Artificial Lift R&D Council

Leveraging Automation Systems

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The Value of Automation

POC install

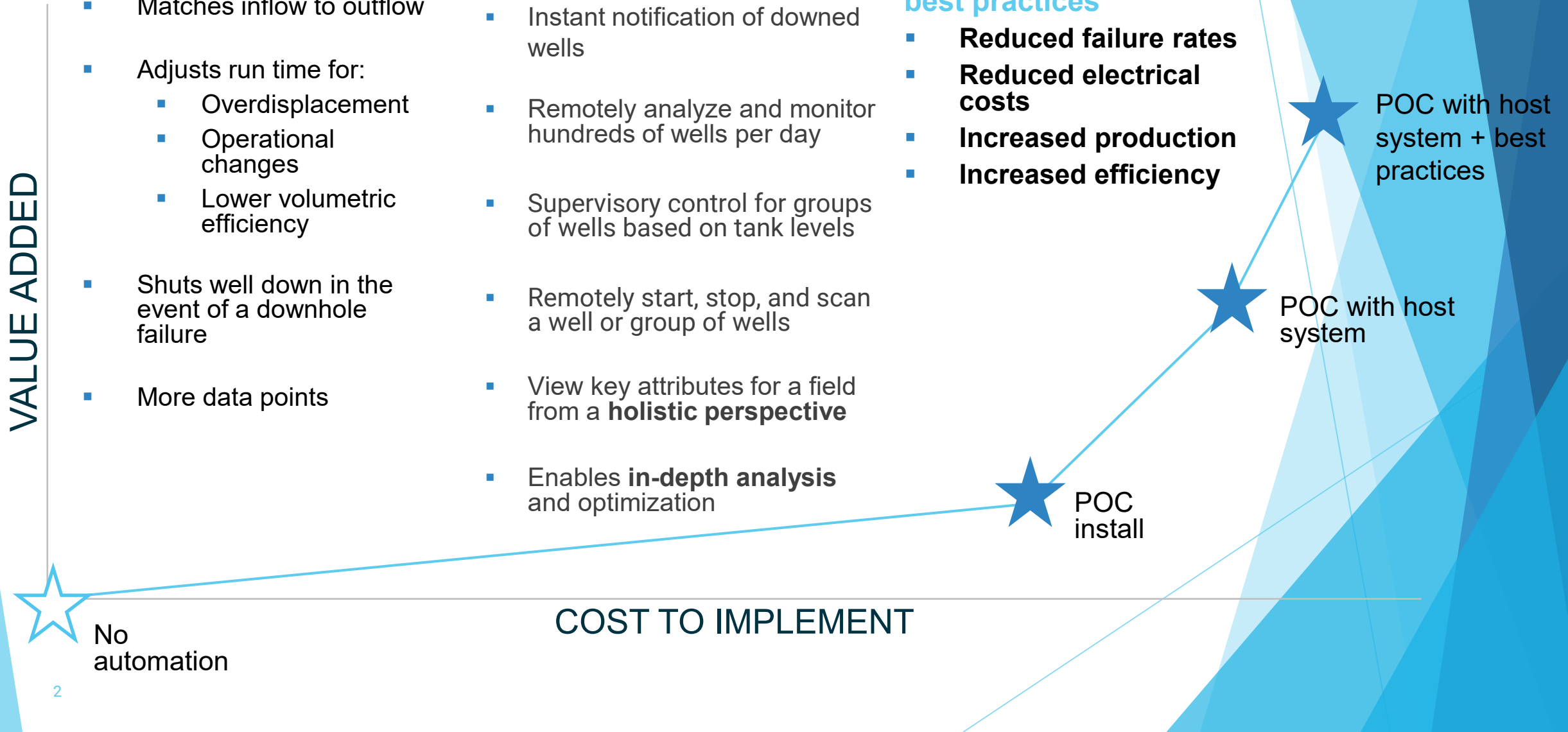
- Matches inflow to outflow
- Adjusts run time for:
  - Overdisplacement
  - Operational changes
  - Lower volumetric efficiency
- Shuts well down in the event of a downhole failure
- More data points

POC with host system

- Instant notification of downed wells
- Remotely analyze and monitor hundreds of wells per day
- Supervisory control for groups of wells based on tank levels
- Remotely start, stop, and scan a well or group of wells
- View key attributes for a field from a **holistic perspective**
- Enables **in-depth analysis** and optimization

POC with host system + best practices

- **Reduced failure rates**
- **Reduced electrical costs**
- **Increased production**
- **Increased efficiency**



Group Status From Host

Well	Last Good Scan	Alarms	%Com	Run Status	Comment	SPM	StrokeLength	Pump Diameter	Water Rate	Oil	% RTY	Yest Cycl	n M P C
Click here to fi...													
Vogler 6- 2	06/01/21 12:42:51 PM	No RPM	100	Shutdown,No...		6.2	120.4	1.5	0	0	0	0	
Vogler 6- 3	06/01/21 12:43:11 PM	OK	96	Run-Stopping		7.1	86	1.5	0	0	58	14	
Vogler 7- 1	06/01/21 12:43:13 PM	OK	99	Running		7.1	87.3	1.5	0	0	40	18	
Vogler 13- 1	06/01/21 12:34:25 PM	OK	100	Idle		7	87.3	1.25	0	0	43	18	
Vogler 13- 2	06/01/21 12:35:02 PM	OK	100	Running - Pu...	Ext MB	7.1	120	1.5	0	0	100	0	
Vogler 13- 3	06/01/21 12:43:15 PM	OK	100	Running		7.9	87.6	1.5	0	0	62	15	
Vogler 14- 1R	06/01/21 12:41:54 PM	OK	100	Running - Pu...		9.2	85	1.25	0	0	94	3	
Vogler 14- 2	06/01/21 12:34:21 PM	OK	100	Idle		7.1	100	1.5	0	0	9	15	
Vogler 14- 3	06/01/21 12:34:23 PM	OK	100	Running		7.1	102.8	1.75	0	0	46	25	
Vogler 15- 1	06/01/21 12:43:17 PM	OK	100	Idle		6.1	103	1.5	0	0	53	12	
Vogler 15- 2	06/01/21 12:43:19 PM	No RPM	100	Shutdown,No...	WoPU - 5/8/21 - Conf...	9.8	103.9	1.5	0	0	0	0	
Vogler 15- 3	06/01/21 12:43:24 PM	OK	99	Running		5.4	103	1.5	0	0	23	20	
Wade Estate 14- 1	06/01/21 12:34:30 PM	OK	100	Running		7.4	120.1	1.5	0	0	22	25	
Wade Estate 15- 1	05/21/21 11:49:24 AM	OK	0	Idle	5/24/21 - Jerad says t...	6.5	121	1.25	0	0	49	6	
Wade Estate 16- 1	06/01/21 12:34:28 PM	HOA	99	Shutdown, HOA	WoPU - 5/12/21 - Su...	6.2	120	1.25	0	0	0	0	

Engagement

- Met with artificial lift team
  - Determined key metrics and best practices
  - Determined acceptable range for each metric
  - Developed report card, or baseline
  - Communicated results

  - *Note: Ongoing POC installation, host install 2017*

Good Comms	Wells In Alarm	Uplift Not Needed	Rods Not Stressed	Well Test Is Recent	SPM In Range	Pump Fill In Range	VE In Range	Cycles in Range
A-	B+	D-	A+	A-	F	F	F	F

Metrics and Ranges

- Good comm between wells and host - 95%
- Wells not in alarm state – 95%
- Uplift not needed – 98% of wells pumped off
- Rods not overstressed – 95% of wells < 100% rod stress
- Well test within 90 days on 95% of wells
- SPM is < 8 when run time < 16 hrs on 95% of wells
- Pump fillage > 70% at pump off on 95% of wells
- Volumetric efficiency > 70% on 95% of wells
- Cycles < 100 on 95% of cycling wells

Key Findings

- Lack of training and understanding
  - Software functionality
  - Technical well analysis
- Lack of confidence in the systems
- Lack of work processes and business rules
- General lack of usage of the systems

Path Forward

- Developed workflows and business rules for each metric and associated target

- **Metric: uplift not needed**
- **Target: 98% of wells are pumped off**

- Criteria for generation of the exception
  - Average runtime of the last 14 days is ≥ 23.5 hrs / day
  - Average pump fillage of the last 14 days is ≥ 95%
  - Volumetric Efficiency > 70%

Workflow Steps

1. Ensure physical data (stroke length and pump size) is accurate
2. Verify well tests and volumetric efficiency
3. Investigate for potential casing leak
4. Shoot fluid level and determine additional displacement needs
5. Consider impact of additional fluids on facilities
6. If conditions warrant, uplift options to consider are increase in SPM, SL, pump size, or pumping unit.

Business Rules

- Determine standards for acceptable time frame and net barrels for temporary vs. sustained conditions
  - *LAI unless 5 bopd OR pumped off within a month*
- Determine for maximum allowable SPMs
  - *10 SPM or 1,500 PRV*
- Determine standards for maximum allowable rod and gearbox stress
  - *110% for each*
- Determine economic threshold for increase in SPM, SL, and pump size
  - *90 day payout*

Conclusion

- Three components to a successful surveillance program:
  - Hardware (POCs; VSDs)
  - Software (host system)
  - Work processes and best practices that leverage the above

Case Histories

	COMPANY A	COMPANY B	COMPANY C	COMPANY D
ELECTRICAL SAVINGS	20%	19%	31%	39%
FAILURE REDUCTION	20% ↓	48% ↓	23% ↓	25% ↓
PRODUCTION INCREASE	4% ↑	14% ↑	3% ↑	17% ↑

Questions?

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