Artificial Lift R&D Council

Balancing Risk & Reward: Evaluating New Technology for Artificial Lift

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Artificial Lift R&D Council

Balancing Risk & Reward: Lessons Learned & Key Success Factors for Field Trial Evaluations of New Technology in Artificial Lift

1. Rewards & Opportunities / Risks & Challenges
2. Evaluate Readiness / Define Metrics to Measure Pilot Results
3. Review Snapshot Case Studies / Lessons Learned
4. Best Practices / Key Success Factors
5. Self- Reflection – Role W e Each Play

Rewards & Opportunities of Field Pilots

PARTICPANTS

Energy
Service
Company

- optimize operations/processes
- reduce costs/downtime
- increase production
- improve safety
- achieve environmental targets
- validate with your own data

Rewards & Opportunities of Field Pilots

New Technology Company

PROVIDERS

- validate value proposition
- verify ROI/field performance
- data analysis
- technical papers
- product awareness/word of mouth
- understanding motivation to solve problem

Risks and Challenges of Field Pilots

PARTICPANTS

Energy / Service Company

- budget - ROI
- alignment
- lack of time/resources for implementation/analysis
- inertia
- downtime/well damage
- solutions provider vetted

Risks and Challenges of Field Pilots

New Technology Company

PROVIDERS

- motivated pilot partners
- appropriate well locations
- lack of money to fund no cost pilots
- providing optional field support
- undefined success parameters
- accessing data during/post pilot

New Technology Company: Are You Ready?

Early adopters are worth the search. Are they willing consider the technology if the pilot is successful?	✓
Ensure new product/solution is properly tested & field ready.	✓
Validate industry field pilot participant is:	✓
A) Motivated to address problem the new technology solves	✓
B) Invested in data collection & analysis of field pilot results	✓
Set clear expectations – No mutual mystification.	✓
Acknowledge road maps for technology adoption may need to allow for detours.	✓
Be honest & transparent / Set realistic internal goals / Communicate potential concerns.	✓

Energy/Service Companies: Are You Ready?

Verify & validate field readiness of the new technology.	✓
Is this a problem the company needs to solve? Short term? Long term?	✓
Is solving the issue or solution going to deliver an adequate ROI to the company?	✓
Define what each functional department hopes to learn/ achieve because of the pilot.	✓
Determine much time / resources should be invested.	✓
Involve the office/production engineers AND the field.	✓
Invest in selecting appropriate well candidates.	✓
Establish & communicate scope/ performance metrics for evaluation.	✓
Assign responsibility to an individual (or small team comprised of members from functional groups) to implement, monitor, analyze & communicate results.	✓
Assess long term viability for the new technology within your operations. Gap analysis.	✓
Provide comprehensive feedback to the field pilot technology provider.	✓

Case Study # 1: Rod String Adjustment/ Rod Rotator Tool

Issue(s): Frequent rod string adjustments/ gas locking/rod pump damage/ rod rotator failures.

Solution: Improve safety/ precision of rod string placement /extend rod rotator longevity.

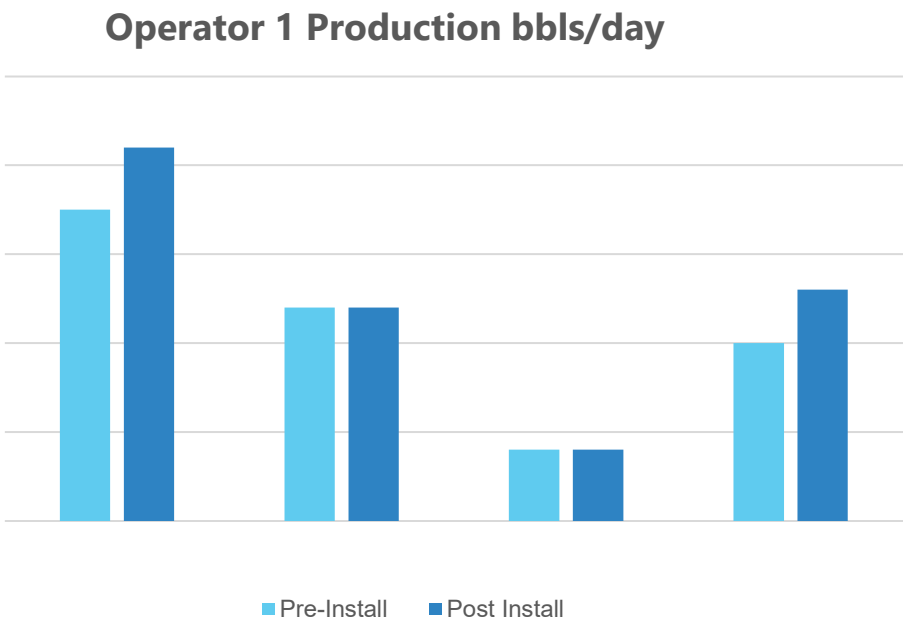
Value Proposition: Optimize safety and operational efficiency by fine tuning rod string spacing & reduce maintenance/ labor costs with improved rod rotator longevity.

Rod String Adjustment & Rod Rotator Tool Key Learnings

- W ireless load cells critical
- Pre- install worksheet
- Data analysis across functional groups challenging
- Regional & basin differences
- Inertia
- Role of distribution
- Long stroke unit application

Conclusions

- Enhanced safety
- Reduced maintenance costs
- Improved/stable production
- W ireless load cell critical



"W e are less than 2 inches off tag. I was hoping the RotaTap would prevent gas locking. I wasn't expecting to get extra production by preventing that gas locking."

Field Engineer

Bakken / May 20 19 Install

Case Study #2: Hydraulic Sheave Lock

Issue: Potential for serious injury exists on/ near beam pumping units due to risks posed by counterweights/ failed brake cables.

Solution: A hydraulic sheave lock engineered & permanently mounted lock to engage the crank arm to isolate & prevent movement.

Value Proposition: Counterweights can be locked in multiple positions to facilitate inspection, service rig work, as well as counterweight and stroke length adjustment. It saves time, improves safety & reduces need for third- party cranes/pickers, while reducing traffic at the well site.

Hydraulic Sheave Lock Field Install – June 2020 Key Learnings

- Evaluation metrics not clearly defined
- Inadequate sample size
- Thermal vs conventional
- Inertia to current methods
- Role of distribution is key
- Cost/benefit calculator required

Case Study #3: Spill Containment for Stuffing Box

Issue: Stuffing box leaks elevate risk of environmental damage, production losses and clean up costs & fines.

Solution: Implement spill containment system at the well head with sensor to shut down pumping unit to eliminate risk associated stuffing box failures.

Value Proposition: Reduce risk & save costly clean up expenses in the event of stuffing box leak by installing a spill containment system on the well.

Spill Containment System – Spring 2020

Spill Containment Key Learnings

- Spill Containment isn't top of mind until an event occurs, and it becomes a priority due to consequences eg. Clean up costs / fines / water contamination

- Incremental product improvements – protect from rain entering/ facilitate ease of greasing to address field level objections

Return on Investment

Reduces Stuffing box leak failures ($$)	Avoid daily clean- up costs ($$)	Free personnel's time for optimization ($$$)
Reduce remediation costs ($$$)	Improve corporate image ($$$$)	Flexibility to schedule maintenance ($)
Protect ground and surface waters	Environmental stewardship	De- risk pumping unit operation

Case Study #4: Variable Speed Hydraulic Drive System

Issue: W ell optimization for off- grid locations lacking variable speed control using traditional diesel engines.

Solution: Harness natural gas onsite, eliminate fuel costs & implement variable speed hydraulic drive system with natural gas engine to reduce lifting costs.

Value Proposition: Patented hydraulic system paired with natural gas engine eliminates fuel costs and the variable speed control improves well productivity and reduces maintenance costs.

Variable Speed Hydraulic System Key Learnings

- Understand regional differences / Prevalence of problem it solves
- Communication between field & head office is key
- Market pricing doesn't always = Product development costs
- US manufacturing partner identified

Best Practices / Key Success Factors

1. Establish clarity – be clear about expectations & performance metrics
1. Be consistent – communicate / Check in / Don't assume
1. Honest feedback / Listen - don't be afraid to hear or deliver difficult messages
1. Kick off meetings build foundation for solid execution/ No surprises
2. Understand issues & mitigate operational impact during field trials
1. Field/ Engineering and ops are all KEY to success
1. Mutual respect & clear communication establishes strong foundation

Advancing New Technology in Artificial Lift: How Can You Play A Role?

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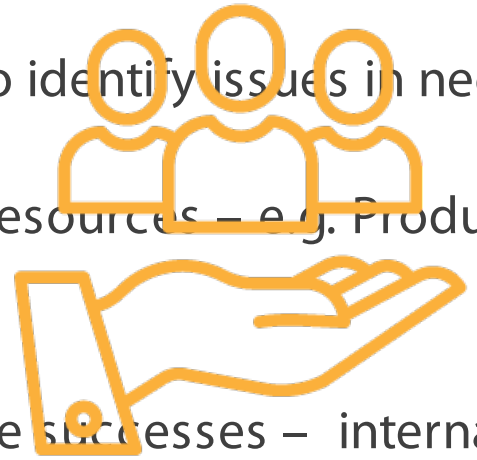
1. Open minded / Unbiased / Life- long learner
1. Define & implement a process to evaluate & pre- qualify field trial candidates
1. Collaboratively & creatively address issues / Barriers to field trials
1. Develop a culture/ Compensation plan to reward innovation
1. Engage cross functional teams internally to identify issues in need of solutions
1. Explore avenues of alternative funding & resources – e.g. Product Development Program
1. Be vocal – share data & findings/ Celebrate successes – internally & externally



Acknowledgements

Thank You!

Spears Insider – Ahead of the Bit
November 15, 2019
Predicting Technology Adoption

"Innovation – any new idea – by definition, will not be accepted at first. It takes repeated attempts, endless demonstrations, monotonous rehearsals, before innovation can be accepted and internalized by an organization. This requires courageous patience."

Warren Bennis

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