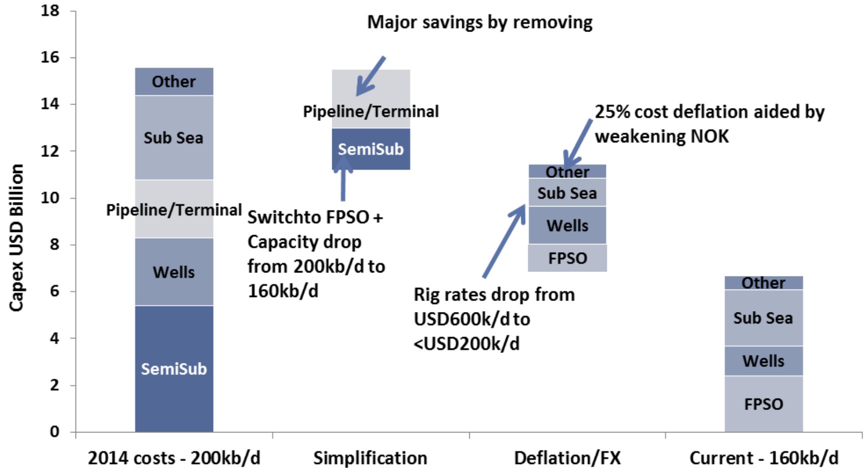
Johan Castberg



Source: Company data, Goldman Sachs Investment Research

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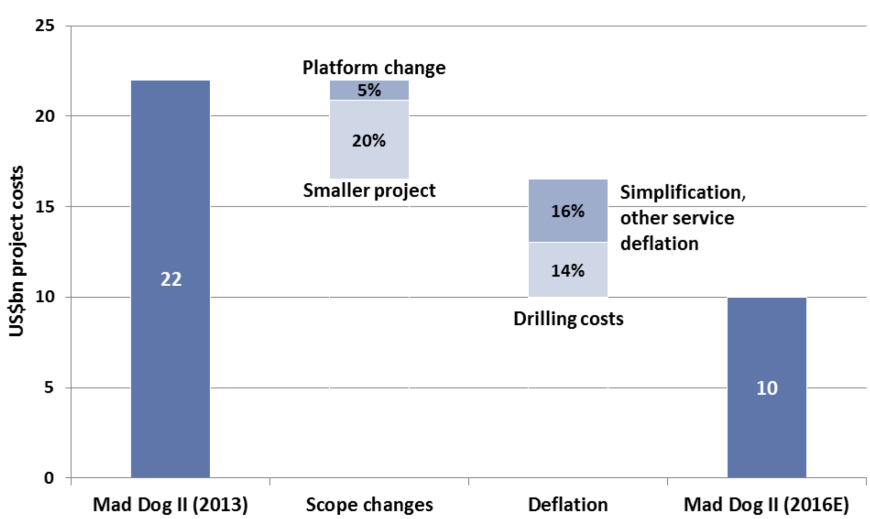
Mad Dog II



Source: Company data, Goldman Sachs Investment Research

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Innovation & the Business Cycle

When Oil & Gas Prices are Falling or Low

- Academic & government O&G research winds downs
- Industry R&D shrinks
  - Hiring is cut
  - Less emphasis on novel techniques
  - Efficiency improvements prioritized
  - Some innovations are lost
- Technology development outsourced
  - Downsizing of risk
  - IOCs → Service Cos → Start Ups
- Technology leaders of the next up-cycle shrink the least
  - Industry-changing innovations develop over 10 - 20 years
  - Technology true believers carry on through thick and thin