Technologies Impacting US Unconventional

Stephen R Ingram

Halliburton
The Frac Site

Time Based

Time & Outcome Based

Outcome Based
<table>
<thead>
<tr>
<th>Basin</th>
<th>Plays</th>
<th>Avg Lat.</th>
<th>Avg Stgs</th>
<th>Sand</th>
<th>HHP</th>
<th>Pad Drilling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midland</td>
<td>Lower Sprayberry, Wolfcamp A, B, C &amp; D, Cline</td>
<td>10,100</td>
<td>54</td>
<td>19M</td>
<td>30k</td>
<td>45%</td>
</tr>
<tr>
<td>Delaware</td>
<td>Avalon, Bone Spring 1, 2 &amp; 4, Wolfcamp</td>
<td>8,500</td>
<td>44</td>
<td>20.4M</td>
<td>38k</td>
<td>60%</td>
</tr>
<tr>
<td>Eagle Ford</td>
<td>Eagle Ford, Austin Chalk, Eagle Bine</td>
<td>7,500</td>
<td>25-40</td>
<td>8-11M</td>
<td>40k</td>
<td>93%</td>
</tr>
<tr>
<td>DJ</td>
<td>Niobrara, Codell</td>
<td>7,500</td>
<td>40</td>
<td>12M</td>
<td>28k</td>
<td>99%</td>
</tr>
<tr>
<td>Williston</td>
<td>Bakken, Three Forks</td>
<td>10,000</td>
<td>35-50</td>
<td>10M</td>
<td>28k</td>
<td>95%</td>
</tr>
<tr>
<td>Marcellus</td>
<td>Lower &amp; Upper Marcellus, Geneseo / Burkett</td>
<td>7,250</td>
<td>45</td>
<td>20.5M</td>
<td>28k</td>
<td>94%</td>
</tr>
<tr>
<td>Utica (OH)</td>
<td>Point Pleasant</td>
<td>10,000</td>
<td>50</td>
<td>23M</td>
<td>32k</td>
<td>90%</td>
</tr>
<tr>
<td>Anadarko</td>
<td>SCOOP/STACK, Cana, Woodford, Osage, Merge, Mississippi Lime, Barnett,</td>
<td>7,800</td>
<td>26</td>
<td>10M</td>
<td>34k</td>
<td>25%</td>
</tr>
</tbody>
</table>
The Frac Site

Time Based

Time & Outcome Based

Outcome Based
1) Frac Site Advances
Time Based Efficiencies
The Frac Site

Time Based

Time & Outcome Based

Outcome Based
2) Frac Site Advances

Time & Outcome Based

- Algorithm-based decision making
- Manufactured Delivery
- Design replication stage-by-stage
- Reduce risk of screen-out
- Backbone for faster learnings

- Dynamically control flow rate
- Use real-time measurements
- Adjust to stage design and formation variability

Process consistency
The Frac Site

Time Based

Time & Outcome Based

Outcome Based
3) Frac Site Advances
Outcome Based (Fiber Optic Technology)
3) Frac Site Advances
Outcome Based (Fiber Optic Technology)
3) Frac Site Advances
Outcome Based (Fiber Optic Technology)

- Data Provided Real-time
- Key Design Parameters Adjusted
  - Stage length
  - Number of clusters per stage
  - Rates
  - Volumes
  - Proppant Staging
  - Cluster Spacing
  - Diversion