The ideas and thoughts expressed herein are for discussion purposes only. They do not necessarily represent the views of Anadarko Petroleum Corporation or its subsidiaries, affiliates, shareholders, directors or officers.
Our Mission

Anadarko Petroleum Corporation’s mission is to deliver a competitive and sustainable rate of return to shareholders by exploring for, acquiring and developing oil and natural gas resources vital to the world’s health and welfare. As of year-end 2016, the company had approximately 1.72 billion barrels-equivalent of proved reserves, making it one of the world’s largest independent oil and natural gas exploration and production companies.
Developing a Data Science Organization

- It begins with a Strategy

“What if we don’t change at all ... and something magical just happens?”
Role of Data Science at Anadarko Petroleum

Advanced Analytics & Emerging Technologies Structure

<table>
<thead>
<tr>
<th>Digital Operations</th>
<th>Market Intelligence</th>
<th>Reservoir Characterization</th>
<th>Geophysics</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORE GROUP</td>
<td>Teams of 35+</td>
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<td></td>
<td>• Deliver insights</td>
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<td></td>
<td>• Develop prototypes</td>
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<tr>
<td>Data Scientist</td>
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<td>Geoscientist</td>
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<td>Engineer</td>
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<td>Prototypes</td>
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<tr>
<td>Business Strategy</td>
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<tr>
<td>• Strategic partners</td>
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<tr>
<td>• Emerging tech – Pilots</td>
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<tr>
<td>DEVELOPMENT OPERATIONS</td>
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<tr>
<td>• Prototype productization</td>
<td></td>
<td></td>
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<tr>
<td>• Technology stack</td>
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</tbody>
</table>

Key Performance Indicators

1. Data ➔ Data foundation & aggregation
2. Algorithms ➔ In-House Analytics
3. Talent ➔ Pairing SMEs with Data Scientists
4. Outputs ➔ Automation, predictive power, speed

2017 Anadarko Technology Successes

<table>
<thead>
<tr>
<th>Category</th>
<th>Achievements</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Intelligence</td>
<td>Reduction of high-quality basin screening time from 6 months to 30 days</td>
<td>US Onshore Exploration</td>
</tr>
<tr>
<td>Reservoir Characterization</td>
<td>Early cumulative production gains of more than 35% in the DJ Basin</td>
<td>DJ Basin</td>
</tr>
<tr>
<td>Digital Operations</td>
<td>Continuous improvement on drilling cycle time reduction and efficiency gains</td>
<td>DJ and Delaware Basins</td>
</tr>
<tr>
<td></td>
<td>In-house surveillance logic on 12 Deepwater facilities.</td>
<td>Gulf of Mexico, International</td>
</tr>
</tbody>
</table>
Required Components for a Data Science Org

Organizational Structure

HR

Organizational Integration

Technology

Data

*Adapted from Amy Gershkoff – CDO at Ancestry.com
1. Organizational Structure

Where is Data Science located? → Defines Success

- CEO
- COO
- CIO / IT
- CTO / Software Engineering
- CFO
- R&D

... Overall Business Performance
Revenue & Operations Efficiency
Improving Processes
Digital Transformation
Reducing Costs
True R&D
1. Organizational Structure

- **Realistic Expectations:**
  - Data Scientists can’t fix a broken business model

"Quick! Somebody find me a data scientist!"
2. Organizational Integration

- Integration with the Subject Matter Experts (SMEs)

- Communication with the Business

- Understanding and Measuring Success

- Operating Model (i.e., Agile / Scrum, Ad Hoc, Waterfall)
3. HR

- TALENT IS KEY!!

- Job Title, Career Ladder, Development Opportunities, Compensation Structure

- Recruit, Attract, & Retain the best talent
  - What matters to Data Scientists?

- Building out the best team
  - Diversity of the individuals, background, & thought

What do you mean "clean all this data"?
This was sold to me as the 'sexiest job of the 21st Century'.

mark.stevenson@welovesalt.com
@agent_analytics
4. Data Infrastructure

- Garbage In – Garbage Out

- Enterprise Data Architecture
  - Appropriate Technology

- High Data Availability & Quality
  - QAed regularly

- Accessible for Data Scientists
5. Technology Infrastructure

- **Software approach & resources**

- **Hardware resources**
  - Individual workstations with NVIDIA P6000 cards
  - NVIDIA DGX boxes each with 8 Volta-chipset GPUs
  - Google Cloud Platform (TPUs and GPUs)

- **Model deployment strategy**

- **Partnership with IT & Technology**
Salt interpretation for velocity model building using long-offset multi-WAZ data improves the subsalt image in the eastern Mississippi Canyon in the GoM. (Courtesy: TGS)

Public image from http://petroscan.co.uk/seismic-vectorising/
HPC Projects – Rapid Onshore Basin Evaluation

- Deep Learning Networks for propagating formation tops across a basin
- Automatically QC large volumes of Well logs using Machine Learning

![Diagram showing various geological areas and Mean EUR Areas with labels for Highest EUR’s, Upside Potential, and Lower EUR’s.](image.png)
Other HPC Projects

- **Optimization Frameworks**
  - Massive Parallel Computing Problems

- **Reservoir Simulation for Unconventionals and Conventionals**
  - Static and Dynamic Modeling
  - Uncertainty Quantification
Conclusion

- Challenging Problems
- Talent is Key
- 5 Components for Data Science success

We don’t want our Data Scientists to be...