Infill Wells - Part 1: North America’s Largest Oilfield Challenge
Minimizing Losses During Well Shut-In and Restart Operations

Infill Wells - Part 2: Maximizing Returns through Successful Planning & Design
DELF1 - Cognitive E&P Environment

Infill Wells - Part 3 - Drilling & Cementing for Optimal Frac Performance
Advances in Remote Land Operations

Infill Wells - Part 4: Real-Time Frac Hit Mitigation Strategies
Digital Oilfield: The Future is Now

Infill Wells - Part 5: Sustaining Optimal Infill Well Production
Minimizing Losses during Shut In Operations
Solutions for improving production and lowering costs
Presented by: Jason Baihly

Thursday, May 28th
11:00AM – 12:00PM MST

Benefitting Denver AND Houston Communities
Infill Wells Part 1: North America’s Largest Oilfield Challenge
Presented by: Efe Ejofodomi

Thursday, May 14th
11:00AM – 12:00PM MST
EFE EJOFODOMI

INSIGHTS

- Languages: English | Spanish
- Favorite Food: Meats | Salads
- Favorite Drink: All except Tequila

SCHLUMBERGER JOURNEY

- 14 YRS: Field | Technical | Operations | Management
- LOCATIONS: Multiple countries and regions
Definition

What is an Infill well?

A horizontal well completed within 2,000 ft of an existing well (parent) with at least 6 months of production.
Infill Well Analytics App

**Infill Well Definition**
- < 2,000 ft
- > 6 Months

**Keywords**
- Basin Trends
- Technology Impact
- Operator Activity
- Infill Performance
- Completion
- Benchmarking
- Production
- Service Providers
Historical Efficiency Landscape – US Land

**DRILLING EFFICIENCY**

- Days / 1,000 ft
- 1.35
- 1.15
- 0.95
- 0.75

**INFILL WELL RATE**

- 0%
- 20%
- 40%
- 60%
- 80%
- 100%

**STAGES PER HZ WELL**

- 0
- 10
- 20
- 30
- 40
- 50

**INFILL WELL PERFORMANCE**

- 0
- 2000
- 4000
- 6000
- 8000

Normalized production represents best 12 months BOE cum normalized by lateral length and proppant volume.

Includes content supplied by IHS Markit Inc.; Copyright © IHS Markit Inc., 2019. All rights reserved.
## Infill Well Development Impact

### % INFILL WELLS

<table>
<thead>
<tr>
<th>Region</th>
<th>Infill Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Williston</td>
<td>86%</td>
</tr>
<tr>
<td>Eagle Ford</td>
<td>76%</td>
</tr>
<tr>
<td>DJ</td>
<td>68%</td>
</tr>
<tr>
<td>Delaware</td>
<td>64%</td>
</tr>
<tr>
<td>US LAND</td>
<td>60%</td>
</tr>
<tr>
<td>Midland</td>
<td>54%</td>
</tr>
<tr>
<td>Haynesville</td>
<td>49%</td>
</tr>
<tr>
<td>Marcellus</td>
<td>48%</td>
</tr>
<tr>
<td>Powder River</td>
<td>31%</td>
</tr>
</tbody>
</table>

### INFILL VS. PARENT PRODUCTION

<table>
<thead>
<tr>
<th>Region</th>
<th>Infill vs. Parent Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Williston</td>
<td>-47%</td>
</tr>
<tr>
<td>Eagle Ford</td>
<td>-49%</td>
</tr>
<tr>
<td>DJ</td>
<td>-80%</td>
</tr>
<tr>
<td>Delaware</td>
<td>-42%</td>
</tr>
<tr>
<td>US LAND</td>
<td>-46%</td>
</tr>
<tr>
<td>Midland</td>
<td>-24%</td>
</tr>
<tr>
<td>Haynesville</td>
<td>-64%</td>
</tr>
<tr>
<td>Marcellus</td>
<td>-8%</td>
</tr>
<tr>
<td>Powder River</td>
<td>-61%</td>
</tr>
</tbody>
</table>

1. SPE-780200

Normalized production represents best 12 months BOE cum normalized by lateral length and proppant volume.
Consequences of Infill Well Development

INFILL WELLS

STIMULATION
INEFFECTIVE FRAC EFFICIENCY
POOR OVERAGE

PRODUCTION
PRODUCTION DEGRADATION
BYPASSED DRAINAGE

CASH FLOW
POOR PERFORMANCE
LOWER ECONOMIC RETURNS

ECONOMIC IMPACT
OF INFILL WELL INTERFERENCE

OFFSET WELLS

DRILLING
STUCK PIPE
LOST CIRCULATION (MUD, CEMENT)

PRODUCTION
PRODUCTION LOSS
DEFERRED PRODUCTION

DAMAGE
TEMPORARY (Well debris >> Clean up costs)
PERMANENT (Liner, production equipment, etc.)

$21B

1. Schlumberger NAM analysis

Schlumberger-Private
Infill Well Development Challenges

PLANNING & DESIGN
- Surface location
- Landing Locations
- Lateral Spacing
- Staging
- Size
- Well Count

PRODUCTION
- Plug Drill Out
- Flowback
- Flow Optimization
- RT Monitoring
- RT Optimization

CONSTRUCTION
- Geosteering
- Loss Circulation
- Mud Losses
- Well Construction
- Cement Placement
- Zonal Isolation

COMPLETION
- Cluster Efficiency
- Frac Initiation
- Frac Propagation
- Sequencing
- Intra-well Interference
- Inter-well Interference

Infill Development Challenges

1. Cluster Efficiency
2. Frac Initiation
3. Frac Propagation
4. Sequencing
5. Intra-well Interference
6. Inter-well Interference
Infill Well Digital Program

- **Infill Planning**
- **Design to Produce**
- **Infill Construction**
- **Frac to Produce**
- **Infill Production**

**Workflows**
- **Design**
- **Digital Oilfield**

**Digital Products**

**Ecosystem**

**Plan to Produce**
- Digital Design
- Digital Oilfield
Continued Innovation Driving Performance

PLAN to PRODUCE – DELAWARE BASIN CASE STUDY

Digital infill well stacking and spacing planning maximizes recovery with least wells per section

$48MM COST SAVINGS

Continued Innovation Driving Performance

PLAN to PRODUCE – DELAWARE BASIN CASE STUDY

Digital infill well stacking and spacing planning maximizes recovery with least wells per section

$48MM COST SAVINGS
**Fulcrum Technology Application**

Cement-conveyed frac performance technology

*First* technology to improve zonal isolation for wells drilled with OBM

Enhance stimulation effectiveness by inhibiting fluids communication behind casing to initiate fractures on target interval

---

**Case Studies**

**DRILL to PRODUCE – DELAWARE BASIN CASE STUDY**

5 Fulcrum wells compared to 53 wells within a 10-mil radius

Mean 3-month cumulative liquids production, bbl

- Normalized by Laterla Length
- Normalized by Mass Proppant

- +22% OIL PRODUCTION
- +42% ROI

Normalized by Laterla Length

Normalized by Mass Proppant

Wells treated conventionally

Wells treated with Fulcrum technology

+22 – 42%

329%
Case Study – Real-Time Infill Well Optimization (SPE 194333-MS)
Fracture Geometry Control Technology Mitigates Negative Well Interference
Technology Implementation Strategy

WELLWATCHER STIM
Real-time
High Frequency Pressure Monitoring
(All Wells)

BROADBAND SEQUENCE
Near-wellbore diverter
(All stages)

Well 2 – Child

BROADBAND SEQUENCE
Near-wellbore diverter
(All stages)

Well 3 – Child

BROADBAND SHIELD
Far-field diverter
Stages (20 of 50)

Well 1 – Parent

800 ft
1300 ft
900 ft
Field Application – Results

- **Well 3** (Child): All Stages treated conventionally
- **Well 2** (Child): Stages with BroadBand Sequence only
- **Well 2** (Child): Stages with BroadBand Sequence + BroadBand Shield

Normalized production represents best 3 months BOE cum normalized by lateral length and proppant volume.

Infill Well Production Comparison

- **Well 3**
- **Well 2**
- **Offset 1**
- **Offset 2**
- **Offset 3**
- **Offset 4**
- **Offset 5**
- **Offset 6**
- **Offset 7**
- **Offset 8**

Includes content supplied by IHS Markit Inc.; Copyright © IHS Markit Inc., 2019. All rights reserved.
Field Application – Full Campaign Results

FULL CAMPAIGN RESULTS (14 Wells)

- **COST SAVINGS**: $2.5M
- **OIL PRODUCTION**: +48%
- **ROI**: 519%
- **FRAC HIT OCCURRENCE**: -84%

PILOT TEST RESULTS

- **Infill Well Production Comparison**
- **Conventional Stages**: 61%
- **Technology Stages**: 42%
- **Full Campaign Results (14 Wells)**: 0%

CASE STUDIES
Schlumberger Infill Well Program Experience

**Technology**
- Deployed across all US Unconventional basins

**Expertise**
- >100 Articles and publications across various industry professional events

**Recognition**
- >60 Technology highlighted at corporate earnings press releases

**Cost Savings**
- $1.5bn

**Production**
- +60%
Infill Well Webinar Series

- **PART 1**: North America’s Largest Oilfield Challenge
- **PART 2**: Maximizing Returns through Successful Planning & Design
- **PART 3**: Drilling & Cementing for Optimal Frac Performance
- **PART 4**: Real-Time Frac Hit Mitigation Strategies
- **PART 5**: Sustaining Optimal Infill Well Production

*Summary*
Infill Well Optimization

Harness the power of comprehensive technologies and digital workflows to maximize returns from your infill well investment.

Infill drilling accounts for more than 60% of the new wells drilled in North America, making it more important than ever to follow a consistent and holistic process of planning, designing, constructing, completing, and producing them.

Infill well best practices across North America

- **Williston Basin**
  - Factors for success in North Dakota, US, and Saskatchewan and Manitoba, Canada.

- **Permian Basin**
  - Factors for success in the Midland Basin and Delaware Basin of West Texas and southeastern New Mexico.

- **Eagle Ford Shale**
  - Factors for success in South Texas.

- **Eagle Ford Shale**
  - Factors for success in South Texas.

- **Haynesville Shale**
  - Factors for success in East Texas and northern Louisiana.

www.slb.com/infill
Make Every Child Well
Outperform its Parent Well

www.slb.com/infill
Minimizing Losses during Shut In Operations
Solutions for improving production and lowering costs
Presented by: Jason Baihly

Thursday, May 28th
11:00AM – 12:00PM MST

Benefitting Denver AND Houston Communities