Predicting Drilling Dysfunction With AI-Powered Automation

Philippe Herve

VP Solutions, SparkCognition

SPE Webinars are Sponsored by:

SPE

SPE Foundation

Speaker

Philippe Herve

3

Poll Questions

What geographic region are you from?

Poll Question

How many years of experience do you have?

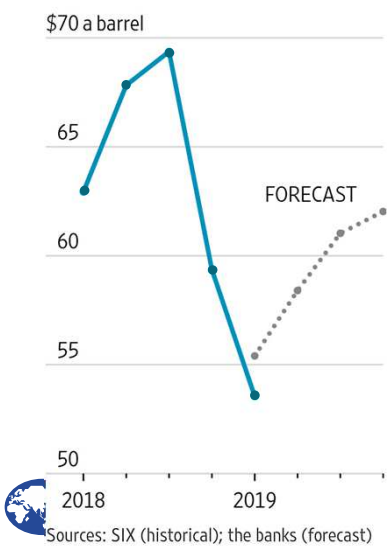
Poll Question

Who is your employer?

Poll Questions

Webinars

What is your job title?



Remaining profitable in the oil and gas industry is **not** about **clairvoyance**.

It's about…

RESILIENCY

Machine learning

A holistic approach to optimizing O&G operations

Webinars

Processes Information

Draws Conclusions

Codifies Instinct & Experience Into Learning

Machine learning

A holistic approach to optimizing O&G operations

- **Predictive and Prescriptive Maintenance**
- **Monitoring Downhole Conditions**
- **Increased Operational Safety and Insights**
- **Cyber Threat Detection**

Maintenance paradigms are ripe for change

Asset Failure Modes

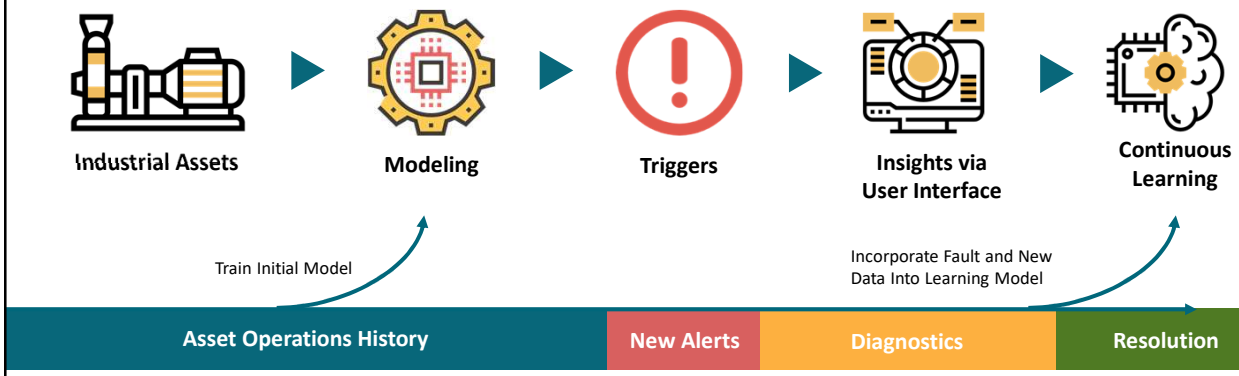
What?	How?	When?
Known	Known	**Rules-based**
Known	Unknown	**Pattern Rec.**
Known	Unknown	**AI & ML**
Unknown	Unknown	**AI & ML**

From REACTIVE
(Human-defined)

to PREDICTIVE…
(AI-defined)

and PRESCRIPTIVE
(AI-defined)

AI approach to predictive maintenance



Case study: Predictive maintenance for production platform subcomponents

75% Events impacting production identified

9 Days average identification lead time

$750M-$1.5B* **Yearly Opportunity Across Fleet by Eliminating Unscheduled Downtime**

*200k BBL | Crude price at $60 bbl | Nat gas at $2.80/CM

Monitoring downhole conditions

- Downhole conditions can be volatile, and any unexpected changes can massively disrupt the drilling process.
- Machine learning algorithms use sensor data to analyze downhole conditions and immediately alert personnel when an issue arises, increasing speed and accuracy of detection.

Production and drilling optimizations

Even 1% improvement can lead to millions in savings

"Improving production efficiency by 10% can yield up to $220 million to $260 million bottom-line impact on a single mature asset"

-McKinsey&Company

Machine Learning

How is it Used to Optimize Production?

Predictive Algorithm

Based on historical data, models predict production rates given settings of all operator-controlled variables

Continuous Monitoring

Real-time data streaming from production sites

Multidimensional Optimization

Machine learning models evaluate all control variables and select the most relevant and impactful

Timely Recommendations

Recommendations for operators when identifying potential for improvement

Actionable Output

Models provide recommendations on adjustments and the potential improvement in production rate

Enhanced Decision Making

Support tool to make informed decisions and maximize production

Classification of drilling states

20 – 25% of all rig operating time is **non-productive time**. This can add up to **billions of dollars in lost revenue** per year

- To identify and minimize non-productive time and invisible lost time, and improve efficiency of operations, operators must be able to detect and classify drilling states
- Using this data, operators can better evaluate and optimize drilling performance

Real-time classification

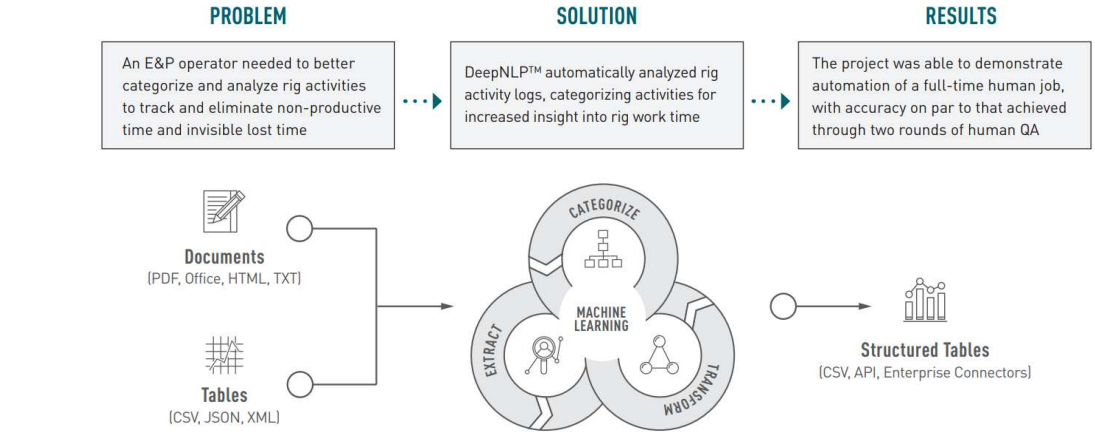
Machine learning models analyze sensor data during drilling to identify current drilling state

- *Sensor data includes: hookload, block position, flow rates, pump pressure, borehole and bit depth, RPM, torque, rate of penetration, weight on bit*

Classification of historical data

Machine learning-powered natural language processing (NLP) is used to analyze rig activity logs

Case study: Identifying non-productive time and invisible lost time using NLP



Case study: Drilling optimization for stuck pipe and washout failures

Client: Top 5 independent Oil and Gas Operator

Use Case: Improve well efficiency by reducing stuck pipe and drill string washout failures

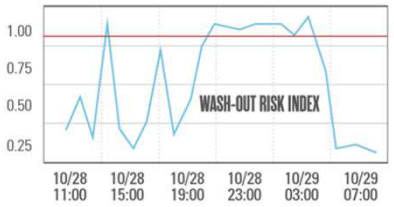
Accuracy: >90%, combined for misses and false positives

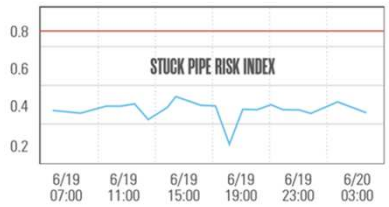
Benefits:

- Provides timely (>1 hour) notice for preventive action
- Automatically accounts for state of drill rig

Data:

- Pressure, temperature, RPM, chemicals, flow rate, tubing material grade, wellbore temp, fluid density, composition etc.
- Equipment make, supervisor experience etc.





Increased operational safety and insights

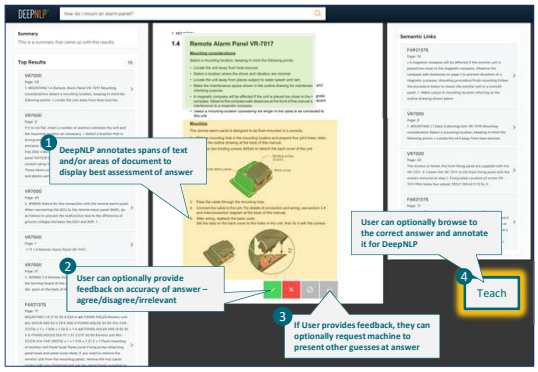
Can data help keep oil & gas workers safe?

UNSTRUCTURED INFORMATION
The Lifeblood of Organizations

Contained within these safety records is the information oil and gas operators need to better understand prevent injuries by understanding near-misses likely to recur and events that can be avoided.

- **Financial/legal documents**
- **Technical documentation**
- **Maintenance reports**
- **Safety assessments**
- **Emails**

NLP "Understands" Documents



- Extract lists, summaries, tables, images that provide the best answer for questions in natural language
- Expand query based on document specific semantics
- [Roadmap] Extract document structure, browse, jump to page where possible
- [Roadmap] Highlight found "answer" in document and optionally improve it
- [Roadmap] Improve results based on user feedback and supporting evidence

NLP engine provides immediate list answering the question asked, details can be seen by clicking on list entries

Safety log searches

"Find incidents involving debris falling on lone employees"

Keyword search	Semantic search	***Cognitive NLP search***
534 *incidents*	**1,027** *incidents*	**347** *incidents*

Cognitive Search Difference:

- Removed incorrect references to body parts: "foot" as a measurement, "toe board"
- Focused on references to body parts in the context of injuries

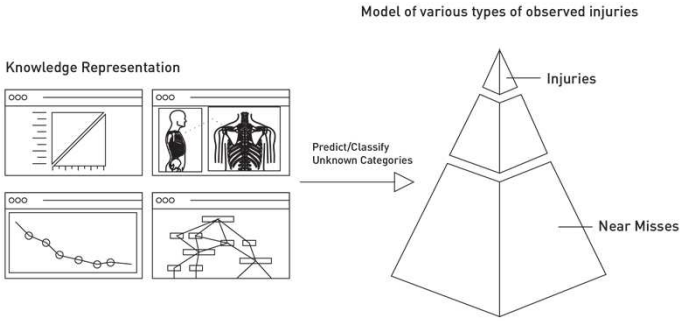
"Was hit by a piece of plastic that had come loose while working solo on a rig"

Case study: Insight generation

NLP surfaces unknown correlations between potential hazards and injuries

SparkCognition used machine learning to analyze and classify safety records to prevent future injuries

- Extract and disambiguate terms to accurately classify large volume of incident reports by severity
- Encourage logging of records and enable the "Safety Pyramid" process
- Cognitive analytics of free text and structured data enables discovery of unknown trends



Cyber threat detection

The signature-based approach to endpoint protection is broken. A new approach is needed to keep up with the evolving threat landscape.

Traditional ***perimeter detection*** can no longer keep up with the greater number of outside connections in OT networks

Traditional ***endpoint detection*** can no longer keep up with the proliferation of new sensors and endpoints to guard

Anomaly detection and machine learning

Anomaly detection is designed to monitor the behavior of endpoint devices within the network and flag any unusual behaviors or abnormal signals being sent out.

OT systems are designed for repeatable communications. The expected signals and behaviors of OT components are well defined, making anomalies particularly uncommon—and particularly easy to identify.

This is most effective when powered by machine learning.

Anomaly detection and machine learning

Webinars

Subtler cyberattacks may involve unusual behaviors that still fall within the normal rules of operation.

EX: A control system suddenly tells a device that regulates valves to close a valve that is usually left open. This is a normal type of message sent between the correct devices—but the content and timing is statistically unusual.

Rules-based anomaly detection would not catch this, but a machine learning system would.

How machine learning-powered anomaly detection could have caught Stuxnet

Webinars

A learning anomaly detection program could have caught Stuxnet at a variety of stages:

Initial propagation of Stuxnet worm between nodes in system would have been flagged as anomalous before it could reach the targeted programmable logic controllers

Would have recognized that a worm had found its way into the device and blocked it from executing, therefore preventing it from sending sabotaging orders to Iran's nuclear centrifuges

Operates outside PLCs, so would not have been fooled by Stuxnet's false signals from PLCs that operations were normal and would have detected anomalous operations in centrifuges

Guiding Principals To Pick Projects

GUIDING PRINCIPLE	IMPLICATION
QUANTIFIABLE	Easy availability of quantitative and qualitative data to design solution
IMPACTFUL	Clearly distinguish impact of initiative from others & also from market conditions
SUSTAINABLE	Doesn't require radical management of change to implement solution
TIME TO IMPACT	Easy to implement solution and gauge success over course of the pilot (6 months)

Q&A