Safety and Reliability Improvements with Vibration Monitoring and Predictive Maintenance in Oil & Gas

2015 SGICC Innovation Contest

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$20M in R&D Funding = SmartDiagnostics® Machine Monitoring

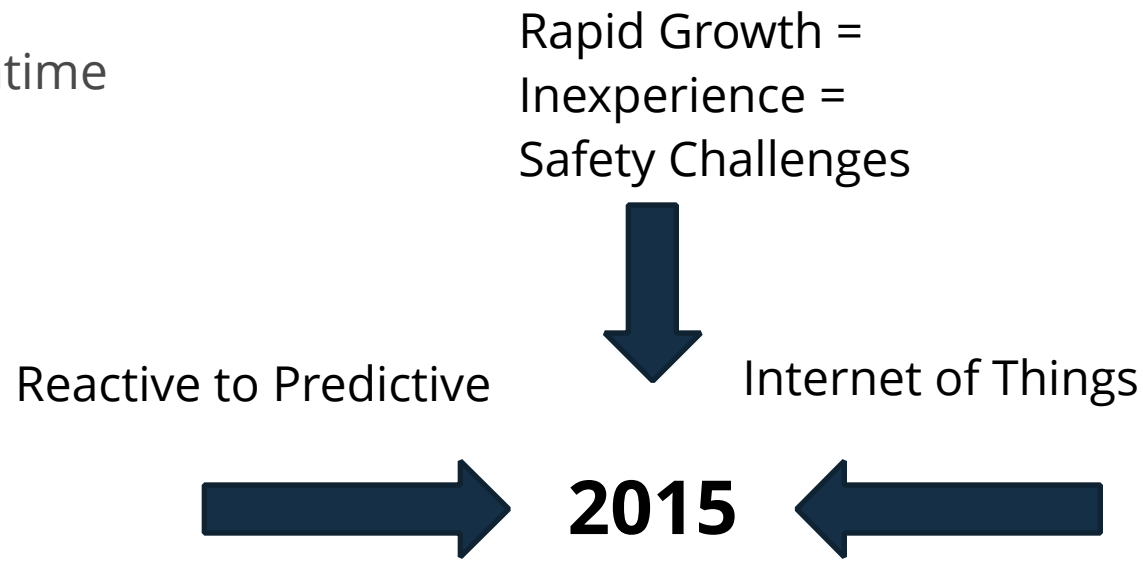
Deploy Predictive Sensor Technology to Improve Safety & Reliability - NOW

SmartDiagnostics® achieves:

- Improved Safety
- Reduced Failures & Downtime
- Improved Predictability

Key Factors

- Comprehensive Wireless
- Remote & Real-Time
- Easy to Install

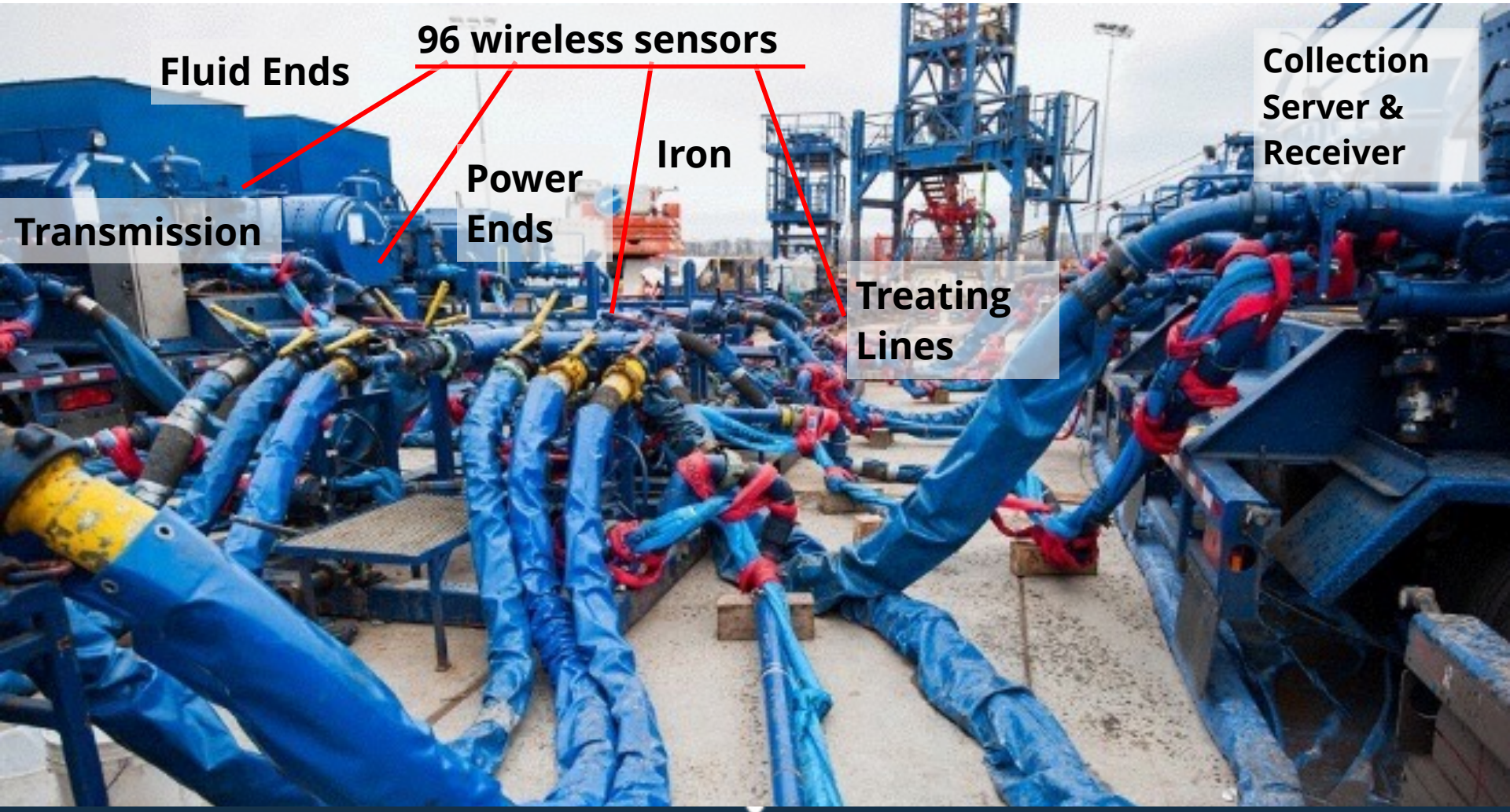


Current Reality for Well Completion

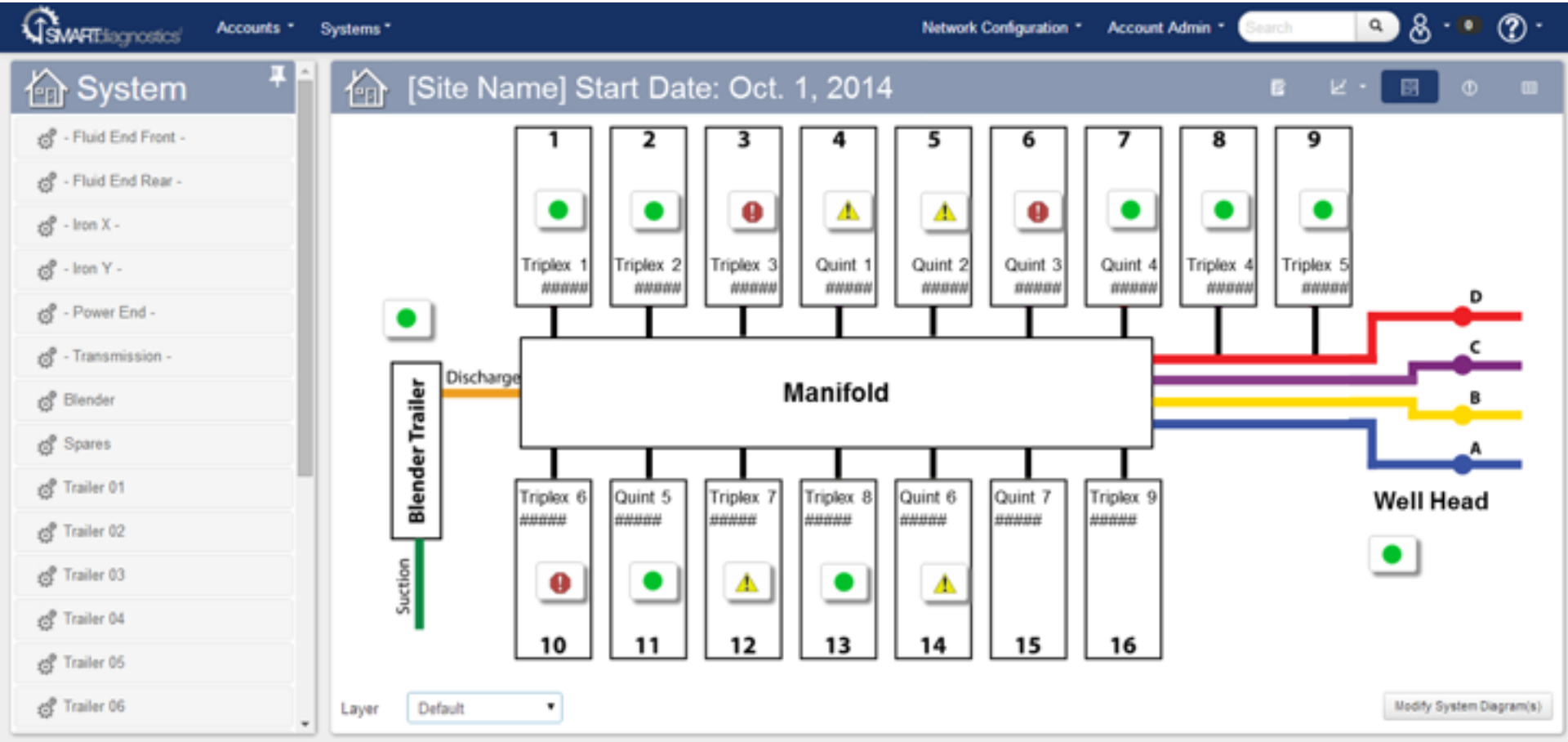
- **Impossible to monitor equipment in real time (red safety zone)**
- **Wear & tear on equipment (cavitation) reduces life by 10X to 30X+**
- **Fleets consume $3 Million+/year from excessive use**

Asset	Rated hrs	Actual hrs	Cost to Replace	Total Pumps	High-Damage Pumps	Cost Exceedence per Asset	Cost per Crew
Fluid End	1000	350	$ 70,000	14	4	$ 292,500	$ 1,170,000
Power End	4000	1600	$ 200,000	14	4	$ 168,750	$ 675,000
Transmission	2400	1200	$ 150,000	14	4	$ 140,625	$ 562,500
Packing	600	60	$ 1,600	14	4	$ 54,000	$ 216,000
Valves	80	40	$ 1,200	14	4	$ 33,750	$ 135,000
Seats	160	50	$ 1,600	14	4	$ 49,500	$ 198,000
						TOTAL	$ 2,956,500

Installation & Setup – Quick & Easy



Live Dashboard – Pressure Pumping Site



Damage/Vibration Comparison Between Fleets

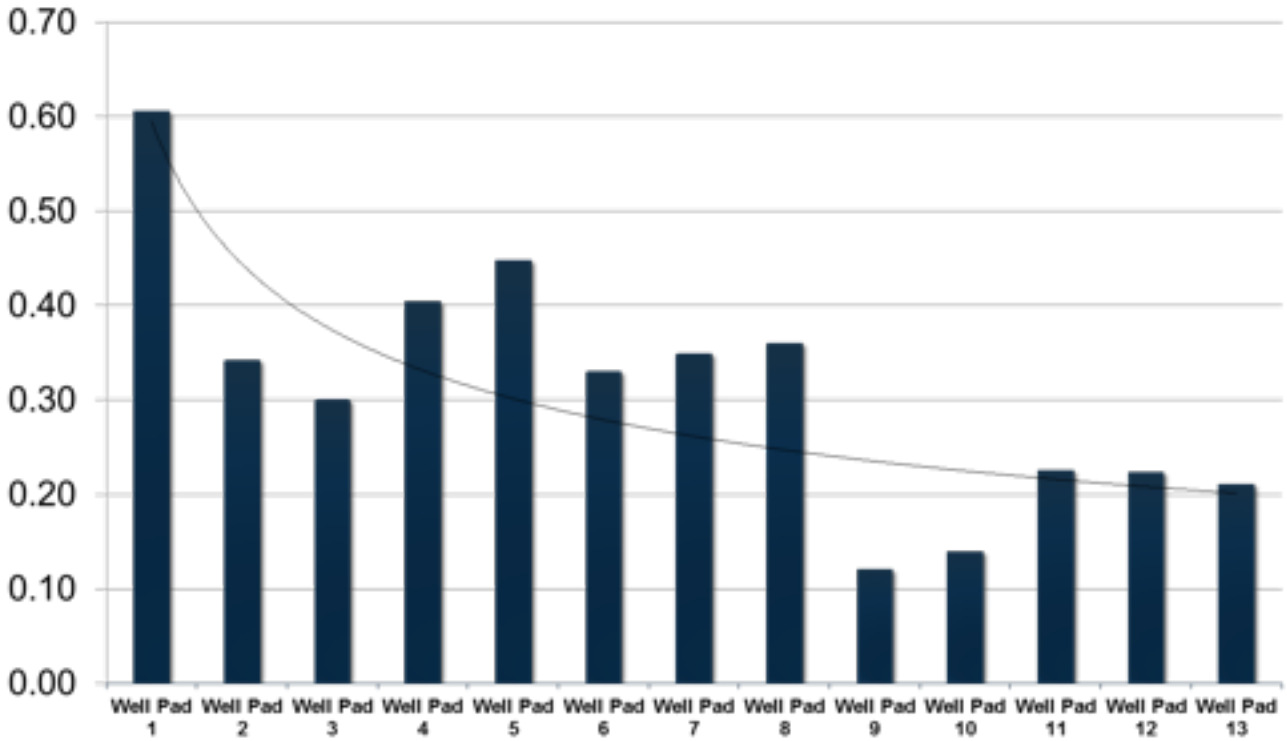
Fluid End	Iron	Power End	Transmission
53.34	35.30	231.4	272.1
N/A	14.89	59.34	95.65
85.67	N/A	313.1	N/A
479.1*	39.31	40.38	47.00
94.45	N/A	17.46	148.0
48.80	131.7	128.1	1.227
94.46	N/A	635.0	24.89
10.10	17.47	50.00	14.77
29.22	20.45	26.67	N/A
11.48	N/A	1.683	11.61
12.01	17.12	6.508	393.2
246.1	169.5	N/A	650.2
23.22	373.0	11.27	N/A
32.66	12.67	11.26	166.2
167.9	122.2	159.9	332.4
129.7**	80.42	27.12	106.3
44.43	62.82	15.31	271.9
162.2	68.96	198.4	N/A

Fluid End	Iron	Power End	Transmission
Not on site			
2.235	7.172	13.06	110.4
4.026	1.667	0.2445	37.12
Not on site			
UNINSTRUMENTED			
5.303	0.708	1.404	N/A
27.58	0.537	1.791	N/A
N/A	0.156	2.104	29.01
N/A	N/A	N/A	N/A
Not on site			
6.926	416.9	3.289	11.68
Not on site			
6.519	0.0907	2.922	17.59
3.439	0.353	N/A	14.19
4.865	6.978	15.39	18.19
3.706	0.537	20.14	50.67
UNINSTRUMENTED			

Fluid End – Failure @ 50 hours

"…**fluid end has less than 50 hours on it**, and the surface where the side cap seals on the middle suction bore is worn. This is causing leaking during the stage, which means it's **sucking air through this hole and causing cavitation**."

Improved Safety in the Marcellus – Reduction of Incidents (NPT)



Fluid End Hours

Pump Truck	Hours/Baseline
##01	112%
##02	145%
##03	120%
##04	240%
##05	14%
##06	266%
##07	206%
##08	121%
##09	135%
##10	69%
##11	257%
##12	203%
##13	302%
##14	200%
##15	160%
Average	**170%**