Digital Oilfield Trends & Opportunities
SPE Members in Transition

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Managing Director
Unconventional Capital

CEO
Ambyint
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1. Quick Background
2. Digital Oilfield Trends & Opportunities
3. Industry Changes & Career Opportunities
4. Entrepreneurial Considerations
What is Unconventional Capital?

Background

Who is UC?

= Alex Robart
  + Chris Robart

Backgrounds

PacWest Consulting Partners

IHS

Booz & Company

Charles River Associates
What have we invested in?

### UC Investments

<table>
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<tr>
<th>DOF</th>
<th>General Technology</th>
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<tr>
<td>WaterLens™</td>
<td>LawnStarter</td>
</tr>
<tr>
<td>CORVA</td>
<td>dv01</td>
</tr>
<tr>
<td>ambyint™</td>
<td>SUMMIT SYNC</td>
</tr>
</tbody>
</table>

## What is Ambyint?

**ambyAI: artificial lift insights**

Software-only solution using customer data to feed ambyint models and analytics

Implementation: IT only

**AmbyAI will deliver:**
- Analysis of customer artificial lift data
- Validation of value creation opportunities
- Relevant insights and optimization recommendations

**Full value of ambyint solution not realized due to:**
- Limited data quality
- Desktop exercise
- Inability to implement recommendations and data science insights in real time at the field-level

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**ambyControl: end-to-end adaptive control**

Hardware+software implementation of end-to-end solution at wellsite

Implementation: field + IT

**AmbyControl will deliver:**
- High quality, stroke-based data (70-100 records/stroke)
- Real-time AL control (dynamic setpoint changes)
- Advanced diagnostics and predictive analytics
- Automated recommendations to engineers + field
- Automation of routine and low-level actions
- Workflow tools to automate field level tasks/reporting

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50% Realization | Value Creation | 100% Realization
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4. Entrepreneurial Considerations
Why does Digital Oilfield (DOF) matter today?

DOF Drivers

Market Context
- Low Oil Prices
- Margin Pressures
- Reduced Headcounts
- Vendor Pricing Reduced to Limits

Adoption Drivers
- Low-Cost Solutions
- Manufacturing Mode
- Crew Change

Technology-enabled operational models will be a part of the solution
Digital oilfield opportunity is large; changing customer and market structure creating major opportunities

<table>
<thead>
<tr>
<th>Market Opportunity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Changing Customer Landscape</strong></td>
<td>- Legacy factors held back digital adoption, but evolving market and culture opening way for new wave of adoption</td>
</tr>
<tr>
<td><strong>Weak Digital Infrastructure</strong></td>
<td>- Major gaps and failure to adopt leading-edge technologies</td>
</tr>
<tr>
<td><strong>Emerging Startups</strong></td>
<td>- Early in adoption cycle; wave of immature new startups</td>
</tr>
<tr>
<td><strong>Underfunded Landscape</strong></td>
<td>- Massive early stage gap; few investors with deep oilfield+software understanding</td>
</tr>
</tbody>
</table>
Industry has been a laggard in the adoption of digital oilfield solutions due to legacy barriers; evolving market structure is game-changer

Digital Oilfield Opportunity

<table>
<thead>
<tr>
<th>Legacy Barrier</th>
<th>Description</th>
<th>Catalyst</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed Operations</td>
<td>Geographically distributed ops challenged economics of digital</td>
<td>Low-Cost Solutions</td>
<td>NEW OPPORTUNITIES</td>
</tr>
<tr>
<td>One-off Project Development</td>
<td>Traditional ‘one-off’ conventional development reduced benefits of digital</td>
<td>Manufacturing Mode</td>
<td></td>
</tr>
<tr>
<td>Supplier Fragmentation</td>
<td>Fragmented and complex; barriers between producers, consumers of data</td>
<td>Consolidation</td>
<td></td>
</tr>
<tr>
<td>Cultural Resistance</td>
<td>Cultural aversion to digital solutions at field and managerial level</td>
<td>Crew Change</td>
<td></td>
</tr>
<tr>
<td>Production Focus</td>
<td>Priority was getting BOEs out of ground as quickly as possible</td>
<td>Margin Pressures</td>
<td></td>
</tr>
</tbody>
</table>

Digital technologies will be one of the key enablers of new operational models that reduce cost structures and improve recoveries.
Landscape surging with immature startups, but we are still in early innings of adoption of new generation of digital solutions

**Emerging Startups & Industry Adoption**

**Startup Landscape Mapping**

- Total = ~1,000
- **INITIAL**

**Implications**

- Emerging set of players that customers are struggling to make sense of
- Good timing to begin working with customers to develop solutions

**Industry Hype Cycle**

- A lot of hype and noise but more stable digital adoption is finally approaching

Notes: Update to landscaping mapping exercise is in-process

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Combining leading-edge technologies to support industry priorities provide company-building opportunities

**Innovation Enablers & Themes**

**Innovation Enablers**
- Analytics/Big Data
- Marketplace
- Knowledge Management
- Robotics/Artificial Intelligence
- Internet-of-Things
- Automation & Integration
- Next-Gen Data Architecture
- Next-Gen Communications Infrastructure

**Innovation Themes**
- Next-Gen Reservoir Understanding
- D&C Operations Automation
- Production Optimization
- Intelligent Field
- Production Operations Automation
- Intelligent Equipment
- Logistics Optimization
- Remote Operations

**Opportunity**
Analytics hold great promise, but are not a stand-alone offering; require integration and deep domain expertise

### Customer Priority: Big Data/Analytics

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Required Capabilities</th>
<th>Barriers</th>
</tr>
</thead>
</table>
| ■ Emergence of new analytics tools (led by Silicon Valley) hold great promise | ■ However, big data/analytics tools require tight integration of three disciplines:  
- Data management: infrastructure in place that manages data and ensures data quality  
- Data analytics: advanced analytics tools that integrate tightly into existing workflow and technology stack  
- Domain expertise: pain point and process knowledge that develop “productized” tools that create value | ■ Most E&Ps have not developed robust data infrastructures that address gaps in data quality  
■ Sophisticated vendors from outside of industry are struggling to adjust to o/g business models and requirements  
■ Shortage of O/G domain experts that also understand analytics to drive identification of use cases and “productize” offerings |
| ■ Can be generally divided into two broad sets and data architectures/tools, designed to manage different types of data:  
  - Data at-rest (ie. data lake)  
  - Data in-motion (ie. real-time analytics) | | |
| ■ Customers are enthusiastic about prospects for advanced analytics tools to deliver value across the E&P operation | | |
Convergence of IT and OT (operations technology) will drive shift in decision-making from IT to Operations staff

Customer Priority: Industrial IoT

**Industrial Automation**
- Networks: Proprietary
- I/O: Proprietary
- Computing Infra: On-Premise
- Adoption Business Case: Efficiency

**IT/OT Convergence**
- Networks: Hybrid
- I/O: Hybrid
- Computing Infra: Hybrid
- Adoption Business Case: Cost Savings

**Industrial IoT**
- Networks: Internet Protocol
- I/O: Internet Protocol
- Computing Infra: Mostly Cloud
- Adoption Business Case: New Revenue Models

Industry just beginning to advance beyond traditional SCADA to newer automation/control technologies

**IT/OT Convergence**
- Bulk of IT spend resided within IT org, which exercises primary control over purchasing decisions
- IT/OT convergence requires technology/capabilities be embedded within operations

**Decision-Making Implications**
- With technology adoption shifting beyond corporate functions, operations will increasingly take a more active role to play in digital decision-making
- Operations will increasingly manage digital spend and lead purchasing decisions

Source: 451 Research
# Voice of Customer

<table>
<thead>
<tr>
<th>Drivers</th>
<th>Investment</th>
<th>Top Priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Better</strong></td>
<td>60%</td>
<td><strong>Big Data/Analytics</strong></td>
</tr>
<tr>
<td><strong>Faster</strong></td>
<td>% of companies investing same/more in next 2 years</td>
<td>- Mgmt of large data sets</td>
</tr>
<tr>
<td><strong>Cheaper</strong></td>
<td>80%</td>
<td>- Real-time visualization/analysis</td>
</tr>
<tr>
<td></td>
<td>% of companies investing same/more in next 3-5 years</td>
<td>- Real-time alarms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Remote asset monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Real-time data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- HSE</td>
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<tr>
<td></td>
<td></td>
<td>- “As-a-service” models</td>
</tr>
</tbody>
</table>

**Perceived barriers: existing workflows + security**

Source: Accenture/Microsoft Oil & Gas Digital & Technology Trends Survey, 2015
Industry is complex and so is digital oilfield

Digital Oilfield Segmentation

<table>
<thead>
<tr>
<th>Exploration</th>
<th>Drilling</th>
<th>Completion</th>
<th>Production</th>
<th>Midstream</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismic Ops</td>
<td>Well Ops, Planning &amp; Optimization</td>
<td>Well Ops, Planning &amp; Optimization</td>
<td>Reservoir Optimization</td>
<td>EPC Ops, Planning &amp; Optimization</td>
</tr>
<tr>
<td>Reservoir Data Processing &amp; Interpretation</td>
<td>Drilling Optimization</td>
<td>Casing/Cement Design</td>
<td>Field Monitoring, Automation &amp; Optimization</td>
<td>Flow Monitoring &amp; Ops</td>
</tr>
<tr>
<td>Lease &amp; Land Management</td>
<td>Drilling Ops &amp; Automation</td>
<td>Completion &amp; Stimulation Treatment Design</td>
<td>Fluids Mgmt. Optimization</td>
<td>Equipment Automation &amp; Optimization</td>
</tr>
<tr>
<td></td>
<td>Formation Evaluation</td>
<td>Frac Ops &amp; Automation</td>
<td>Production Optimization</td>
<td>Asset Integrity, Inspection &amp; R&amp;M</td>
</tr>
<tr>
<td></td>
<td>Materials Mgmt. Optimization</td>
<td>Fluids Mgmt. Optimization</td>
<td>Secondary Recovery Optimization</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Asset Integrity, Inspection &amp; R&amp;M</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Well Maintenance &amp; Intervention</td>
<td></td>
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</tbody>
</table>

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<thead>
<tr>
<th>Corporate</th>
<th>Logistics</th>
</tr>
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<tbody>
<tr>
<td>ERP</td>
<td>Fleet Ops</td>
</tr>
<tr>
<td>Finance, Accounting &amp; Royalty Mgmt.</td>
<td>Logistic Optimization</td>
</tr>
<tr>
<td>Regulatory, HSE &amp; Compliance</td>
<td></td>
</tr>
<tr>
<td>Supply Chain Mgmt.</td>
<td></td>
</tr>
<tr>
<td>Marketing &amp; Trading</td>
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</tr>
</tbody>
</table>

Legend

- Orange = Subsurface Operations
- Gray = Surface Operations
- Light Gray = Sub/Surface Operations
How big is the DOF opportunity?

**Market Size**

- **$33 billion**: UC bottom-up estimate, based on ~500 companies
- **$43 billion**: Upstream Intelligence estimate
- **$60 billion**: UC top-down estimate, based on global production/revenue benchmark

- **+5% 5-yr CAGR**: UC estimate, based on customer investment feedback
- **+10% 5-yr CAGR**: Upstream Intelligence estimate

DOF likely to achieve above-market growth
UC estimates $45 billion market size in 2015, with 11% CAGR forecast through 2020; expect Production will be growth leader

Global DOF Market

Market Size & Growth, by Value Chain Segment ($billion)

Notes: RE&WP = Reservoir Engineering & Field Planning

Source: UC analysis
Who are the players?

Competitive Landscape

- CAMERON
- FMC Technologies
- GE
- NOV
- Emerson
- Honeywell
- Schneider Electric
- Rockwell Automation
- peloton
- Paradigm
- QUORUM Business Solutions, Inc.
- Seven Lakes Technologies
- PetroLink
- Kongsberg
- CGG
- PGS
- Geokinetics
- ION
- Fugro
- Pure-Play DOF
- G&G

Communications

- RigNet
- Cisco
- Texas Energy Network
- SAP
- Oracle
- SAS
- Microsoft
- Amazon
- Hortonworks
- Cloudera
- OSIsoft
- TIBCO
- Infosys
- IBM

Generalist Software

- DOF
- Oilfield Equipment
- Process Control

Oilfield Services

- Schlumberger
- Halliburton
- Baker Hughes
- Weatherford
- EY
- Capgemini
- Accenture
- PwC
- TATA
- TATA Consultancy Services

Consulting
What business models do these DOF players employ to serve customers and generate value

**Offerings / Business Models**

**Consulting**
Technical consulting services to design or implement solutions

**Data/Research**
Data and research/insights products

**Equipment**
Measurement, control, and automation tools provided alongside of equipment

**Communications**
Communications services, particularly 3G/LTE

**Software-Enabled Consulting**
Technical consulting services delivered around a software product

**Cloud Software**
Software delivered via public or private cloud infrastructure

**On-Premise Software**
Software installed on the customers’ data centers or desktops

**IoT**
Integration of next generation hardware and software tools: SCADA 2.0

**Process Control**
Industrial automation offerings, including both hardware and software, such as SCADA

**Intelligent Wellbore**
Subsurface data acquisition and integration into RE&FP tools

Source: UC analysis
Who owns the DOF market?

**Market Structure**

DOF Revenues, by Company ($billions)

- **Highly Fragmented**
- **Long Tail of DOF Players**

Sources: UC analysis
Where have DOF investments been focused historically?

**Investment Trends**

**DOF Acquisitions, by Segment(s)**

- Production
- Corporate/ERP
- Completion
- Drilling
- Subsurface
- G&G

**70%**

Corporation/ERP + G&G + Subsurface deals

**DOF Companies Included**

- Schlumberger
- Halliburton
- Paradigm
- P2
- iHS

Note: Analysis based on transaction database consisting of ~104 DOF transactions between 1996 and 2015. Acquired companies may operate in more than one software segment. G&G = Geologic & Geophysics. Subsurf. = Reservoir Engineering & Field Planning.

Confidential Source: CapitalIQ, industry sources, UC analysis
**How should we think about investments in DOF?**

<table>
<thead>
<tr>
<th>Investment Prospects</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Scalability</strong></td>
<td><strong>Valuations</strong></td>
</tr>
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- Slow customer adoption
- Niche segments

\[ \text{Limited scalability} \]

- High DOF valuations are symptomatic of the broader tech valuation bubble that is just beginning to deflate
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NAM oil production continues to grow...

**Industry Context**

**North American Oil Production**

**Canadian Oil & Gas Industry Cash Flows**

**North American Natural Gas Production**

**Canadian Oil & Gas: Capital Reinvestment**

Source: ARC Institute

Confidential
... While capital and operating costs continue to fall

Well Breakeven by Basin

Source: Wood Mackenzie
In this “new normal” environment, costs and innovation matter

Transition Underway

From **Scarcity** to **Abundance**…

Structural changes are underway…

...Winners and losers will emerge
Operational excellence is increasingly a critical factor

Operational Excellence

Operating Costs

Capital Costs

Operating Model

Elements of the “new” Standard Operating Procedure

 ► Alignment
 ► Sustainability
 ► Rigour
 ► Collaboration
 ► Scalability

The survival focus to date:

 ► Cut operating costs
 ► Cut capital costs, capital spending
 ► Monetize assets where possible
 ► Preserve cash

The winner’s focus for tomorrow:

 ► Excellence in business processes; and
 ► The “right” operating model
Innovation is a core element of operational excellence

**Innovation**

- **Disruptive innovation** - creating a step change shift, while **operational excellence** results in continuous cost savings

**Innovation expansion: transition through the innovation spectrum**
- moving from **sustaining innovation** - low cost-low impact
- to **disruptive innovation** - high cost-high impact

Source: EY
Innovation/Technology does not generate value in isolation

Delivering Value with Technology
Petroleum engineering fundamentals remain critical but new skills are increasingly important

<table>
<thead>
<tr>
<th>New Skills = New Opportunities</th>
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</thead>
<tbody>
<tr>
<td>Operations &amp; Process</td>
</tr>
<tr>
<td>Continuous Improvement</td>
</tr>
<tr>
<td>Intelligent Process Automation</td>
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Domain Expertise
Application Expertise
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Entrepreneurship is hard work, a lot of fun, but definitely not for everyone

**Entrepreneurship?**

- What does it mean to be an entrepreneur?
- What are the key qualities?
- How do you learn to be an entrepreneur?
- 8 qualities that I think are critical parts of entrepreneurship...
Risk and entrepreneurship are fundamentally intertwined

Entrepreneurial Factor 1

Risk-Taking
You need to work harder than most people for a lot of years to learn enough to succeed as an entrepreneur

Entrepreneurial Factor 2

Hard Work

Timing, perseverance and ten years of trying will eventually make you look like an overnight success.

Biz Stone
Co-founder of Twitter, Co-founder and CEO of Jelly
Intelligence is obviously important, but there are a lot of smart people in the world; drive just as important

**Entrepreneurial Factor 3**

**Intelligence**

INTELLIGENCE WITHOUT AMBITION IS A BIRD

WITHOUT WINGS

Salvador Dali
Entrepreneurship involves a great deal of creativity to generate new ideas and solve problems

Entrepreneurial Factor 4

Creativity
Some entrepreneurs are so smart that they do not need it, but it has been critical to my success

Entrepreneurial Factor 5

Emotional Intelligence

Lesson 1
Empathize with Your Enemy
Best laid plans... nothing ever happens according to plan

Entrepreneurial Factor 6

Adaptability
There are probably no successful entrepreneurs who didn’t have at least one failure... lessons learned

Entrepreneurial Factor 7

Failure
If you don’t enjoy what you are doing, it makes it really hard to succeed

Entrepreneurial Factor 8

Fun

I never did a day's work in my life. It was all fun.

Thomas A Edison
Entrepreneurship is hard work, a lot of fun, but definitely not for everyone

Entrepreneurship?

- Solving a real customer pain point?
- Is the solution scalable?
- Can the team execute?
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Discussion?